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

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

Subject: Additional Information Supporting Request for License Amendment Regarding Offsite Power Instrumentation and Voltage Control

References:

1. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Request for License Amendment Regarding Offsite Power Instrumentation and Voltage Control," dated April 4, 2005

2. Letter from M. Banerjee (U. S. NRC) to C. M. Crane (Exelon Generation Company, LLC), "Dresden Nuclear Power Station, Units 2 and 3 – Request for Additional Information (RAI) Re: Technical Specification Changes Related to Offsite Power Instrumentation and Voltage Control (TAC Nos. MC6712 and MC6713)," dated November 3, 2005

In Reference 1, Exelon Generation Company, LLC (EGC) requested an amendment to Renewed Facility Operating License Nos. DPR-19 and DPR-25 for Dresden Nuclear Power Station (DNPS), Units 2 and 3. The proposed changes revise Technical Specification Section 3.3.8.1, "Loss of Power (LOP) Instrumentation," and also revise the Updated Final Safety Analysis Report to implement use of automatic load tap changers on transformers that provide offsite power to DNPS, Units 2 and 3.

In Reference 2, the NRC requested additional information to support its review. In response to Reference 2, EGC has prepared the attached information.

EGC has reviewed the information supporting a finding of no significant hazards consideration that was previously provided to the NRC in Attachment 1 of Reference 1. The supplemental information provided in this submittal does not affect the bases for concluding that the proposed license amendment does not involve a significant hazards consideration.

There are no regulatory commitments contained in this letter. Should you have any questions related to this letter, please contact Mr. Kenneth M. Nicely at (630) 657-2803.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 13th day of January 2006.

Respectfully,

Patrick R. Simpson

Patrick R. Simpson
Manager – Licensing

Attachments:

1. Response to Request for Additional Information
2. Calculation 8982-13-19-6, "Second Level Undervoltage Relay Setpoint – Unit 2," Revision 005
3. Calculation 8982-17-19-2, "Second Level Undervoltage Relay Setpoint – Unit 3," Revision 004
4. Procedure MA-DR-771-402, "Unit 2 – 4 kV Tech Spec Undervoltage and Degraded Voltage Relay Routines," Revision 03
5. Procedure MA-DR-771-403, "Unit 3 – 4 kV Tech Spec Undervoltage and Degraded Voltage Relay Routines," Revision 3

NRC Request 1

Describe what testing will be performed on the automatic load tap changer (LTC) transformers to demonstrate functionality.

Response

The LTC transformers for both Dresden Nuclear Power Station (DNPS), Units 2 and 3, were recently installed. The Unit 2 transformer has been in service in the manual mode of operation for approximately two years, and the Unit 3 transformer was installed in November 2005. Both transformers were subjected to standard transformer tests during acceptance testing. These tests include Doble/sweep frequency response, transformer through-fault, core ground, turns ratio on all taps, low voltage excitation, winding megger, and alternating current impedance testing. Also, operation of the LTC on each transformer was verified over the full range of tap positions.

For both Unit 2 and Unit 3, LTC transformer control circuits, controls, and control switches were verified to function properly in accordance with the applicable schematic diagrams. Also, the local and control room indication for the transformer LTC were checked for proper functionality.

Testing of the main and backup controllers included verifying with a simulated voltage input that the LTC regulating relay provided the correct raise/lower response and the LTC backup relay provided the proper blocking function.

Additionally, on a two year frequency, the LTC will be verified both manually and electrically for proper timing and sequencing of operation. On a six year frequency, preventive maintenance consisting of inspection of contacts for damage and pitting, checks for loose or damaged components, and functional testing of the LTC (i.e., similar to the two year test) will be performed.

NRC Request 2

What is the response time of the LTC transformers (i.e., how fast can a tap change occur) and in the event of a voltage dip, how responsive will the LTC be in preventing a trip of the degraded voltage relays?

Response

The regulating relays controlling the LTCs are set with an initial delay of 1 second (i.e., the voltage must be out of band for 1 second before the controls initiate a tap change). Once given a signal to change taps, either manually or automatically, the tap changer will complete a tap change in two seconds.

In the event of a voltage dip with no accident signal present, the second-level degraded voltage relay scheme includes a nominal 5-minute timer to allow voltage to recover before the safety buses are disconnected from offsite power. The 5-minute timer allows adequate time to complete needed tap changes to correct the transient before disconnecting from offsite power.

In the event of a voltage dip concurrent with an accident, the second-level degraded voltage relays are set with a nominal time delay of 7 seconds after which, if the voltage does not recover, the safety buses will be disconnected from offsite power. If a loss-of-coolant accident were to occur at full power operations, it has been determined that two tap changes are required to support the additional continuous load imposed on the transformer and compensate for the resulting switchyard voltage drop due to loss of the unit. Considering the additional time needed for the 1 second initial delay before the two tap changes begin, the LTC will complete voltage correction in 5 seconds. The allowable value for the nominal 7-second degraded voltage time delay is $\geq$ 5.7 seconds and $\leq$ 8.3 seconds, as specified in Technical Specification (TS) Table 3.3.8.1-1, "Loss of Power Instrumentation." Therefore, the LTC will be successful in preventing a trip of the degraded voltage relays in the event of a voltage dip, precluding unnecessary disconnection of the safety buses from offsite power.

NRC Request 3

Provide the setpoint methodology with setpoint calculation used at Dresden to establish the allowable value (AV), trip setpoint, as-left (value) tolerance band, and as-found (value) tolerance band.

Response

The setpoint methodology used at DNPS is described in engineering standard NES-EIC-20.04, "Analysis of Instrument Channel Setpoint Error and Instrument Loop Accuracy." This methodology was provided to the NRC as Attachment 1 of Reference 1, in support of the conversion to Improved Technical Specifications (ITS). In Reference 2, further clarification regarding the setpoint methodology used at DNPS was provided to the NRC. The NRC approved the conversion to ITS for DNPS in Reference 3, and concluded that the instrument setpoint methodology is acceptable.

Attachments 2 and 3 provide calculations 8982-13-19-6, Revision 005, "Second Level Undervoltage Relay Setpoint – Unit 2," and 8982-17-19-2, Revision 004, "Second Level Undervoltage Relay Setpoint – Unit 3." These calculations establish the AV, trip setpoint, as-left (value) tolerance band, and as-found (value) tolerance band.

NRC Request 4

Discuss the channel calibration procedure and channel operational test procedure. Include in your discussion how the technical specification (TS) surveillances ensure the operability of the instrument channel.

Response

The function of the degraded voltage relay is to monitor Essential Service System (ESS) bus voltage to ensure adequate voltage is maintained to support operation of required equipment. In the event that the minimum required voltage is not maintained, the buses are disconnected from offsite power and connected to the onsite emergency diesel generator. The Channel Functional Test is performed on each required channel to ensure that the channel will perform the intended function. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay.

A Channel Calibration is a complete check of the instrument loop and the sensor. This test verifies the channel responds to the measured parameter within the necessary range and accuracy. Channel Calibration leaves the channel adjusted to account for instrument drifts between successive calibrations consistent with the plant specific setpoint methodology.

The ESS bus degraded voltage relays are surveilled, by means of calibration and functional testing, on an 18-month frequency. The instruments are isolated by test switches, removed from the panel, and then calibrated. If, during calibrations, the relays are found to be outside the setting tolerance, the relays are re-calibrated. After calibration is complete, the relays are reinstalled in the panel and a functional test is performed. The functional test involves tripping the relays by means of test switches and verifying the degraded voltage relay contacts operate properly for both trip and reset conditions.

The degraded voltage relay surveillance is specified in procedures MA-DR-771-402, Revision 03, "Unit 2 – 4 kV Tech Spec Undervoltage and Degraded Voltage Relay Routines" and MA-DR-771-403, Revision 3, "Unit 3 – 4 kV Tech Spec Undervoltage and Degraded Voltage Relay Routines." These procedures are provided as Attachments 4 and 5, respectively.

NRC Request 5

Explain why this amendment request is not applicable to the TS requirements of 10 CFR 50.36 related to limiting safety system settings.

Response

10 CFR 50.36, "Technical specifications," requires that the TS include safety limits (SL), limiting safety system settings (LSSS), and limiting conditions for operation (LCO) among other items. 10 CFR 50.36(c)(1)(i)(A) sets forth the criteria for safety limits, and 10 CFR 50.36(c)(1)(ii)(A) sets forth the criteria for LSSS.

- 10 CFR 50.36(c)(1)(i)(A) states "Safety limits for nuclear reactors are limits upon important process variables that are found to be necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity."

- 10 CFR 50.36(c)(1)(ii)(A) states "Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded."

As required by 10 CFR 50.36, the DNPS SLs and LSSS are defined in the TS. The DNPS SLs are defined in TS Section 2.1 as follows.

- TS SL 2.1.1.1 requires that the THERMAL POWER shall be $\leq$ 25% rated thermal power with the reactor steam dome pressure < 785 psig or core flow < 10% rated core flow.

- TS SL 2.1.1.2 requires that the minimum critical power ratio (MCPR) for Unit 2 shall be ≥ 1.11 for two recirculation loop operation or ≥ 1.12 for single recirculation loop operation, and the MCPR for Unit 3 shall be ≥ 1.10 for two recirculation loop operation or ≥ 1.11 for single recirculation loop operation, with the reactor steam dome pressure ≥ 785 psig and core flow ≥ 10% rated core flow.

- TS SL 2.1.1.3 requires that the reactor vessel water level shall be greater than the top of active irradiated fuel.

- TS SL 2.1.2 requires that the reactor steam dome pressure shall be ≤ 1345 psig.

Prior to implementation of Improved Technical Specifications (ITS), the DNPS TS defined the SLs and LSSS parameters in Section 2.0. This section clearly indicated that the only LSSS parameters at DNPS were those associated with the Reactor Protection System (RPS). This LSSS section became part of the RPS section as a result of NRC approval of ITS. The Background section of the RPS TS Bases was revised as part of ITS implementation to address how the LSSS parameters are directly monitored by RPS.

The LSSS are clearly specified for parameters directly monitored by the RPS. Whether the LSSS concept applies to systems or instrumentation outside of RPS is not presently defined. As documented in Reference 4, the NRC staff stated that the systems the LSSS related instruments are typically associated with are RPS and emergency core cooling systems (ECCS) for boiling water reactors. In Reference 4, the NRC also stated that there may be other plant-specific systems that could be included within the scope of systems covered by 10 CFR 50.36.

Exelon Generation Company, LLC (EGC) agrees that there are LSSS parameters monitored by RPS and select ECCS instrumentation. EGC has evaluated whether the loss of power (LOP) instrumentation directly protects an SL. The LOP instrumentation is required for the Engineered Safety Features to function in any accident with a loss of offsite power. The LOP instrumentation monitors the 4160 V ESS buses. Offsite power is the preferred source of power for the 4160 V ESS buses. If the LOP instrumentation determines that insufficient voltage is available, the buses are disconnected from the offsite power sources and connected to the onsite diesel generator (DG) power sources.

Based on the definition of an LSSS as provided in 10 CFR 50.36, the settings that are to be classified as an LSSS in TS shall protect the SLs contained in TS Section 2.1. The trip setpoint values for these parameters must be directly associated with an SL for the parameter to be an LSSS. The results of the evaluation of the LOP instrumentation parameters against the above SLs are provided below.

<u>Reactor Core Safety Limits (Thermal Power & MCPR) and LOP Instrumentation</u>

SLs as defined in TS Sections 2.1.1.1 and 2.1.1.2 are protected by the settings associated with certain RPS functions. The RPS setpoints, in combination with other LCOs, are designed to prevent any anticipated combination of transient conditions for reactor coolant system water level, pressure, and thermal power level that would result in reaching the MCPR SL. A reactor scram is initiated by these RPS functions to ensure that fuel limits are not exceeded. Protection of the thermal power and MCPR SLs does not require the standby AC system (i.e., DGs) or LOP instrumentation.

Reactor Coolant System Pressure SL and LOP Instrumentation

TS SL 2.1.2 is protected by both the RPS reactor vessel steam dome pressure-high scram function as well as the pressure relief function of the safety/relief valves, which are defined as LSSS. The LOP instrumentation function is not required to protect SL 2.1.2.

Reactor Vessel Water Level SL and LOP Instrumentation

The top of active fuel SL is protected by both the RPS low level scram function and the low level initiation of the ECCS. Establishment of ECCS initiation setpoints higher than this SL provides margin such that the SL will not be reached or exceeded.

The DNPS ECCS consists of High Pressure Coolant Injection, Automatic Depressurization System, Low Pressure Coolant Injection, and Core Spray. These systems have initiation signals based on low reactor pressure vessel water level, which are required to protect the SL. Based on this, the associated ECCS settings are considered as LSSS in the DNPS TS.

Successful operation of the required safety functions of the ECCS is dependent upon the availability of adequate power sources for energizing the various components such as pump motors, motor operated valves, and the associated control circuits. The LOP instrumentation monitors the 4160 V ESS buses. Offsite power is the preferred source of power for the 4160 V ESS buses. If the monitors determine that insufficient voltage is available, the buses are disconnected from the offsite power sources and connected to the onsite DG power sources.

The primary effect of the assumption that the offsite power becomes unavailable coincident with a LOCA is an increase in the time delay for injection by the low pressure ECCS. Therefore, based on the transfer function from offsite power sources to the onsite power sources, the LOP instrumentation is required for the transfer function, which in turn is required for ECCS operation. Since the LOP instrumentation affects the availability of adequate power sources for certain ECCS functions and not the safety limit (i.e., reactor vessel water level) directly, the LOP instrumentation is not an LSSS.

Conclusion

The settings for the LOP instrumentation are based on station voltage regulation studies to assure that safety related equipment has an adequate power supply. In accordance with Instrument Society of America (ISA) S67.04, "Setpoints for Nuclear Safety-Related Instrumentation," instrument settings are derived from Analytical Limits (ALs), which are "established by the safety analysis to ensure that a safety limit is not exceeded." The voltage regulation analysis is not directly tied to any of the SLs. Since the LOP instrument settings are not derived to directly protect the SLs via automatic action, they are not an LSSS as specified in 10 CFR 50.36.

References

1. Letter from R. M. Krich (Commonwealth Edison Company) to U. S. NRC, "Supplemental Information to Support Request for Technical Specifications Changes," dated June 5, 2000

2. Letter from R. M. Krich (Commonwealth Edison Company) to U. S. NRC, "Supplemental Information to Support Request for Technical Specifications Changes," dated November 30, 2000

3. Letter from S. N. Bailey (U. S. NRC) to O. D. Kingsley (Exelon Generation Company, LLC), "Issuance of Amendments (TAC Nos. MA8382 and MA8383)," dated March 30, 2001

4. Letter from J. A. Lyons (U. S. NRC) to A. Marion (Nuclear Energy Institute), "Instrumentation, Systems, and Automation Society S67.04 Methods for determining Trip Setpoints and Allowable Values for Safety-Related Instrumentation," dated March 31, 2005

ATTACHMENT 2

Calculation 8982-13-19-6, "Second Level Undervoltage Relay Setpoint – Unit 2," Revision 005

			Last Page No. 15
Analysis No.	8982-13-19-6	**Revision**	005
EC/ECR No.	350335 & 350336	**Revision**	000
Title:	Second Level Undervoltage Relay Setpoint – Unit 2		

		Component(s)	
Station(s)	Dresden		
Unit No.:	2		
Discipline	E		
Description Code/ Keyword	E07, E13		
Safety Class	Safety Related		
System Code	67		
Structure	N/A		

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# N/A

Is a Supplemental Review Required? Yes ☐ No ☒ If yes, complete Attachment 3

	Print Name	Sign Name	Date
Preparer	Patricia A. Ugorcak	Patricia A. Ugorcak	7-21-04
Reviewer	Richard Low	Richard Low	7-21-04

Method of Review ☒ Detailed Review ☐ Alternate Calculations ☐ Testing

Review Notes:

	Print Name	Sign Name	Date
Approver	R. Murr	[signature]	8-16-04

(For External Analyses Only)

	Print Name	Sign Name	Date
Exelon Reviewer	DALE EAMAN	Dale Eaman	8-16-04
Approver	Karaba	Karaba	8-18-04

QA COPY MADE

Description of Revision (list affected pages for partials): Incorporate ITS DCR 990552 (EC 13947) and minor revision 4A. Apply latest methodology to determine new setpoint, Allowable Values and Expanded Tolerances. Reformat entire calc. Revision bars shown only for content changes, not for format or section numbering changes.

THIS DESIGN ANALYSIS SUPERCEDES: 8982-13-19-6 Revision 4, 4A

ATTACHMENT 2
Owners Acceptance Review Checklist for External Design Analysis
Page 1 of 1

DESIGN ANALYSIS NO. 8982-13-19-6 **REV:** 005

		Yes	No	N/A	
1.	Do assumptions have sufficient rationale?	☐	☐	☒	} NONE.
2.	Are assumptions compatible with the way the plant is operated and with the licensing basis?	☐	☐	☒	
3.	Do the design inputs have sufficient rationale?	☒	☐	☐	
4.	Are design inputs correct and reasonable?	☒	☐	☐	
5.	Are design inputs compatible with the way the plant is operated and with the licensing basis?	☒ *	☐	☐	
6.	Are Engineering Judgments clearly documented and justified?	☐	☐	☒	} NONE.
7.	Are Engineering Judgments compatible with the way the plant is operated and with the licensing basis?	☐	☐	☒	
8.	Do the results and conclusions satisfy the purpose and objective of the design analysis?	☒	☐	☐	
9.	Are the results and conclusions compatible with the way the plant is operated and with the licensing basis?	☒ *	☐	☐	
10.	Does the design analysis include the applicable design basis documentation?	☒	☐	☐	
11.	Have any limitations on the use of the results been identified and transmitted to the appropriate organizations?	☒	☐	☐	
12.	Are there any unverified assumptions?	☐	☒	☐	
13.	Do all unverified assumptions have a tracking and closure mechanism in place?	☐	☐	☒	

EXELON REVIEWER: DALE EAMAN / Dale Eaman **DATE:** 8-16-04
Print / Sign

* REVISION 005 SUPPORTS A LICENSE AMENDMENT REQUEST (LAR). THE DESIGN INPUTS AND THE RESULTS/CONCLUSIONS ARE COMPATIBLE WITH THE LAR.

CALCULATION TABLE OF CONTENTS

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1. PURPOSE

The purpose of this calculation is to determine a setpoint, the allowable values, and the expanded tolerances for the second-level undervoltage relays at Dresden Unit 2 based on post LOCA voltage analysis.

The setpoint will consider the setpoint error of the circuit that monitors the voltage at the 4.16 kV safety-related switchgears 23-1 (Div. I) and 24-1 (Div. II). The circuit consists of a GE type JVM-3 4200-120 volt potential transformer (PT) (catalog no. 643X94) and an ITE-27N undervoltage relay (catalog number 411T4375-L-HF-DP).

2. METHODOLOGY

The methodology for determining the loop uncertainties, setpoints, allowable values, and extended tolerances is done in accordance with NES-EIC-20.04 (Ref. 6.14) and the main body of Reference 6.17 with the clarifications as identified below. Appendix 1 of Reference 6.17 does not apply to this calculation because Appendix 1 is a documentation of guidelines for the Exelon calculations prepared under a different scope of work. However, where the setting tolerance (ST) is greater than the drift tolerance interval (DTIc), the methodology identified on page 23 of Reference 6.17 (part of Appendix 1) is used to determine loop random errors. The nomenclature for the relay setpoint terms, such as pickup, dropout, and reset is taken directly from the relay instruction bulletin (Reference 6.1.3).

2.1. The error associated with the PT will be established. The error for the PT is classified as a random process error and will be based on the accuracy assigned 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.

2.2. 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 control voltage). Per the methodology of Reference 6.14, reference accuracy or repeatability as specified by the manufacturer are taken as 2σ values, unless specified otherwise.
- Calibration instrument error (defined by the mfr). The error due to calibration standards is considered negligible per the methodology of Reference 6.14.
- 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 Input Data Section 5.4)
- Drift error

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

- Seismic error
- Humidity error
- Pressure error
- Radiation error

2.3. Per the methodology of Reference 6.14, the errors identified above will be combined into total error by adding the total random error to the total non-random error, as follows.

All random error are converted to 1σ values and combined by the "Square root of the sum of the squares"(SRSS) method. The outcome of the SRSS is then doubled to a 2σ value.

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

2.4. The nominal dropout for the two relays 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.

2.5. The drift based on vendor specifications (DTIv) is determined by calculating the square root sum of squares of reference accuracy (RA), calibration error (CAL), setting tolerance (ST), and drift (DR).

If specific values for drift are not provided by the vendor, then a default random [2σ] value of ±1% of span per refueling cycle for mechanical components and ±0.5% of span per refueling cycle for electrical components is assigned (Section 3.1 of Ref. 6.14).

2.6. Allowable Value

An allowable value will be determine utilizing the following equations based on Appendix C of Reference 6.14 as applicable:

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

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

Where AV: is the allowable value

SPc is the calculated setpoint

Zav^{+}, Zav^{-} is the total error (positive, negative) applicable during calibration.

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

The errors that are included for the determination of the allowable values (Zav) are only those applicable during calibration. Thus, only reference accuracy (RA), calibration errors (CAL), setting tolerance (ST), drift (DR) and if applicable, the input error (σin) are included. If DTIc is available, then RA, CAL, ST and DR errors will be replaced by the calculated drift (DTIc).

2.7. Expanded Tolerances (ET)

Expanded tolerances are determined as follows:

a. ET = ±[0.7*(Zav – ST) + ST], where ST is used at a 2σ value.

b. If any of the tolerances determined using the equations above result 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 is still utilized as the as-left tolerance.

3. ACCEPTANCE CRITERIA

The relay setpoints will be chosen such that the lowest possible voltage for relay operation, considering setpoint error, will be no lower than the Analytical Limits as identified in Section 5.6 of this calculation:

3820 V or 91.8% of 4160 V at Switchgear 23-1 (Div I)

3820 V or 91.8% of 4160 V at Switchgear 24-1 (Div II)

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 2.7 and are acceptable if the result is greater than or equal to the application setting tolerance and do not result in a violation of an applicable limit.

4. ASSUMPTIONS/ENGINEERING JUDGEMENTS

None

5. INPUT DATA

5.1. Instrument Channel Configuration (per Reference 6.1.1)

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. Per Reference 6.19, the burden on the PT is within the standard test burden of the PT.

5.2. Loop Element Data (per Reference 6.1.2, 6.5, 6.6, & 6.1.3)

5.2.1. The PT is a GE, type JVM-3 (catalog number 643X94)(See Reference 6.6)

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

5.2.2. The trip unit is an ABB/ITE, type 27N undervoltage relay with a Harmonic Filter (catalog number 411T4375-L-HF-DP, Ref. 6.1.2)

<u>Setpoint Ranges (per Ref. 6.1.3)</u>

Pickup:	70 V - 120 V (See Reference 6.1.3)
Dropout:	70% - 99.5% * of Pickup
Dropout Delay:	1 - 10 sec.

* Note: - Difference between pickup and dropout can be set as low as 0.5%. The setting is 99.50% of pickup (References 6.15 and 6.18).

<u>Operating Ranges (per Refs. 6.5, 6.1.3, and 6.13)</u>

Control Voltage:	38-58 Vdc (48 Vdc nominal)
	95-140 Vdc (125 Vdc nom.) (Reference 6.13)
	89 Vdc for 1 sec. (Reference 6.13)
Temperature:	-20 to +55°C (normal)
	-30 to +70°C (accident)
Seismic:	6g ZPA

Humidity:	0 to 100% no condensation (Reference 6.10, Section 10.3)	
Pressure:	Atmospheric, to 5000 ft	
Radiation:	Gamma 100k rads over 40 yrs	

Repeatability Tolerances (per Reference 6.1.3)

@ 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 taken as 2σ values per Reference 6.7).

For the tolerance over temperature range, the repeatability effect is linear over the range of 0 to +55°C, as indicated in Reference 6.7.

5.3. Calibration Instrument Data (per References 6.2 and 6.13)

The Fluke 45 Digital Multimeter will be used for the calibration of the trip unit (see Ref. 6.13 included as Attachment J).

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

5.4. Calibration Procedure Data

The setting tolerance when setting the trip unit voltage is ±0.2 V (Ref. 6.13, 6.15 and 6.18 which is taken as a 3σ value per the methodology in Reference 6.14.

5.5. Station Data

The circuits for these two processes are located entirely in the Reactor Building in Environment Zone 26 per Reference 6.1.2. The following are the conditions that the circuits will be subject to:

Normal Conditions

Control Voltage Range:	95-140Vdc (Ref. 6.13)
Temperature Range:	+18.33 - +39.44°C (see Ref. 6.11)
Humidity Range:	0 - 90%
Radiation Level:	<10k rads over 40 years

Accident Conditions

Control Voltage Range:	95-140Vdc; 89 Vdc for 1 sec. (Ref. 6.13)
Temperature Range:	+18.33 - +39 44°C (see Ref. 6.11)
Humidity Range:	0 - 100% non-condensing

As noted in Reference 6.12, 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 relays are installed will be approximately 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 42.22°C.

The relay has already been qualified for humidity variation, seismic events, radiation exposure, and pressure variation as discussed in References 6.1.2, 6.5, and 6.10.

5.6. Analytical Limit of Switchgear Voltage

The minimum voltages required at the 4160 V safety-related switchgear for adequate auxiliary system performance are taken from References 6.3, 6.4 and 6.16 as:

3820 V or 91.8% of 4160 V at Switchgear 23-1 (Div I)

3820 V or 91.8% of 4160 V at Switchgear 24-1 (Div II)

5.7. Per Reference 6.19, the burden on the PT is within the standard test burden of the PT.

6. REFERENCES

6.1. DIT Number DR-EPED-0671-00, entitled,"ITE-27N Undervoltage Relay and Potential Transformer Technical Informatino", dated 1-22-92 (Attachment A). The following were included in the DIT:

6.1.1. Dresden Unit 2 Drawings:

12E-2301, Sheet 3, Rev. AD

12E-2334, Rev. T

12E-2345, Sheet 3, Rev. AD

12E-2346. Sheet 3, Rev. AD

12E-2655G, Rev. T

6.1.2. Work Request Number D-97548/D-97549, Rev. 0, entitled "Minor Plant Design Change Package for Commonwealth Edison Company, Dresden Unit 2, Replacement of Second-Level Undervoltage Relays," dated 1-15-92.

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

6.2. User's Manual for Fluke 45 Dual Display Multimeter, Appendix A, Rev. 4, dated 7/97 (Attachment B).

6.3. S&L Calculation Number 9198-18-19-1, Rev. 3, entitled "Calc. for Dresden 2/I Safety-related Continuous Loads - Running/Starting Voltages"

6.4. S&L Calculation Number 9198-18-19-2, Rev. 3, entitled "Calc. for Dresden 2/II Safety-related Continuous Loads - Running/Starting Voltages"

6.5. S&L Interoffice Memorandum from J. F. White, entitled "Seismic Qualification of ITE/ABB Undervoltage Relay Model 27N, Series 411T," which references ABB document number RC-5039-A, entitled "Equipment Performance Specifications, 27N Undervoltage Relay." (Attachment C)

6.6. GE document 7910, page 131, providing information for type JVM-3 Potential Transformer, dated 6-20-77 (Attachment D).

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

6.8. Dresden Unit 2 Technical Specification Number DPR-15, Amendment number 108, specifically table 3.2.2, page 3/4.2-10. This reference provides the second-level undervoltage relay time delay requirement.

6.9. 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 (Attachment F).

6.10. 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 (Attachment G).

6.11. DIT Number DR-EPED-0671-01, "Reactor Building Ventilation, Minimum Temperature," dated 5-08-92 (Attachment I).

6.12. DIT Number BB-EPED-0178, "Undervoltage Relay Accuracy Calculation Input Data," dated 5-07-92 (Attachment M).

6.13. Interoffice Memorandum from Bipin Desai (EPED), dated December 1, 1993 to R. M. Higdon (EAD) which contains information required for assumption verification (Attachment I).

6.14. NES-EIC-20.04, Revision 3, "Analysis of Instrument Channel Setpoint Error and Instrument Loop Accuracy" (Not Attached)

6.15. Current Relay Setting Orders for the Second Level Undervoltage Relays (Attachment J)

6.16. DOC ID 0006191944, Rev. 5-DIT transmitting Improved Technical Specification (ITS) Analytical Limits (Attachment K).

6.17. "Improved Technical Specifications and 24-Month Technical Specification Project Technical Plan", Revision 2 dated 04/28/2000

6.18. Telecon between John Kovach of ComEd and Craig Tobias of Sargent & Lundy dated 4/20/2000 verifying the relay setting orders for the degraded voltage and loss of voltage relays (Attachment L).

6.19. EC 8228, ITS Disconnect U2 Watt-Hr Meter at 23-1 & 24-1, Rev. 0, Work Order 99261478-01

7. CALCULATIONS

7.1. Per inputs 5.1 and 5.2.1, the PT has a standard published error of ± 0.3% and the burden of 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 random 2σ error. Therefore the PT 1σ error value is ± 0.15%.

7.2. Second Level Undervoltage Relay Random Errors:

7.2.1. Reference accuracy (RA):

Per Input 5.2.2, repeatability at constant temperature and control voltage is ± 0.1% of voltage reading [2σ]. Dividing by 2 to take to a 1σ value:

RA = 0.05% of reading [1σ].

7.2.2. Calibration Instrument error (CAL):

The reference accuracy at medium sampling rate (Reference 6.13) of a 60 Hz voltage signal is ± (0.2% of reading + 10 least significant digits), to a 2σ value per the methodology of Reference 6.14. 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 2σ reference accuracy is ± (0.2% of reading + 10*0.01 V).

Conservatively taking this at a reading 112 V, which is slightly larger than the existing relay setpoint value, and dividing by 2 to get a 1σ value:

$CAL_v = \pm(0.2\%*112\ V + 10 * 0.01V)/2 = 0.162\ V$ [1σ]

In terms of % of reading (taken at a reading of 112 V):

$CAL = CAL_v/112\ V = 0.162\ V / 112\ V = 0.145\%$ of reading [1σ]

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 Input Data Section 5.3)

7.2.3. Setting Tolerance (ST)

Per Input Section 5.4, the relay setting tolerance is a random error of ± 0.2 V [3σ]. Converting this to terms of % of reading, for a 112V reading, and dividing by 3 to get the 1σ value:

$ST = \pm(0.2\ V) / ((112\ V) * 3) = \pm 0.060\%$ of reading [1σ]

7.2.4. Drift (DR)

According to Reference 6.7, no drift error is expected for the relay as long as the relay is calibrated at reasonable intervals. Thus, DR = 0. However, this is not the case. From operating experience it is known that these relays do drift some. Unfortunately, there is not enough data to perform a drift uncertainty calculation.

Based on the above discussion, a drift value is needed. It is considered conservative to use the default drift effect of 0.5% of span per refueling cycle (reference 6.14). This specification conservatively encompasses the 18 month calibration interval plus 25% late factor (22.5 months) considered in this calculation. The 0.5% of span is a 2σ value. Per Section 5.2.2, the relay functions over a voltage range of 70 V to 120 V, for a span of 50 V. Converting the drift to % of reading, by conservatively setting the reading at 112V, and taking to a 1σ value:

DR = (± 0.5% of span) * (120 V – 70 V) / (112 V) / 2 = ± 0.112% of reading

7.2.5. Random Input Error (σin)

The random input error present at the relay is the random error from the PT, which per Section 7.1 is 0.15%. Thus:

σin = 0.15% of reading [1σ]

7.2.6. Drift Tolerance Interval (DTIv)

$DTIv = \pm (RA^2 + CAL^2 + ST^2 + DR^2)^{1/2}$

Where RA = reference accuracy = 0.050% per Section 7.2.1
CAL = calibration error = 0.145% per Section 7.2.2
ST = setting tolerance = 0.060% per Section 7.2.3
DR = drift = 0.112% per Section 7.2.4

Thus:

$DTIv = \pm [(0.050\%)^2 + (0.145\%)^2 + (0.060\%)^2 + (0.112\%)^2)^{1/2}$

DTIv = ± 0.199% of reading [1σ]

7.2.7. Total Random Error (σ)

The total random error is the SRSS of the random errors from Sections 7.2.1 through 7.2.6. Therefore:

$\sigma = \pm (RA^2 + CAL^2 + ST^2 + DR^2 + \sigma in^2)^{1/2}$

$\sigma = \pm [(0.050\%)^2 + (0.145\%)^2 + (0.060\%)^2 + (0.112\%)^2 + (0.150\%)^2)^{1/2}$

σ = ± 0.249% of reading [1σ]

7.3. Relay Non-Random Errors

7.3.1. Temperature effect (eT):

Per Input 5.2, the temperature effect is ±0.75%, and the absolute effect is 1.5% over the temperature range of 0 to +55°C. Per References 6.7 and 6.9, the relay operating voltage increases or decreases approximately linearly with temperature. Applying the 1.5% linearly across the 0 to 55°C range results in a rate of 1.5% / (55 – 0)°C = 0.0273% / °C.

The actual pickup or dropout voltage is lower than the setpoint value if the operating temperature is higher than the temperature at which the relay was calibrated.

Similarly the pickup or dropout voltage is higher than the setpoint value if the operating temperature is lower than the calibration temperature.

Then, for a temperature range of +18.72 to +42.22°C and a relay calibration temperature range of 21 to 24°C (per Reference 6.13), 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 (per Reference 6.13). 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. At 24°C, a larger portion of the error used in the calculation for relay temperature effect will be negative, which will provide a conservative nominal dropout.

Neg. Temp. Effect:

-eT = (24-18.72°C)*0.0273%/°C = 0.144%

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 (per Reference 6.13). 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 21°C rather than 24°C, a larger portion of the error used in the calculation for relay temperature effect will be positive, which will provide a conservative determination of the relay maximum dropout.

Pos. Temp. Effect:

+eT = (42.22-21°C)*0.0273%/°C = 0.579%

Thus, the temperature effect is -0.579%/+0.144%.

This is classified as a non-random error.

7.3.2. Control Voltage Effect (CV)

Per Input 5.2, control voltage effect is ± 0.1% over the dc control voltage range of 100-140 Vdc. This is classified as a non-random error.

CV = ± 0.1% of reading

7.3.3. Environmental Effects

By comparison of the acceptable relay conditions provided in Section 5.2.2 with the expected station conditions provided in Section 5.5, it is evident that no effect on functional capability is introduced as a result of pressure variation or humidity variation.

7.3.4. Seismic Effects

As discussed in Reference 6.1.2, section 1.7, 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.

7.3.5. Total Non-Random Error

The total non-random error is the sum of the non-random errors from sections 7.3.1 through 7.3.2. Therefore:

Negative non-random error is the addition of the negative relay temperature effect (-eT) from Section 7.3.1 and the negative control voltage effect (CV) from Section 7.3.2:

Σe- = -eT + (-CV) = (- 0.579%) + (- 0.1%) = - 0.679% of reading

Positive non-random error is the addition of the positive relay temperature effect (+eT) from Section 7.3.1 and the positive control voltage effect (CV) from Section 7.3.2:

Σe+ = +eT + (+CV) = (+ 0.144%) + (+ 0.1%) = + 0.244% of reading

7.4. Total Error

It should be noted that this calculation utilizes the methodology defined in Sections 2.3 and 2.4 to calculate the dropout setpoint. The calculation uses the Total Negative Error (TNE) in determining the dropout setpoint and the Total Positive Error (TPE) in determining the maximum dropout value. These definitions of error do not follow the methodology defined in Sections 2.6 and 2.7 for calculating the Allowable Values and Expanded Tolerances. Thus, TNE and TPE are used in the determination of the dropout setpoint and maximum dropout value, and Z+, Z-, Zav+ and Zav- are used in the determination of the Allowable Values and Expanded Tolerances.

The total error present at the relay is the combination of the random and non-random errors determined in Sections 7.2.7 and 7.3.5.

Total Error = $2\sigma + \Sigma e$

Total Negative Error (TNE) = 2 * (0.249%) + (0.679%) = 1.177% of reading

Total Positive Error (TPE) = 2 * (0.249%) + (0.244%) = 0.742% of reading

Converting to 4kV voltage process units, by conservatively taking the relay voltage reading at 112V, and then multiplying by the voltage ratio:

TNE = 1.177% * (112 V) * (4200 V/ 120 V) = 46 V (in the 4kV process)

TPE = 0.742% * (112 V) * (4200 V/ 120 V) = 29 V (in the 4kV process)

In this calculation, the terms of Total Positive Error (TPE) and Total Negative Error (TNE) are used for calculating the setpoint. A positive error is one that would cause the actual trip value to be higher than the setpoint value. Using this definition when the errors are applied to calculating the Allowable Values and Expanded Tolerances results in the following relationships:

Z+ = TNE

Z- = TPE

$\Sigma e+$ = Negative Non-Random Errors = 0.679% of reading

$\Sigma e-$ = Positive Non-Random Errors = 0.244 % of reading

Per Section 2.6, Z_{AV} will be used to determine the allowable value random errors. Because the relay is bench calibrated, Z_{AV} includes only the contributions of DTIv, which from Section 7.2.6, is ± 0.199% of reading. Therefore,

σ_{AV} = DTIv = ±0.199% of reading

Per Section 2.6, the total errors for determining allowable values are:

$Z_{AV}+ = 2\sigma_{AV}+$ = 2 * (+ 0.199%) = + 0.398% of reading

$Z_{AV}- = 2\sigma_{AV}-$ = 2 * (- 0.199%) = - 0.398% of reading

Converting to voltage at relay, by using a reading at 112V:

Z_{AV} = (0.398% of reading) * (112 V) = 0.45 V at relay

7.5. Setpoint Determination

The setpoints for 4160 V Switchgear 23-1 (Div. I) and 24-1 (Div. 2) are calculated as:

Nominal Trip Setpoint for Dropout ($NTSP_{DO}$)= Analytical Limit (AL) + TNE

$NTSP_{DO}$ = AL + TNE (Using values from Sections 5.6 and 7.4)

= 3820 V + 46 V = 3866 V at 4.19 kV bus

Converting to voltage read at the relay by multiplying by the voltage ratio:

$NTSP_{DO-R}$ = $NTSP_{DO}$ * (120 V) / (4200 V) = (3866 V) * (120 V)/(4200 V)
= 110.46 V ≈ 110.5 V at relay

$NTSP_{PU-R}$ = $NTSP_{DO-R}$ / 0.995 = 110.5 V / 0.995
= 111.06 V ≈ 111.1 V at relay

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

Maximum Dropout = $NTSP_{DO}$ + TPE = (3866 V) + (0.74% * 3866)
= 3895 V at 4.16 kV bus

Converting to terms of voltage at the relay: (3895 V) * (120 V)/(4200 V) = 111.3 V

Maximum Pickup = Maximum Dropout / (dropout/pickup ratio) = 3895 V / 0.995
= 3915 V at 4.16 kV bus

Converting to terms of voltage at the relay: (3915 V) * (120 V)/(4200 V) = 111.9 V

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

7.6. Allowable Value Determination

Per Section 2.6, the Allowable Value is determined.

The lower allowable value for the dropout setpoint is determined as:

$AV_{DOL} \geq SPc - |Z_{AV}+|$ [lower limit]

SPc_{DO} = 3866 V at 4.16 kV bus (Section 7.5)

$Z_{AV}+$ = 0.398% of reading (Section 7.4)

$AV_{DOL} \geq$ (3866 V) – (0.398% * (3866 V)) = 3851 V

Converting to voltage at the relay, by multiplying by the voltage ratio:

$AV_{DOL-R} \geq$ (3851 V) * (120 V) / (4200 V) = 110.029 V ≈ 110.0 V

Applying the applicable uncertainties to determine the upper dropout AV:

$AV_{DOU} \leq SPc + |Z_{AV}+|$ [lower limit]

$AV_{DOU} \leq$ (3866 V) + (0.398% * (3866 V)) = 3881 V

Converting to voltage at the relay, by multiplying by the voltage ratio:

$AV_{DOU-R} \leq$ (3881 V) * (120 V) / (4200 V) = 110.886 V ≈ 110.9 V

7.7. Expanded Tolerance Determination

Per Section 2.7, the Expanded Tolerance is determined as:

$ET = \pm [0.7 * (|Z_{AV}+| - ST) + ST]$ where ST is taken to a 2σ value

$Z_{AV}+$ = 0.398% of reading (Section 7.4)

ST = 0.2 V [3σ] (Section 5.4)

Taking the ET at a reading of 112V at the relay:

ET = ± [(0.7 * ((0.398% of reading) * (112 V) – (0.2 V *2/3)) + (0.2 V *2/3) = ± 0.352 V at relay

ET ≈ ± 0.35 V at relay

The ET is now checked to ensure that the applicable limits are maintained:

Check 1:	ET	≥	ST ?	
	± 0.35 V	≥	± 0.2 V	PASS
Check 2:	SPc – ET	≥	AV ? [lower limit]	
	110.5 – 0.35 V	≥	110.0 V	
	110.15 V	≥	110.0 V	PASS
Check 3:	SPc + ET	≤	AV ? [upper limit]	
	110.5 + 0.35 V	≤	110.9 V	
	110.85	≤	110.9 V	PASS

8. SUMMARY AND CONCLUSIONS

The following are the recommended settings for the Division I and II second-level undervoltage relays:

The results summarized below are applicable for normal and accident operating conditions, for the existing Analytical Limit of 3820 V. It should be noted that the field setpoint value is required to be revised per this calculation.

Calculated Values Summary

Description	Div. I / II V at relay	Div. I / II (4.16kV equiv.)
SPc (DO)	110.5	3866
SPc (PU)	111.1	3885
AV(DO) lower	≥ 110.0	≥ 3851
AV(DO) upper	≤ 110.9	≤ 3881
Max. DO	111.3	3895
Max. PU	111.9	3915

NOTE: Pickup (PU) is 99.5% of Dropout (DO) (see Section 5.2.2)

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 Dresden Unit 2 Technical Specifications (Reference 6.8), which is 7 seconds.

Please utilize the Instruction Bulletin I.B. 7.4.1.7-7, Issue D (Reference 6.1.3) when setting the relay since the setpoints and setpoint terminology in this calculation are based on this instruction bulletin

Calibration Summary

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

Calibration Setpoint / Allowable Value (for Dropout (DO)):

EPN	Parameter	Process Units
127-3(4)-B23-1 127-3(4)-B24-1	Field Calibration Setpoint	≥ 110.5 V
	Allowable Value - Lower	≥ 110.0 V
	Allowable Value - Upper	≤ 110.9 V

Calibration Frequency, Setting Tolerances and Expanded Tolerances:

	Surveillance Interval	Setting Tolerance	Expanded Tolerance
Channel Calibration	18 months	± 0.2 V	± 0.35 V

The values calculated above are dependent on the relays being calibrated with a Fluke 45, set on medium rate, to read the voltage at the relay, in the 300 Vac range. Use of other M&TE is only permitted if it is analyzed to be of equal or better accuracy than the Fluke 45.

ATTACHMENT A

DIT DR-EPED-0671-00

SARGENT & LUNDY ENGINEERS

DESIGN INFORMATION TRANSMITTAL

☐ SAFETY-RELATED ☐ NON-SAFETY-RELATED

DIT No. - DR-EPED-0671-00

Page 1 of

To W. G. BLOETHE

CLIENT CECO

STATION DRESDEN UNIT(S) 2

PROJECT NO(S). 8982-13

SUBJECT ITE-27N UNDERVOLTAGE RELAY AND POTENTIAL TRANSFORMER TECHNICAL INFORMATION.

MODIFICATION OR DESIGN CHANGE NUMBER(S) —

S. K. SAHA / J.W. HYRC	EPED	S.K. Saha / J.W. Hyrc	1-22-'92
Preparer (Please print name)	Division	Preparer's signature	Issue date

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.)

APPROVED FOR USE

Calc. No. 8982-13-19-6
Rev. 3
Page A2 of
Project No. 8982-64

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.)

12E-2301 SH. 3 REV. AD
12E-2334 REV. T
12E-2345 SH. 3 REV. AD
12E-2346 SH. 3 REV. AD
12E-2655G REV. T
SWITCHGEAR PROPOSAL DATA SHEET (PAGE 6) FOR SPEC. K-2175
INSTRUCTIONS BULLETIN IB 7.4.1.7-7 ISSUE D

} POTENTIAL TRANSFORMER (PT) AND ITE-27N UNDER VOLTAGE RELAY INFORMATIONS.

A { MINOR PLANT CHANGE DESIGN PACKAGE, W.R. NO. D-97548/D-97549 REV. 0, DATED JANUARY 15, 1992.
FOR STATION ENVIOURNMENTAL INFORMATION.

SOURCE OF INFORMATION

Calc. no. — — Rev. and/or date Report no. — — Rev. and/or date

Other —

DISTRIBUTION

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R. H. JASON - 21
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Calculation No. 8982-13-19-6
Revision 005
Attachment: A
Page A2 of A72

F613A (1/2)
01-87- F3

Form GQ-3.17.1 Rev.2 (01-08-87)

3

MINOR PLANT CHANGE DESIGN PACKAGE

FOR

COMMONWEALTH EDISON COMPANY

DRESDEN STATION

UNIT 2

REPLACEMENT OF SECOND LEVEL UNDERVOLTAGE RELAYS

January 15, 1992

Minor Plant Change Design Package
for
Commonwealth Edison Company
Dresden Station - Unit 2
Replacement of Second Level Undervoltage Relays
Connected to the Class 1E Buses 23-1 & 24-1
Revision 0 Date: January 15, 1992

PROJECT IDENTIFICATION:

CECo:

P.O./Release	327125/NED 753
W.R./Function #	D-97548, D-97549/59139-2084
Budget #	N/A
AIR #	N/A
Mod #	N/A

AE:

Project No.	8982-58
(Other)	

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Senior Elect.	T. R. Eisenbart	(312) 269-6670
Elect. Proj. Eng.	M. E. Hill	(312) 269-2190
Elect. Eng.	J. W. Hyrc	(312) 269-3535

COMMITMENTS:

NRC Required Completion	None
INPO Commitment	None
Outage Requirement	Yes

CLASSIFICATION:

Safety-Related	X
Non-Safety-Related	
Reliability Related	
Environmental Qualification	
Regulatory-Related	

REVISION STATUS

Revision Purpose	Date	Revision
0	01-15-92	First issue, pages 1 thru 20 for use

DESIGN INPUT REQUIREMENTS - TABLE OF CONTENTS

1.0 DESIGN INPUT REQUIREMENTS

1.1 BASIC FUNCTIONS TO BE PERFORMED

The basic function to be performed by this Minor Plant Change is to replace the existing second level undervoltage relays Type ITE-27D connected to the Class 1E 4.16-kV Buses 23-1 and 24-1 with Type ITE-27N. This Minor Plant Change also relocates the second level undervoltage Panel 2252-83 and routes new cables to it from 4.16-kV Switchgear 23-1.

1.2 PERFORMANCE REQUIREMENTS

The performance requirement is for the second level degraded voltage protection scheme relays for the Class 1E 4.16-kV Buses 23-1 and 24-1 to be able to reset (once they drop out) when the system voltage recovers to an acceptable level within the time delay setting. This can be achieved by replacing the existing ITE-27D with ITE-27N relays.

1.3 CODES, STANDARDS, REGULATORY REQUIREMENTS, AND QA REQUIREMENTS

The codes and standards listed below will be used as guidelines for this Minor Plant Change. Some portions of the Minor Plant Change may not be designed or procured according to these, but the design will conform to them whenever practical.

	Code	Standard
A)	ANSI C37.90	Relay and Relay System Associated with Electric Power Apparatus.
B)	ANSI C37.90A	Guide for Surge Withstand Capability.
C)	ANSI C37.98-1978	Standard Seismic Testing of Relays.
D)	ANSI N45.2-1971 or NQA-1 (1986)	Quality Assurance Program Requirements for Nuclear Facilities.

E)	ANSI N45.2.2-1978	Packaging, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants.
F)	*IEEE-308-1980	Criteria for Class 1E Power Systems for Nuclear Power Generating Stations.
G)	*IEEE-323-1983	Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.
H)	*IEEE-344-1975	Recommended Practices for Seismic Qualification of Class 1E Equipment.
I)	10 CFR 21	Reporting of Defects and Noncompliance.
J)	10 CFR 50, App. A	General Design Criteria.
K)	10 CFR 50, App. B	Quality Assurance.
L)	10 CFR 50.49	Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants.
M)	Specification K-4080 Rev. 5	General Work Specification for Maintenance/Modification Work.
N)	Specification 13524-068-N102, Rev. 3	Equipment Qualification Specification (by Bechtel).
O)	DC-SE-002-DR, Rev. 2	Dresden Seismic Design Criteria.
P)	Specification 13524-068-N101, Rev. 1	Bechtel Radiation Study
Q)	Nuclear Station Work Procedures	

R)	CECo Electrical Installation Standard (EIS), Rev. 2	
S)	10 CFR 50.59	Changes, Tests, and Experiments
T)	AWS D.1.1, Rev. 1	Structural Welding Code
U)	DC-SE-01-DQ	Project Structural Design Criteria
V)	*IEEE-383-1974	Type Test of Class 1E Electrical Cable, Field Splices, and Connections for Nuclear Power Generating Stations.

Note: An asterisk (*) designates a code or standard to which CECo has committed Dresden Station, Unit 2. The revision committed to is not necessarily the same one as is to b used in the design of this Minor Plant Change.

1.4 DESIGN CONDITIONS

The Type ITE-27N relays shall operate under all plant operating conditions and in the environmental conditions given in Section 1.6. The ITE-27N relays will be purchased with an internal harmonic filter to eliminate harmonic distortion in the ac input circuit. The ITE-27N relay has a lower pickup voltage/dropout voltage ratio, which allows the relay to reset (once it drops out) when the system voltage recovers to an acceptable level. Thus, avoiding unnecessary tripping of the off-site power source and transferring of the Class 1E 4.16-kV buses to the on-site diesel generators. See also Section 1.12 for electrical design conditions.

1.5 DESIGN LOADS

The new ITE-27N relays are the same size as the existing ITE-27D relays. Structural loading will be affected as the result of relocation of Panel 2252-83, however, the weight increase in the new panel location will not be significant. Structural loads (i.e., seismic and dead weight) have been evaluated for this Minor Plant Change and found acceptable (see also

Sections 1.7 and 1.11). The new relay has an input circuit at 0.5 VA/120 Vac and a control circuit at 0.05 A/125 Vdc which are less than 1.2 VA/120 Vac and 0.08 A/125 Vdc for the existing relay. The new relays will have no significant thermal heat contribution to the area where they will be located.

1.6 ENVIRONMENTAL CONDITIONS

The existing Dresden, Unit 2 second level undervoltage relays are mounted in Panels 2252-83 and 2252-84. Each panel contains two undervoltage relays. These panels are associated with and located just behind 4160-kV Switchgear Buses 23-1 and 24-1, respectively. These switchgears and panels are located on elevation 545'-6" of the Unit 2 Reactor Building. This area is Environmental Zone 26. The environmental parameters (based on E. Q. Binder 44D and Bechtel Specification 13524-068-N101, Rev. 1) were determined for the present locations of these undervoltage relays as presented below:

Parameter	Normal	LOCA
Temperature	104°F	104°F
Pressure	14.7 psia	14.7 psia
Humidity	<90%	100% (non-condensing)
Radiation	<1.0E04	*
Duration	40 years	1 year

* Further detailed reviews (based on distances from radiation sources) have determined that Core Spray Pipe 1404-12" is the relevant radiation source for the panel locations. The existing location of Panel 2252-83 is 6 feet away from the core spray pipe and the radiation level at its location is 2.8E05 rads. This radiation level exceeds the vendor radiation limit for the new replacement undervoltage relays (ITE-27N), which is 1.0E05 rads. Therefore, Panel 2252-83 will be relocated to the distance of 18 feet from the pipe in order to decrease the radiation level below the relay's limit. Comparison of the distances of both panels from this pipe provided the one-year post Loss Of Coolant Accident (LOCA) doses as shown in the following:

Panel No.	Distance From Pipe 1404-12"	Dose (rads)
2252-83	18 feet (new location)	3.5E04 (mild)
2252-84	27 feet	3.0E04 (mild)

Panels 2253-83 and 2253-84 are subject to the effects of an RWCU line break at this location. This area is considered to be a harsh environment in the event of an RWCU line break. However, per EQ binder 44D, the second level undervoltage relay is not required to mitigate the consequences of an RWCU line break (Bechtel Chron 13303 and MLEA Calculation 88011-03, dated 11/15/88).

1.7 SEISMIC QUALIFICATIONS

The seismic information contained in ABB Certification Report RC-5039-A (submitted for Modification M12-3-89-53) was compared against the seismic requirements for the location of the relays in each subject panel. The Seismic Design Criteria DC-SE-002-DR provides the response spectra damping values and seismic design requirements for the Dresden Station. The new conduit supports and support for Panel 2252-83 will be seismically qualified (Reference Calculation 8900-03-EE-S, Rev. 1). The results of this review is that the ITE-27N relays, purchased to the ABB Report mentioned above, do indeed envelop the seismic requirements for this location and the relays would, therefore, maintain their functional ability during and after a seismic event (Reference Calculation CQD-051325, Rev. 1). Seismic evaluation of Panel 2252-83 relocation is provided in Calculation CQD-510158, Rev. 0.

1.8 ENVIRONMENTAL QUALIFICATIONS

The new relays will be installed in Panels 2252-83 and 2252-84. Panel 2252-83 will be relocated to an area with a lower radiation level. For a LOCA condition, Panels 2252-83 and 2252-84 are considered to be in a mild environment. For a HELB condition, specifically an RWCU line break, these panels are considered to be in a harsh environment. But, second level undervoltage relays are not required to mitigate the consequences of an RWCU line break (see EQ Checklist ENC-QE-6.6). Therefore, the second level undervoltage relays do not require environmental qualifications.

1.9 INTERFACE REQUIREMENTS

This Minor Plant Change is limited to the second level undervoltage protection of the Class 1E 4.16-kV Buses 23-1 and 24-1. No other plant system is impacted. This Minor Plant Change will increase the reliability of the second level undervoltage protection by using ITE-27N relays, which have a lower pickup voltage/dropout voltage ratio.

1.10 MATERIAL REQUIREMENTS

In addition to the ABB ITE-27N undervoltage relays, the following materials are required for this Minor Plant Change:

a) Terminal lugs for #14 AWG SIS wires.

b) Switchboard wires, #14 AWG, and 600-V Type SIS.

c) Control Cable.

d) Conduits

e) Conduit Supports

f) Mounting hardware for Panel 2252-83

1.11 STRUCTURAL REQUIREMENTS

The impact of replacing the second level undervoltage relays on Panels 2252-83 and 2252-84 have been seismically evaluated (see Section 1.7 above). The new relays provide no significant change to the structural loading of the subject panels. The new conduit supports and new support for Panel 2252-83 shall be designed to meet allowable stress requirements under normal seismic loading conditions as described in FSAR, Section 12, Seismic Design Criteria DC-SE-002-DR, and Project Structural Design Criteria DC-SE-01-DQ. The building structure was evaluated for the additional loads from the new conduit supports and relocated Panel 2252-83. The normal and seismic loads were found to be within the allowable stress requirements described in FSAR, Section 12 and DC-SE-01-DQ.

1.12 ELECTRICAL REQUIREMENTS

This Minor Plant Change does not change the existing design and electrical function of the second level undervoltage relays. The new undervoltage relays shall meet the following specifications:

Detailed Description:

Type:	ABB ITE-27N (High Accuracy Undervoltage Protective Relay)
Control Voltage:	125 Vdc (Nominal)
Input Voltage:	125 Vac (Nominal), Single-Phase
Input Frequency:	60 Hz
Case:	Test Case
Mounting:	Semi-Flush
Operating Time:	Definite Time Delay Unit (Dropout Range 1 to 10 Seconds)
Harmonic Filter:	Yes
Standards:	Per IEEE-344 (1975) ANSI C37.90 and C37.98
Catalog No.:	**411T4375-L-HF-DP**

Replacement relays will have the same settings as the existing relays. System Planning will issue the relay setting order and Electrical/Instrument and Control Group may review the relay setting order.

The Dresden Station Technical Specification, ELMS, electrical design drawings, vendor supplied information, and field walkdowns are utilized to establish the necessary electrical parameters for the second level undervoltage relays.

1.13 LAYOUT AND ARRANGEMENT REQUIREMENTS

The outline dimensions and panel drilling for the new ITE-27N undervoltage relays are identical to the existing ITE-27D relays. Therefore, there will be no additional layout arrangement requirements. Layout of new box location will be specified on Engineering Change Notice 12-00470E.

1.14 OPERATIONAL REQUIREMENTS

The plant operational requirements are not changed by this Minor Plant Change.

The second level undervoltage relays are required to protect Class 1E 4.16-kV Buses 23-1 and 24-1 against a degraded voltage condition. The relays are required to initiate a timer (five-minute time delay setting) if a degraded voltage condition persists (see Tech. Spec. Table 3.2.2). After the delay, the relays actuate associated circuits to trip off-site power source breakers, initiate load shedding and start the diesel generators. The relays are also required to be able to reset when the line voltage recovers to an acceptable level within the time delay setting. Thus, overriding unnecessary tripping of off-site power source breaker, load-shedding and starting of the diesel generator.

1.15 INSTRUMENTATION AND CONTROL REQUIREMENTS

There are no additional instrumentation and control requirements since this Minor Plant Change does not change the function or logic circuitry of the second level undervoltage protection scheme.

1.16 TECHNICAL SPECIFICATION CHANGES

This Minor Plant Change does not change any set points or time delay settings for the existing undervoltage protection scheme. The new relay has a drop out tolerance of +/- 0.5% which is bounded by the existing relay tolerance of +/- 2%. This tolerance is stated in Table 3.2.2 of the Technical Specification. The lower reset voltage is an internal characteristic of the new undervoltage relay. Therefore, no changes to the Technical Specifications are required as result of this Minor Plant Change. The Dresden station, Unit 2, Technical Specifications, Sections 3.2 and 3.9, and Table 3.2.2 were reviewed in making this determination.

1.17 FSAR/UFSAR CHANGES

This Minor Plant Change does not require changes to the Dresden Station, Unit 2 Final Safety Analysis Report (FSAR)/Updated Final Safety Analysis Report (UFSAR). The FSAR/UFSAR, Section 8.2.3.1. was reviewed in making this determination.

1.18 REDUNDANCY, DIVERSITY, AND SEPARATION REQUIREMENTS

The redundancy, diversity, and separation requirements for the Class 1E 4.16-kV Buses 23-1 (Division I) and 24-1 (Division II) are not affected by this Minor Plant Change.

1.19 FAILURE EFFECTS REQUIREMENTS

This Minor Plant Change will reduce the probability of inadvertent tripping of the Class 1E 4.16-kV buses off-site power source when the system voltage is at an acceptable level, and thus minimize unnecessary load shedding and starting of the diesel generators. No other failure effects are changed by this modification.

1.20 TEST, NDE, AND WELDING REQUIREMENTS

CECo and S&L will define the applicable tests and the acceptance criteria for the tests. This test declares the relays operable after the implementation of this Minor Plant Change. Welding of the conduit support to its base should conform to the requirements of AWS D.1.1.

1.21 ACCESSIBILITY , MAINTENANCE, REPAIR, AND ISI

This Minor Plant Change does not affect or change the accessibility for maintenance, repair, and in-service inspection of the undervoltage relays.

1.22 RISK TO HEALTH AND SAFETY OF THE PUBLIC

This Minor Plant Change will not increase the risk to the health and safety of the public.

1.23 SUITABILITY OF PARTS, EQUIPMENT, PROCESSES, AND MATERIALS

All components used for this Minor Plant Change shall be compatible with the existing design and shall comply with the requirements in Sections 1.2, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, and 1.12.

1.24 PERSONNEL SAFETY

No special personnel safety requirements exist for installing this Minor Plant Change. Standard precautions for working on electrical equipment are considered adequate for this project. No hazardous materials (e.g., asbestos) are to be used.

1.25 CATHODIC PROTECTION REQUIREMENTS

Cathodic protection is not required for this Minor Plant Change, since no new metal pipes or structures are being added.

1.26 INDUSTRY EXPERIENCE (SER/SOER KEYWORD INDEX)

After the degraded system voltage events at the Millstone Unit 2 Nuclear Plant in 1976, the Nuclear Regulatory Commission concluded that system design alone does not ensure the adequacy of the off-site power supply, and therefore, undervoltage relaying schemes should be installed on the system to protect against the possibility of degraded system voltage. Experience with the added protection system over the past 10 years has revealed some problems in scheme logic and application that caused loss of the off-site power supply. The following is a brief review of one of these occurrences:

On August 1, 1983, the Monticello Nuclear Generating Plant experienced an actuation of the degraded voltage protection system. The plant was operating at rated power. The safety buses were running at 95.2% of nominal bus voltage. This is 1.8% higher than the degraded voltage protection system setpoint. During this time, a large safety-related pump motor was started. The voltage dip from starting the motor caused the voltage to drop below the degraded voltage protection system's setpoint. This activated the undervoltage relay and initiated the time intended to allow the protection system override such motor starting events. After the motor started, the voltage at the bus recovered to about 95% of bus nominal voltage, the same voltage level prevailing before the motor starting event. This, however, did not allow the undervoltage relay to reset at a higher level than the voltage of the buses even prior to the motor starting (95.8%). This actuated the degraded voltage protection system. This event suggested that the undervoltage relay reset characteristics have not been carefully considered in analyzing the system or selecting the hardware. In this case, the relay reset point is 2.6% higher than the trip setpoint. This would require that the bus voltage be maintained at a level 2.6% higher than the relay setpoint to prevent inadvertent loss of off-site power.

This Minor Plant Change is being initiated to prevent a similar occurrence at the Dresden Station, Unit 2.

1.27 STANDARD INSTALLATION SPECIFICATIONS

Installation work for this Minor Plant Change will be performed in accordance with the CECo's EIS, NSWP, General Work Specification K-4080, and Asea Brown Boveri Instruction Manual for ITE-27N relays.

1.28 STANDARD STATION INSTALLATION PROCEDURES AND QC PROCEDURES

Standard Station Installation and QC Procedures will be used for this Minor Plant Change.

1.29 ENGINEERING CHECKLISTS

Attachment 11.1 contains the following engineering checklists required by Procedure ENC-QE-06.

1.29.1 System Interaction

The Nuclear Engineering Department (NED) Procedure ENC-QE-06.2, Exhibit A, "System Interaction Checklist," was used to evaluate system interactions that might be created by the installation of this Minor Plant Change and, therefore, must be considered in its design. Input for this evaluation was taken from the Dresden Final Safety Analysis Report (FSAR), Updated Final Safety Analysis Report (UFSAR), applicable station drawings, vendor information, and walkdown information. There are no system interactions that must be accounted for.

1.29.2 Acceptance Testing

The NED Procedure QE-06.4, Exhibit A, "Modification Acceptance Testing Checklist," was used to evaluate the testing requirements. The testing requirements are described in the Summary of Testing Acceptance Criteria. Input for this evaluation is from the documents used as the guidance for writing the test procedures and other references listed in the Summary of Testing Acceptance Criteria.

1.29.3 ALARA

The NED Procedure ENC-QE-06.5, Exhibit A, "ALARA Review Checklist," was used to evaluate the ALARA requirements for this Minor Plant Change. Input for this evaluation is from station personnel, Radiation Zone Maps, Regulatory Guide 8.8, and the modification description.

The radiological impact of this Minor Plant Change is minimal. Therefore, a formal ALARA plan is not required and that standard radiological control procedures may be followed.

1.29.4 Environmental Qualification

The NED Procedure ENC-QE-06.6, Exhibit A, "Equipment Environmental Qualification Flowchart Checklist" was used to evaluate the environmental qualification requirements for this Minor Plant Change. Input for this evaluation is from Bechtel's Specification 13524-068-N101, Dresden Station UFSAR, and Mr. Hunsader to Mr. Viehl letter, dated January 8, 1992.

1.29.5 Fire Protection

The NED Procedure ENC-QE-06.7, Exhibit A, "Fire Protection Review Checklist," was used to evaluate the fire protection and safe shutdown requirements for this Minor Plant Change. The Fire Protection System in the surrounding area where the undervoltage relays are located is not required to be modified as a result of this Minor Plant Change. No other fire protection or safe shutdown concerns were identified.

2.0 WALKDOWNS

2.1 Designer's Walkdown

The Designer's Walkdown was performed on January 3, 1992, to confirm and provide input for the detailed design of this Minor Plant Change. The Designer's Walkdown Checklist is included as an attachment.

2.2 Installer's Walkdown

The Installer's Walkdown was on January 13, 1992, to verify constructability of this Minor Plant Change. The Installer's Walkdown Checklist is included in the Minor Plant Change Design.

3.0 CONCEPTUAL DESIGN DOCUMENTS

No conceptual design documents were required for this Minor Plant Change.

4.0 SAFETY-RELATED COMPONENT OR MASTER EQUIPMENT LIST

The new second level undervoltage relays for the Class 1E 4.16-kV Buses 23-1 and 24-1 are classified as safety-related. The Master Equipment List should be updated to include the device numbers for the new relays. the Master Equipment List Update Form (Exhibit C, ENC-QE-12.1) is included as an attachment.

5.0 COMPONENT CLASSIFICATION

The new second level undervoltage relays are classified as safety-related. The Classification of Component Form (Exhibit B, ENC-QE-12.1) is included as an attachment.

6.0 INSTALLATION PROCEDURES

Installation work for this Minor Plant Change shall be performed in accordance with the CECo EIS and standard procedures for safety-related work.

7.0 PROCUREMENT DOCUMENTS

7.1 Bill of Materials

Bill of Materials associated with conduit supports and panel mounting apply for this Minor Plant Change. They are specified in the conduit support drawings of the ECNs and ERSs.

7.2 Equipment Specifications

No equipment specifications are required for this Minor Plant Change.

7.3 Material Specifications

No material specifications are required for this Minor Plant Change.

7.4 Equipment Requirements Schedules (ERS)

Materials other than the protective relays required for this Minor Plant Change are specified in the ERS.

7.5 Purchase Orders

The undervoltage relays have already been procured and are on site. Therefore, no purchase orders are required for this Minor Plant Change.

8.0A AC/DC LOAD TICKETS

DC Load Data forms have been completed to reflect the new undervoltage relays (ITE-27N). The affected dc bus circuits include other loads, therefore, the total load on the circuit is the combination of the relays and the other loads. Thus, the load ticket reflects the combination of all the loads on the circuit. The data forms and load tickets are included as an attachment.

8.0B ELECTRICAL PROTECTIVE DEVICE SETTINGS

System Planning will issue the relay setting order to CECo. Electrical/Instrument and Control group may review the relay setting order. New relays will have the same settings.

9.0 ENGINEERING DESIGN EVALUATION (QP 3-1)

The design documents for this Minor Plant Change have been reviewed in accordance with Quality Procedures 3.1.

10.0 REFERENCE TO CONFIRMATORY ANALYSES

10.1 Calculations

Seismic Qualification Calculation CQD-051325
Calculation CQD-510158
Structural Calculation 8900-03-EE-S
Electrical Calculation 7056-00-19-5, Rev. 12

10.2 Technical Reports

There are no Technical Reports prepared for this Minor Plant Change.

10.3 Stress Reports/Overpressure Protection Report

This Minor Plant Change does not require a Stress Report or Overpressure Protection Report.

10.4 <u>Computer I/O Listings</u>

No Computer I/O Listings were generated for this Minor Plant Change.

11.0 ATTACHMENTS

11.1 Engineering Checklists
11.2 Walkdown Checklists
11.3 ENC-QE-12.1 Forms
11.4 DC Load Data Forms/Load Tickets

Approved by: ______________________ Date: ____________________

JWH:dmd
WDQC2433.EP

ATTACHMENTS 11.0

ATTACHMENTS 11.1

Engineering Checklists

System Interaction	Exhibit A, ENC-QE-06.2
Modification Acceptance Testing	Exhibit A, ENC-QE-06.4
ALARA Review	Exhibit A, ENC-QE-06.5
Equipment Environmental Qualification Flowchart	Exhibit A, ENC-QE-06.6
Fire Protection Review	Exhibit A, ENC-QE-06.7

MOD. NO. W.R. Nos. D-97548 & D-97549

SYSTEMS INTERACTION CHECKLIST

	Yes	No	N.A.
I. General Evaluation			
A. Does this modification connect non-safety-related equipment (piping, electrical, etc.) to safety-related equipment? Documents reviewed during determination of answer to this question; Station Drawings	*	X	*
B. Does this modification result in the interconnection of safety-related systems that provide the same safety function? Documents reviewed during determination of answer to this question; Station Drawings	*	X	*
C. Does this modification require the connection to/interface with (ie, core holes, expansion anchors, anchor bolts, steel beams, embedded plate attachments, HVAC seals, etc.) Safety-Related Structural components? Note: Identify in "Safety Classification" and/or "Component Classification" sections of Mod. Approval Letter and Mod. Package. (See Master Equipment List/Q List) Documents reviewed during determination of answer to this question; Structural Calculation 8900-03-EE-S, ECN 12-00470E	*X		*
D. Does this modification add equipment that increases the floor loading? Documents reviewed during determination of answer to this question; Structural Calculation 8900-03-EE-S, ECN 12-00470E	*	X	*
E. Is this equipment to be installed in close proximity to safety-related equipment? Documents reviewed during determination of answer to this question; Station Drawings, ECN 12-00470E	*X		*
F. Will this modification introduce any new or revised operating modes for existing systems or equipment? Note: If new or revised modes are introduced, ensure the equipment is evaluated for operation in these modes and operating procedure limits are considered. Documents reviewed during determination of answer to this question; Station Drawings	*	X	*

MOD. NO. W.R. Nos. D-97548 & D-97549

SYSTEMS INTERACTION CHECKLIST

			Yes	No	N.A.
I.	G.	Does this modification effect other modifications or temporary alteration? Documents reviewed during determination of answer to this question; Verification with Mod. Coord. and Temp. Alt. Log	*	X	
	H.	Does this modification result in (or cause) increased system or component operating voltage and/or pressure? Impact of increased voltage/pressure on existing system components (e.g., relays, relief valves) must be evaluated. Documents reviewed during determination of answer to this question; ABB Instruction Manual, IB 7.4.1.7-7, Issue D	*	X	*
II.		Mechanical Interaction Have the following been considered for their affect on nearby safety-related equipment?			
	A.	Missile Generation	X	*	
	B.	Pipe Whip		*	X
	C.	High Energy Equipment		*	X
	D.	Fire in the Equipment		*	X
	E.	Primary Containment Penetrations		*	X
	F.	Secondary Containment Penetrations		*	X
	G.	Structural Loading or Alteration of Structure (core holes, anchor bolts, expansion anchors, steel beams, HVAC seals etc.)	X	*	
	H.	HELB Analysis (including EQ)	X	*	
	I.	MSLB/LOCA Analysis (including EQ)	X	*	
	J.	Any Attachments to Masonry Walls (conduit, supports, fire protection, etc.)		*	X
	K.	Damage to Safety-Related Equipment Due to Seismic	X	*	
III.		Electrical Interactions Have the following been considered for their affect on nearby safety-related equipment?			
	A.	Cable Qualifications	X	*	
	B.	Cable Separation	X	*	
	C.	Additional Diesel Loading		*	X
	D.	Additional Battery Loading	X	*	
	E.	Load Shed Coordination	X	*	
	F.	Fault Trip Coordination		*	X
	G.	Electromagnetic Capability (EMC)		*	X
	H.	Additional Loading to a Safety-Related AC Distribution Circuit		*	X
	I.	Damage to Safety-Related Equipment due to Seismic	X	*	

SYSTEMS INTERACTION CHECKLIST

	Yes	No	N.A.
IV. Fire Protection			
A. Will this modification impact the safe shutdown analysis?	*	X	
B. Will this modification add significantly to the fire loading determined in the fire hazards analysis?	*	X	
C. Will this modification add a fire hazard not considered in the fire hazard analysis?	*	X	
D. Is additional fire detection and protection required?	*	X	
E. Are new fire stops or fire seals required?	*	X	
F. Is the need to repair existing fire stops documented?		*	X
G. Has the cable tray fill density in an electrical fire stop been exceeded?	*		X
V. Security			
A. Will this modification alter barriers to allow unauthorized access to protected or vital areas?	*		X
B. Will this modification remove equipment that forms part of a security barrier such as piping, valves, that would allow passage of small objects into or out of a vital area?	*		X
C. Will, this modification create holes in protected or vital area barriers to facilitate construction?	*		X
D. Will this modification leave vital area door alarms in access mode after work completion?	*		X
E. Will this modification effect essential security telephones/communication systems, computer systems or lighting?	*		X
F. Will this modification place equipment structures or vehicles within the isolation zones of the protected area or within exterior "clear" zones of sensitive facilities, such as storage vaults?	*		X
VI. Impact on Plant Simulator			
A. Does this modification affect any controls, meters, recorders, alarms, CRT displays or any other items on the Main Control Board which will require alterations to the plant simulator?	*		X
B. Does this modification affect parameters which will affect the response of the plant simulator (e.g., auto-matic initiation interlocks, transient responses, time delay relays, etc.)?	*		X

MOD. NO. W.R. Nos. D-97548 & D-97549

SYSTEMS INTERACTION CHECKLIST

		Yes	No	N.A.
VII. a)	Does this mod affect the process computer inputs to SPDS?	*		X
b)	Does this mod affect the instrumentation providing process computer inputs to SPDS?	*		X
c)	Does this mod affect the SPDS CRT display?	*		X
d)	Does this mod affect the operating limits or values of parameters on SPDS?	*		X
e)	Does this mod affect the logic for computing parameters on SPDS?	*		X

VIII. Explain any * Marked Answers Below.
(Attach Additional Page If Necessary)

See below.

PREPARED BY: ______________________ DATE: __________

APPROVED BY: ______________________ DATE: __________

I.C. Panel 2252-83 will be relocated to Column 39-N in the Reactor Building. It will be mounted to the column utilizing concrete expansion anchors and unistruts.

I.E. The second level undervoltage relays are safety-related and are connected to the safety-related 4.16-kV Buses 23-1 and 24-1. The replacement relays and Panel 2252-83 will be seismically mounted so that they will not affect nearby safety-related equipment.

ALARA REVIEW CHECKLIST
LEVEL 1 REVIEW WR No. D-97548
Modification No.: WR No. D-97549

Exhibit A
ENC-QE-06.5
Revision 3

RADIOLOGICAL SCREENING

Complete Parts 1 And 2

1. PART 1: INSTALLATION — Yes / NO

1.1 **Is any work performed inside radiologically controlled areas?** [X] Yes [ ] No
Comment
[If "Yes" continue. If "No" go to Item 1.6.]

1.2 **Is there a possibility of coming into contact with contaminated liquids?** [ ] Yes [X] No
Comment
[If "Yes" go to Item 1.5. If "No" continue.]

1.3 **Is there a possibility of coming into contact with airborne contamination?** [ ] Yes [X] No
Comment
[If "Yes" go to Item 1.5. If "No" Continue.]

1.4 **Is the estimated installation dose from this modification greater than 1.0 man-rem (calculation below)?** [ ] Yes [X] No
Comment
Documents reviewed during determination of answer to this question; Conversation with station ALARA Coordinator and S&L EPED
[If "Yes" go to Item 1.5. If "No" go to Item 1.6.]

INSTALLATION DOSE CALCULATION

Area Description	Dose Rate Rem/hr	Man-hrs	Dose Man-Rem
Panels 2252-83* 2252-84	.004	200	0.8
Unit 2 Reactor Building El 545'-6"			
Total Estimated Dose			0.8

*Panel 2252-83 will be moved to Col/Row 39-N

1.5 **If questions 1.2, 1.3, or 1.4 are answered "yes," this is a radiologically significant modification. A level 2 ALARA INSTALLATION review must be completed and attached.**

Prepared By: ____________ **Date** ____________

1.6 **This modification does NOT require a level 2 ALARA INSTALLATION review.**

Prepared By: ____________

Calculation No. 8982-13-19-6
Revision 005
Attachment: A

RADIOLOGICAL SCREENING

2. PART 2: DESIGN — Yes / NO

2.1 Does this modification alter systems which contain or could contain radioactivity (e.g., liquid, gaseous, or solid rad-waste; HVAC in contaminated areas; postaccident recovery systems, etc.)? [ ] [X]
Comment
[If "Yes" go to Item 2.5. If "No" continue.]

2.2 Does this modification alter parts or components that could be in a flow path leading to the reactor core? [ ] [X]
Comment
[If "Yes" go to Item 2.5. If "No" continue.]

2.3 Does this modification alter or add radiation shields? [ ] [X]
Comment
[If "Yes" go to Item 2.5. If "No" continue.]

2.4 Is the estimated additional annual operating dose from this modification greater than 1.0 man-rem (calculation below)? [ ] [X]
Comment No anticipated maintenance
[If "Yes" go to Item 2.5. If "No" go to Item 2.6.]

ADDITIONAL OPERATING DOSE CALCULATION

Area Description	Dose Rate	Man-hrs/yr	Dose
Unit-2 Reactor Bldg. El 545'-6"	.001	0	0
Total Estimated Dose			

2.5 If questions 2.1, 2.2, 2.3, or 2.4 are answered "yes," this is a radiologically significant modification. A level 2 ALARA DESIGN review must be completed and attached.

Prepared By: ____________ Date ________

2.6 This modification does NOT require a level 2 ALARA INSTALLATION review.

Prepared By: ____________ Date ________

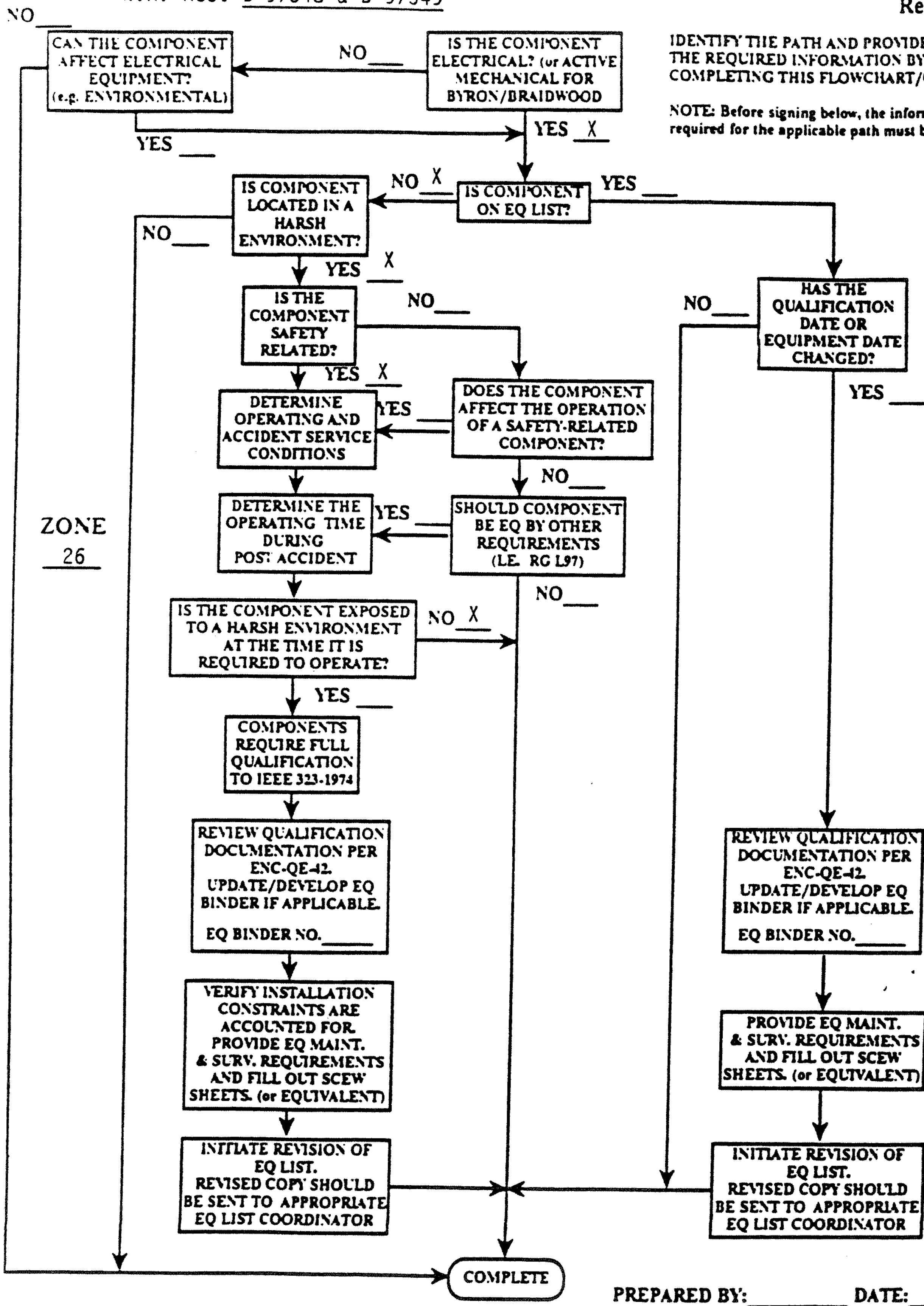
EQUIPMENT ENVIRONMENTAL QUALIFICATION FLOWCHART/CHECKLIST

W.R. Nos. D-97548 & D-97549

EXHIBIT A
ENC-QE-06.6
Revision 1

IDENTIFY THE PATH AND PROVIDE THE REQUIRED INFORMATION BY COMPLETING THIS FLOWCHART/CHECKLIST.

NOTE: Before signing below, the information required for the applicable path must be correct.



PREPARED BY: ________ **DATE:** ________

APPROVED BY: ________ **DATE:** ________

FIRE PROTECTION REVIEW CHECKLIST

* Any of the questions which are answered "yes" shall be explained. If a change to the design is made so that a question can be answered "no", then this change should also be explained.

	YES*	NO*	N/A
I. POST FIRE SAFE SHUTDOWN ANALYSIS			
A. Will the modification alter the function or location of a safe shutdown system or component as described in the safe shutdown report? See the attached sheet.	X		
B. Is an electrical cable (power, control, instrumentation) being added or rerouted or is an electrical control circuit being modified? (If "No", proceed directly to Question I.D. if "Yes", continue). See the atthaced sheet.	X		
1. Will operation of a hot or cold post fire shutdown system be affected by a circuit fault in any way?		X	
2. Will potential fire induced circuit or cable faults introduce additional spurious operations of equipment (e.g., breakers or valves) adverse to safe shutdown and not previously analyzed?		X	
3. Does the circuit share a common power source with post fire safe shutdown equipment in a manner that degrades the availability of that equipment?		X	
4. Does the circuit create a safe shutdown "common enclosure" problem?		X	
C. If any question I.B.1 through I.B.4 is answered "Yes" continue. Otherwise go to Question I.D.			
1. Are the physical separation and electrical isolation commitments in the post fire safe shutdown report violated?			

FIRE PROTECTION REVIEW CHECKLIST

	YES*	NO*	N/A
I. C. 2. Are additional design features (e.g., isolation switch) or manual actions necessary for hot shutdown?			
3. Are additional repair procedures or manual actions necessary for cold shutdown?			
D. Will this modification alter the performance of 1) existing emergency lighting or 2) plant communications systems necessary for post fire safe shutdown or fire fighting?		X	
E. Will this modification block access to or egress from plant areas for post fire safe shutdown equipment operation or fire fighting?		X	
II. FIRE HAZARDS ANALYSIS			
A. Will the modification significantly alter the fire loading considered in the fire hazards analysis?		X	
B. Will this modification create any new fire hazards not considered in the fire hazards analysis?		X	
C. Will this modification violate the separation requirements of the station?		X	
III. FIRE PROTECTION MEASURES			
A. Are the fire detection or suppression systems, rated fire barriers, or curbs being modified or proposed? If "No", go to Question III.B.		X	
1. Have any deviations to applicable NFPA code commitments been identified?			
2. If a new water suppression system is installed, is drainage inadequate?			

FIRE PROTECTION REVIEW CHECKLIST

	YES*	NO*	N/A
III.A. 3. If a suppression system (water, gas, foam, dry chemical) is being modified, are there any adverse effects of actuation on safe shutdown equipment (water spray, local freezing, pressurization, flooding at lower elevations)?	___	___	___
4. If the fire water system or a water suppression system is altered, will the supply from the fire water system be degraded?	___	___	___
5. Is a new fire rated barrier being installed or has the rating of an existing barrier (rated or unrated) been upgraded? (If so, all penetrations should have the same rating as the barrier).	___	___	___
6. Has a new curb been added? (If so, adequate drainage and/or retention capacity must be provided.)	___	___	___
B. The performance of existing fire protection measures may be degraded by any of the following:			
1. Will the modification involve a physical change (e.g., the routing of cable, conduit, HVAC ducts, or piping; change of ventilation air flow; change in a structural element) to a fire area/zone with a detection and/or with a suppression system? (If so, the installation must not prevent a suppression or detection system from performing its intended function).	X	___	___

See the attached sheet.

FIRE PROTECTION REVIEW CHECKLIST

		YES*	NO*	N/A
III.B. 2.	Will the modification block access to or reduce coverage of any of the following manual fire protection equipment.			
	a. hose stations		X	
	b. fire extinguishers		X	
	c. fire protection control panels		X	
	d. fire system valves		X	
	e. manual pull stations.			
3.	The following types of modifications may affect the performance of a barrier to fire:			
	a. Does this modification affect the protective coating on structural steel?		X	
	b. Will this modification involve an alteration to any of the existing fire barriers through the installation, removal, or modification of a penetration or penetration seal?		X	
	i. fire doors		X	
	ii. pipe and HVAC ducts penetration seals		X	
	iii. fire dampers		X	
	iv. electrical penetration seals of trays, conduits, risers		X	
	v. access openings		X	
4.	a. Will the modification route cables through cable tray fire break (Dresden only)?		X	
	b. Do modification design drawings reflect the passage of cables through (not around) cable tray fire breaks (Dresden only)? New cables do not pass through fire breaks		X	
5.	a. Will the modification require the disturbance of a cable tray wrap?		X	

FIRE PROTECTION REVIEW CHECKLIST

	YES*	NO*	N/A
III.B. 5. b. Does the modification involve routing items above fire-wrapped conduits or cable trays or their supports.		X	
6. Have curbs, door sills, ramps, in tray water stops, waterproofing, etc. designed to contain flammable or combustible liquids or water from suppression systems been altered?		X	
7. a. Has smoke removal capability been affected?		X	
b. Will the modification affect the hold time or concentration of a gaseous suppression system?		X	

IV. CONTROL OF COMBUSTIBLES

A. Identify Fire Zone(s) associated with this change. 1.1.2.3

B. Identify fire protection documentation which might be affected by this change:

FIRE ZONE	SER	DEVIATION/ EXEMPTION	SAFE SHUTDOWN ANALYSIS	FHA
1.1.2.3	3.2.2	3.5.4.3	4.2	4.2.3

C. Does this change involve an increase or reduction of fixed combustibles (including electrical cable) in any Zone identified in A? X (YES)

If YES, identify per the following table:

If NO, proceed to D.

FIRE PROTECTION REVIEW CHECKLIST

FIRE ZONE	EQUIPMENT	COMBUSTIBLE	QTY (FT)	HEAT CONTENT BTU/FT	HEAT LOAD BTU
1.1.2.3	Electrical Cable	Insulation	12	1612	19,344*

* This is negligible compared to existing heat load of 2.1 x 10^8 BTU. FHA need not be revised.

	YES*	NO*	N/A
1. Is fixed combustible heat load higher than that identified in the Appendix R SERs and/or Exemption Requests?		X	

If YES, attach NRC submittal. Applicable portion of work may not proceed until NRC approval is granted.

2. Provide FHA text revisions here and submit to Maintenance and Station Support Fire Protection Group for concurrence prior to installations.

3. Provide technical justification and answer the three 10CFR50.59 questions for the revised heat load.

D. Does this change require any estimated temporary increase in combustible heat loads (i.e., during installation and testing)?		X	

If YES, inform the Station Fire Marshall through the Mod Approval Letter for concurrence and appropriate administrative controls.

FIRE ZONE	EQUIPMENT	COMBUSTIBLE	QTY	HEAT CONTENT	HEAT LOAD

FIRE PROTECTION REVIEW CHECKLIST

V. DOCUMENTATION MAINTENANCE

	YES*	NO*	N/A
A. Does this modification change a fire protection commitment to the NRC or change a justification in an approved Appendix R exemption or deviation?		X	
B. Is a revision to the Fire Protection Report or Safe Shutdown Report or a supporting document necessary (e.g., hydraulic analysis)?		X	
C. Is a revision to NFPA code deviation report necessary?		X	
D. Will this modification require a revision to the fire protection drawings? (Dresden and Quad Cities only.)		X	
E. Will this modification change plant conditions as currently described in the Fire Hazards Analysis?		X	
F. Will this modification impact any other part of the fire protection documentation not addressed in Questions A through E above?		X	
G. Will the modification impact the Station's Pre-Fire Plans?		X	
H. Will any question answered "YES" in Section I, II, III, or IV above impact the Fire Hazards Analysis, Pre-Fire Plans or Fire Protection Drawings?		X	

* Any of the questions which are answered "yes" shall be explained. If a change to the design is made so that a question can be answered "no", then this change should also be explained.

PREPARED BY: ______________________ DATE: ____________

APPROVED BY: ______________________ DATE: ____________

Attachment to ENC-QE-06.7, Exhibit A

Following are the explanations related to the questions answered "Yes" in the fire protection review checklist:

I.A. Second level undervoltage relays for 4.16-kV Buses 23-1 and 24-1 will be replaced. Panel 2252-83 with undervoltage relays for Bus 23-1 will be relocated to a new location within the same fire zone. The new relays will provide the same safe shutdown function as the existing ones.

I.B. A control cable will be routed to the new location of Panel 2252-83. None of the electrical control circuits will be altered. The cable routing will be confined to one fire zone. The new cable routing will not block the access to or the function of any fire detection or protection equipment.

III.B.1 The Minor Plant Change does involve routing of new control cables from Bus 23-1 to the new location of the panel. Existing cables from the old location of the panel to Bus 23-1 will be removed. Since the new location is within the same fire zone, no fire boundaries need to breached.

WDQC2433.EP

ATTACHMENT 11.2

Walkdown Checklists

Designer's Walkdown	Exhibit C, ENC-QE-62
Installer's Walkdown	Exhibit D, ENC-QE-62

DESIGNER'S WALKDOWN-PARTICIPANTS

Dresden	2	6705 & 6706	SWR# D97548 D97549
Station	Unit	System	Modification Number

Modification Description: Replacement of Second Level Undervoltage Relays

Participants Date: 1/3/92

Name (Please Print)	Firm/Department	Phone
Chris Collins	CECo / NED	2873
Jeff Rivera	CECo / T.S.	2549
~~[illegible]~~ Al Judge	S&L /	2971
Jeff Sword *	CECo Dresden / MM	2898
Jerry Jurecki *	CECo Dresden / EMs	2445
Kurt LaVois	CECo OPs / OPs	2249
	/	

* SEE LAST PAGE "RESOLUTION RECORD"

Walkdown Instructions

1. The designer (Station or NED) is responsible for arranging this walkdown and notifying participants, and coordinating this activity with NED.
2. The assigned Station representative is responsible for arranging all necessary access clearances and notifying Station walkdown participants.
3. The Designer is responsible for preparing the Designer's Walkdown Checklist (to be completed fully -- N/A in advance as appropriate) and for recording walkdown observations.
4. Each observation should be clearly identified, including location, such as building, room number, elevation, plant coordinates, etc.
5. Clarifying photographs or sketches should be utilized when appropriate.
6. Individual observations should not be lumped into single entries.
7. The Designer is responsible for the resolution of all observations.
8. Copies of previous walkdown checklists with attachments shall be provided for subsequent walkdown reference.
9. The Designer's Walkdown checklist shall be included in the applicable Project Plan.

DESIGNER'S WALKDOWN CHECKLIST

D97548
Modification Number: D97549

Walkdown Questions	Yes	No	N/A	Is resolution required? (Yes or No)
1. Are there special work area access problems? (Bulky or heavy equipment, limited access of work spaces, etc.)		X		No
2. Do work areas require special considerations for construction, operation, or maintenance? (Respirators, temporary work enclosures, radiation access, security, job specific radiation work permits or clearances.)		X		No
3. Is there need to temporarily remove grating, handrails, structural steel, conduit, tubing, piping, supports, equipment, or instruments to facilitate final installation?		X		No
4. Is there need to permanently remove grating, handrails, structural steel, conduit, tubing, piping, supports, equipment, or instruments to facilitate final installation?	X			Need to remove existing enclosure supports
5. Do design or work complexities require special installation or testing procedures? (Special vendor installation requirements?)		X		No
6. Do other modifications affect the work areas, creating potential interferences?		X		No

QE-62(16)

Calculation No. 8982-13-19-6
Revision 005
Attachment: A
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DESIGNER'S WALKDOWN CHECKLIST

Modification Number: 097548 / 092549

Walkdown Questions	Yes	No	N/A	Is resolution required? (Yes or No)
7. Will temporary shielding be required?		X		No
8. Will permanent shielding be required?		X		No
9. Will the design increase radiation/ contamination levels?		X		No
10. Will the design increase radiation/ contamination spread?		X		No
11. Is instrumentation or operating equipment located to minimize installation and operating personnel radiation exposure?	X			No
12. Are alternate designs feasible to reduce potential radiation exposure?			X	No potential radiation exposure
13. Does the routing (conduit, tray, piping, tubing) provide the clearest route relative to installing supports, restraints, etc?	X			No
14. Does the design provide for efficient maintenance of existing equipment/ system?	X			See "Resolution Record"
15. Does the design provide for efficient maintenance of new equipment/system?	X			See "Resolution Record"
16. Does the design provide for efficient operation of existing equipment/system?	X			See "Resolution Record"

QE-62(17)

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Revision 005
Attachment: A
Page A44 of A72

DESIGNER'S WALKDOWN CHECKLIST

Modification Number: 097548
097549

Walkdown Questions	Yes	No	N/A	Is resolution required? (Yes or No)
17. Does the design provide for efficient operation of new equipment or systems?	X			See "Resolution Record"
18. Does the design provide for efficient testing of new equipment or systems?	X			No
19. Does the design provide for efficient testing of existing equipment or systems?		X		No
20. Does the design provide for efficient ISI of new equipment or systems?			X	No ISI equipment associated with design
21. Does the design provide for efficient ISI of existing equipment or systems?			X	No ISI equipment associated with design
22. Are flammable materials being added to the area?		X		No
23. Does the equipment being installed or altered increase fire hazards in the area?		X		No
24. If the equipment is safety-related, do fire hazards exist in the area which may impair its operability?		X		No
25. Are fire barriers being breached by the design?		X		No
26. Are security barriers being breached by the design?		X		No

DESIGNER'S WALKDOWN CHECKLIST

Modification Number: 097548 / 097549

Walkdown Questions	Yes	No	N/A	Is resolution required? (Yes or No)
27. If safety-related, is new equipment located in proximity to high energy pipe whose failure could impair operability due to pipe whip, jet impingement, pressure or temperature conditions?		X		No
28. If new equipment is a high energy system, is it located near safety-related equipment whose operability could be impaired due to failure of the new equipment?			X	New equipment is not high energy system.
29. If the new equipment is safety-related, are there existing non-seismic items located such that their failure could impair the new equipment's safety function?		X		No
30. If the new equipment is non-seismic, could its failure impair adjacent safety-related equipment functions?			X	New equipment and design is seismic
31. Have adequate measures been taken to maintain required separation between redundant equipment?	X			No
32. Can existing structures accommodate new equipment; e.g., are the existing steel beams to be used for supporting the equipment still available?	X			No
33. Has all adjacent equipment been identified that may affect new equipment; e.g., access requirements?	X			See "Resolution Record"

Exhibit C
ENC-QE-62
Revision 2
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DESIGNER'S WALKDOWN CHECKLIST

Modification Number: 097548 097549

Walkdown Questions	Yes	No	N/A	Is resolution required? (Yes or No)
34. What are Installer's requirements, e.g. types of installation drawings, special installation equipment, partial modification requirements and modification installation sequence?	X			Per ECNs 12-004705 and 12-004715 - No other "special" requirements.
35. Is interface information available, e.g. tie-ins?	X			No
36. Are spares available, e.g. penetrations?			X	No
37. Is electrical and I&C information available e.g. spare/correct size MCC compartment?	X			No
38. What are Station practices - electrical, I&C, piping and structural?	X			Electrical and Structural
39. What are warehouse inventory stock items?	X			Relays, Anchor Bolts, Unistrut
40. Does design provide appropriate tolerances?	X			No
41. Have partial modification packages been scoped properly?			X	This is a minor design change.
42. For electrical modifications, do the drawings reflect actual field installed conditions for all terminal points which will be utilized for the modification?	X			No

Note: Develop additional or revised questions depending on the modification scope prior to conducting the walkdown.

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Exhibit C
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DESIGNER'S WALKDOWN RESOLUTION RECORD

Modification Number: 097548 097549

Question No.	Observation (Attach Sketch if Required)	Question No.	Resolution (Attach Sketch if Required)

* AT THE TIME OF THE DESIGNERS WALKDOWN THE INSTALLER WAS NOT KNOWN. NO STATION MAINTENANCE GROUP WAS AVAILABLE TO WALK DOWN THE DESIGN. I HAD REQUESTED JEFF SWORD AND JERRY JURECKI TO INDEPENDENTLY WALK DOWN THE CONCEPTUAL DESIGN TO SEE IF THE NEW LOCATION OF THE ENCLOSE WOULD IMPACT THE MAINTENANCE OF OTHER EQUIPMENT OR THE ENCLOSURE ITSELF. THIS WAS ALSO REQUESTED OF KURT LAVOIE FROM AN OPERATIONS STAND POINT. ALL THREE INDIVIDUALS WERE GIVEN SKETCHES OF THE NEW DESIGN. BOTH JURECKI AND LAVOIE WERE FAMILIAR WITH THE REPLACEMENTS ON UNIT 3 SO THE DETAILED WIRING WAS NOT AS IMPORTANT TO REVIEW BECAUSE IT IS IDENTICAL TO THAT OF UNIT 3s REPLACEMENTS.

ON 1/3/92 JEFF SWORD CONTACTED ME TO SAY HE HAD NO PROBLEM WITH THE NEW LOCATION OF THE ENCLOSURE FROM MAINTENANCE OF EQUIPMENT STAND POINT.

ON 1/7/92 I CONTACTED LAVOIE - HE SAID THE NEW ENCLOSURE LOCATION SHOULD BE NO PROBLEM FROM AN OPERATIONS STAND POINT.

QE-62(21)

Calculation No. 8982-13-19-6
Revision 005
Attachment: A

0235g-21

ATTACHMENT 11.3

ENC-QE-12.1 Forms

Classification of Component	Exhibit B, ENC-QE-12.1
Master Equipment List Update	Exhibit C, ENC-QE-12.1

W.R. Nos. D-97548 & D-97549

CLASSIFICATION OF COMPONENT

Directions: To complete this form, provide written documentation <u>and</u> specific reference(s) for each item. (A Yes, No or N/A answer without a written explanation is <u>not</u> acceptable.)

A. <u>EVALUATION</u>

*1. Identify the system and system classification of the component to be classified.

The second level undervoltage protection for Class 1E 4.16-kV Buses 23-1 and 24-1; Safety-Related.

2. List the components equipment identification number or stores item number as applicable.

127-3-B23-1, 127-4-B23-1, 127-3-B24-1, and 127-4-B24-1

3. Identify the pertinent documents required in describing the operation and required safety function of the component. (Drawings, P&ID's, Wiring Diagrams, Technical Manuals, etc).

Technical Specification DPR-19, Section 3.2, Table 3.2.2; Updated Final Safety Analysis Report, Section 8

4. Identify the failure modes of the component and the effects of a failure on the safety-related system.

Failure of the second level undervoltage relays will result in long-time degraded voltage condition at 4.16-kV Buses 23-1 and 24-1; other undervoltage protection devices are in place to protect these buses.

*5. Do any of these failure modes prevent the system from performing its safety-related function?

Yes. This failure is a design basis of the Updated Final Safety Analysis Report.

W.R. Nos. D-97548 & D-97549

CLASSIFICATION OF COMPONENT

6. Must the component maintain the pressure boundary of a safety-related system.

No.

*7. Would leakage prevent the system from performing its safety related function?

N/A

*8. Is the component required to function to ensure the proper operation of the safety-related system?

Yes. When offsite power has a degraded voltage, the second level under-voltage relays ensure the transfer of the safety-related Buses 23-1 and 24-1 to the diesel generators.

9. Identify special requirements or documentation required for purchase or installation (e.g., Certified Material Test Report, Certificate of Compliance, Environmental Qualification, etc.)

Seismic Test Report, Certified Test Report for Dielectric and Surge Withstand Capability

10. List the persons contacted to discuss the components function and/or operation.

Name	Date	Comments
N/A		

* These items must be evaluated, other items are for documentation purposes. The answers to these questions essentially determine whether the component should be classified as Safety-Related or Non Safety-Related.

W.R. Nos. D-97548 & D-97549

CLASSIFICATION OF COMPONENT

B. CLASSIFICATION OF THE COMPONENT

From the results of this evaluation, it is concluded that the component is:

___ **NON SAFETY-RELATED**

Component malfunction does not prevent the proper operation of the safety-related system. However, since these components are used for Fire Protection Systems, these components are classified as Regulatory-Related.

_X_ **SAFETY-RELATED**

Component malfunction prevents the proper operation of the Safety-Related System.

Prepared by: ______________________ Date: ________

Approved by: ______________________ Date: ________

W.R. Nos. D-97548 & D-97549

MASTER EQUIPMENT LIST UPDATE
(SAFETY-RELATED CLASSIFICATION LIST UPDATE)
MECHANICAL/ELECTRICAL

COMMONWEALTH EDISON COMPANY

STATION: Dresden UNIT: 2 DATE: 01-15-92

EID Number	P T	DESCRIPTION	SAF CLS	E Q	CODE DATA SEC	CODE DATA YEAR	CODE DATA CC	S C	REFERENCE DRAWING	MFR COD	MODEL NUMBER	SOURCE
127-3-B23-1		Second Level	SR						12E-2334	A738	ABB ITE-27N	
		Undervoltage Relay									(CAT. NO. 411T4375-L-HF-DP)	
127-4-B23-1		Second Level	SR						12E-2334	A738	ABB ITE-27N	
		Undervoltage Relay									(CAT. NO. 411T4375-L-HF-DP)	
127-3-B24-1		Second Level	SR						12E-2334	A738	ABB ITE-27N	
		Undervoltage Relay									(CAT. NO. 411T4375-L-HF-DP)	
127-4-B24-1		Second Level	SR						12E-2334	A738	ABB ITE-27N	
		Undervoltage Relay									(CAT. NO. 411T4375-L-HF-DP)	

Prepared by: J. W. Hyn Checked by: [signature] Approved by:

Calculation No. 8982-13-19-6
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Attachment: A
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ATTACHMENT 11.4

DC Load Data Forms/Load Tickets

Undervoltage Relay 127-3-B23-1

Undervoltage Relay 127-4-B23-1

Undervoltage Relay 127-3-B24-1

Undervoltage Relay 127-4-B24-1

SARGENT & LUNDY ENGINEERS

ELECTRICAL LOAD MONITORING SYSTEM (ELMS)

DC LOAD DATA FORM

SAFETY RELATED YES ☒ NO ☐

UTILITY: CECo STATION: DRESDEN UNIT: 2 PROJ. NO.: 8982-58

ITEM	DESCRIPTION	DATA	NOTES
A	LOAD NAME	127-3-823-1	
B	LOAD STATUS (E, N OR M)	M	
C	INRUSH CURRENT - AMPS		
D	INRUSH DURATION - SECONDS		
E	CONTINUOUS LOAD CURRENTS - AMPS	.05 Amps	
F	TIME LOAD STARTS - MM.ss	0.00	
G	LOAD DURATION - MM.ss	240.00	
H	SOURCE BUS OR PANEL	RB DIST PNL 2	
I	SYSTEM CODE		
M	MODIFICATION NUMBER		
N	CABLE NUMBER		

SOURCE OF DATA EXCEPT AS NOTED:

Model #ABB ITE-27N

CAT. No. 411T4375-HF

From ABB Instructions IB 7.4.1.7.7 (Issue D)

Control Input Current = .05 Amps. (MAX.)

DATA FORM PREPARATION				DATA ENTRY INTO (ELMS)			
DATE	PREPARER	REVIEWER	REV.	DATE	PREPARER	REVIEWER	REV.
1/9/92	J. W. Hyre	M. E. Hill	0				

F1068F 08-86-K

SARGENT & LUNDY ENGINEERS

ELECTRICAL LOAD MONITORING SYSTEM (ELMS)

DC LOAD DATA FORM

SAFETY RELATED
YES ☒ NO ☐

UTILITY: CECo STATION: DRESDEN UNIT: 2 PROJ. NO.: 8982-58

ITEM	DESCRIPTION	DATA	NOTES
A	LOAD NAME	127-4-823-1	
B	LOAD STATUS (E,N OR M)	M	
C	INRUSH CURRENT - AMPS		
D	INRUSH DURATION - SECONDS		
E	CONTINUOUS LOAD CURRENTS - AMPS	.05 AMPS.	
F	TIME LOAD STARTS - MM.ss	0.00	
G	LOAD DURATION - MM.ss	240.00	
H	SOURCE BUS OR PANEL	AB DIST PNL 2	
I	SYSTEM CODE		
M	MODIFICATION NUMBER		
N	CABLE NUMBER		

SOURCE OF DATA EXCEPT AS NOTED:

Model #ABB ITE-27N

CAT. No. 411T4375-HF

From ABB Instructions IB 7.4.1.7.7 (Issue D)

Control Input Current = .05 Amps. (MAX.)

DATA FORM PREPARATION				DATA ENTRY INTO (ELMS)			
DATE	PREPARER	REVIEWER	REV.	DATE	PREPARER	REVIEWER	REV.
1/9/92	J. W. Hyre	M. E. Hill	0				

C10688 08-86-K

SARGENT & LUNDY ENGINEERS

ELECTRICAL LOAD MONITORING SYSTEM (ELMS)

DC LOAD DATA FORM

SAFETY RELATED YES ☒ NO ☐

UTILITY: CECo STATION: DRESDEN UNIT: 3 PROJ. NO.: 8982-58

ITEM	DESCRIPTION	DATA	NOTES
A	LOAD NAME	127-3-824-1	
B	LOAD STATUS (E,N OR M)	M	
C	INRUSH CURRENT - AMPS		
D	INRUSH DURATION - SECONDS		
E	CONTINUOUS LOAD CURRENTS - AMPS	.05 AMPS	
F	TIME LOAD STARTS - MM.ss	0.00	
G	LOAD DURATION - MM.ss	240.00	
H	SOURCE BUS OR PANEL	TB RES BUS 2B-1	
I	SYSTEM CODE		
M	MODIFICATION NUMBER		
N	CABLE NUMBER		

SOURCE OF DATA EXCEPT AS NOTED:

Model #ABB ITE-27N

CAT. No. 411T4375-HF

From ABB Instructions IB 7.4.1.7.7 (Issue D)

Control Input Current = .05 Amps. (MAX.)

DATA FORM PREPARATION				DATA ENTRY INTO (ELMS)			
DATE	PREPARER	REVIEWER	REV.	DATE	PREPARER	REVIEWER	REV.
1/9/92	J. W. Myre	M. E. Hill	0				

F1068U 08-86-K

SARGENT & LUNDY ENGINEERS

ELECTRICAL LOAD MONITORING SYSTEM (ELMS)

SAFETY RELATED
YES ☒ NO ☐

DC LOAD DATA FORM

UTILITY: CECo STATION: DRESDEN UNIT: 3 PROJ.NO.: 8982-58

ITEM	DESCRIPTION	DATA	NOTES
A	LOAD NAME	127-4-B24-1	
B	LOAD STATUS (E,N OR M)	M	
C	INRUSH CURRENT - AMPS		
D	INRUSH DURATION - SECONDS		
E	CONTINUOUS LOAD CURRENTS - AMPS	.05 AMPS	
F	TIME LOAD STARTS - MM.ss	0.00	
G	LOAD DURATION - MM.ss	240.00	
H	SOURCE BUS OR PANEL	TB RES BUS 2B-1	
I	SYSTEM CODE		
M	MODIFICATION NUMBER		
N	CABLE NUMBER		

SOURCE OF DATA EXCEPT AS NOTED:

Model #ABB ITE-27N

CAT. No. 411T4375-HF

From ABB Instructions IB 7.4.1.7.7 (Issue D)

Control Input Current = .05 Amps. (MAX.)

DATA FORM PREPARATION				DATA ENTRY INTO (ELMS)			
DATE	PREPARER	REVIEWER	REV.	DATE	PREPARER	REVIEWER	REV.
1/9/92	J.W. Hyre	M.E. Hill	0				

10688 08-86-K

DATE : 01-09-92 *** SARGENT & LUNDY -- ELMS-DC VER 1.20 ***

UTILITY : CECO PROJECT NO. 8982-58
STATION : DRESDEN(FILE: D2D5YLS.M14 2nd Level UV) UNIT NO. 2

DC LOAD TICKET

****

BATTERY NAME : UNIT 2 125VDC BATTERY NOMINAL VOLTS = 125.0

*** Record number = 39 ***

Load name .... 4KV BUS 23-1 MN 1OF4
Status (E,N, or M) .... M (Existing, New, or Modified)
Inrush current - amps 32.749
Inrush duration - sec 5
Cont load current - amps 2.749
Time load starts - MM.ss .... .00
Load duration - MM.ss .... .10
Source bus or panel .... RB BUS 2 CKT 2
System code ....
Source of equipment data .... CALC 705600 19-5
Drawing or other reference .. 12E-2322
Revision ....
Modification ....
Cable number ....

ROUTING:

COMMENTS :

PREPARED BY: S. K. Saha
REVIEWED BY: M. E. Kell
APPROVED BY: O. R. Ereolat

Calc. No. 7056-00-19-5
Rev. 72 Date
Page A 419
Proj. No. 8982-58

Calculation No. 8982-13-19-6
Revision 005
Attachment: A
Page A59 of A72

DATE : 01-09-92 *** SARGENT & LUNDY -- ELMS-DC VER 1.20 ***

UTILITY : CECO PROJECT NO. 8982-58
STATION : DRESDEN(FILE: D3DSYLS.M13 2nd level UV) UNIT NO. 3

DC LOAD TICKET

****
BATTERY NAME : UNIT 3 125VDC BATTERY NOMINAL VOLTS = 125.0

*** Record number = 56 ***

Load name .... 4KV BUS 24-1 MN 1OF4
Status (E,N, or M) .... M (Existing, New, or Modified)
Inrush current - amps 33.440
Inrush duration - sec 5
Cont load current - amps 3.440
Time load starts - MM.ss .... .00
Load duration - MM.ss .... .10
Source bus or panel .... 2B-1 CKT 4
System code ....
Source of equipment data .... CALC 705600 19-5
Drawing or other reference .. 12E-2656E
Revision ....
Modification ....
Cable number ....

ROUTING:

COMMENTS :

Calc. No.	7056-00-19-5
Rev. 12	Date
Page	A-425
Proj. No.	8982-58

PREPARED BY: S. K. Saha
REVIEWED BY: M. E. Hill
APPROVED BY: V. R. Eronlant

Calculation No. 8982-13-19-6
Revision 005
Attachment: A
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Name of Bidder: General Electric Company

SWITCHGEAR DATA, Cont.

	(Insert all data in these columns) 1200 A	2000 A	3000 A
H. Percentage of water absorbed in bus supports per ASTM Test D570 (plastic) or XXXXXXXXXXXXXXX......................(X)	.05 grams		
I. Minimum clearance between buses:			
a. Phase-to-phase................(inches)		4.5	
b. Phase-to-ground...............(inches)		3.0	
J. Bus spacing center-to-center.....(inches)		5.0	
K. Tap spacing center-to-center.....(inches)		6.0	
L. Type and description of bus joints.......	Bolted, Silver plated		
M. Size and material of main bus............	Aluminum		
N. Size and material of ground bus..........	2 X 3/8 Copper		

	Manufacturer	Type
O. Watthour meter...........................		
P. Circuit breaker control switch...........		SBM
Q. Overcurrent relay........................	All	IAC
R. Overcurrent ground relay.................	General	IAC
S. Undervoltage relay.......................	Electric	IAV
T. Elapsed time meter.......................		KT
U. Potential transformer....................	[redacted]	
Accuracy....................................		
V. Current transformer......................		JCS-0
Accuracy....................................	ASA.6 B-0.1, 2.4,	B-0.2, B-0.5, 13-2
W. Cubicle Space Heaters:		
Watts per cubicle...........................		
Voltage rating..............................		

9. BUS DUCT ASSEMBLIES (Furnish information for both indoor and outdoor designs, where different):
   A. High potential withstand test at factory on assembled structure:
      60-cycle (1 minute)................(kv)

ABB
ASEA BROWN BOVERI

IB 7.4.1.7-7
Issue D

INSTRUCTIONS

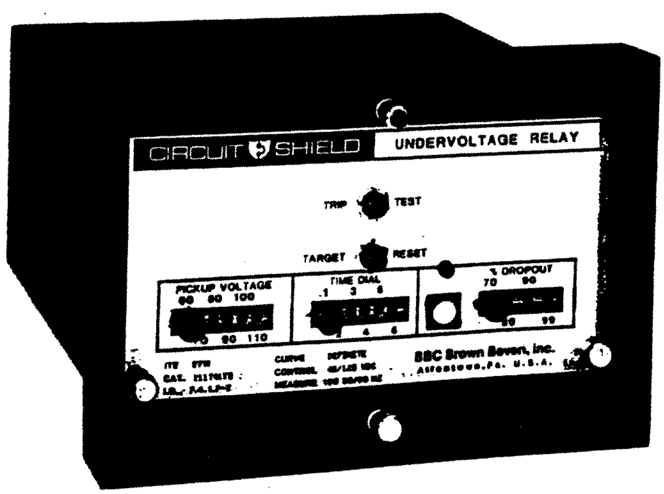
Single Phase Voltage Relays

Type 27N HIGH ACCURACY UNDERVOLTAGE RELAY

Type 59N HIGH ACCURACY OVERVOLTAGE RELAY

Type 27N	Catalog Series 211T	Standard Case
Type 27N	Catalog Series 411T	Test Case
Type 59N	Catalog Series 211U	Standard Case
Type 59N	Catalog Series 411U	Test Case

Reference? B-K can be found in Dresden Book? for Unit 2 cal ... other ... SSL ...



ASEA BROWN BOVERI

Calculation No. 8982-13-19-6
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TABLE OF CONTENTS

INTRODUCTION

These instructions contain the information required to properly install, operate, and test certain single-phase undervoltage relays type 27N, catalog series 211T and 411T; and overvoltage relays, type 59N, catalog series 211U and 411U.

The relay is housed in a case suitable for conventional semiflush panel mounting. All connections to the relay are made at the rear of the case and are clearly numbered. Relays of the 411T, and 411U catalog series are similar to relays of the 211T, and 211U series. Both series provide the same basic functions and are of totally drawout construction; however, the 411T and 411U series relays provide integral test facilities. Also, sequenced disconnects on the 410 series prevent nuisance operation during withdrawal or insertion of the relay if the normally-open contacts are used in the application.

Basic settings are made on the front panel of the relay, behind a removable clear plastic cover. Additional adjustment is provided by means of calibration potentiometers inside the relay on the circuit board. The target is reset by means of a pushbutton extending through the relay cover.

PRECAUTIONS

The following precautions should be taken when applying these relays:

1. Incorrect wiring may result in damage. Be sure wiring agrees with the connection diagram for the particular relay before energizing.

2. Apply only the rated control voltage marked on the relay front panel. The proper polarity must be observed when the dc control power connections are made.

3. For relays with dual-rated control voltage, withdraw the relay from the case and check that the movable link on the printed circuit board is in the correct position for the system control voltage.

4. High voltage insulation tests are not recommended. See the section on testing for additional information.

5. The entire circuit assembly of the relay is removable. The unit should insert smoothly. Do not use excessive force.

6. Follow test instructions to verify that the relay is in proper working order.

CAUTION: ***since troubleshooting entails working with energized equipment, care should be taken to avoid personal shock. Only competant technicians familiar with good safety practices should service these devices.***

PLACING THE RELAY INTO SERVICE

1. RECEIVING, HANDLING, STORAGE

Upon receipt of the relay (when not included as part of a switchboard) examine for shipping damage. If damage or loss is evident, file a claim at once and promptly notify Asea Brown Boveri. Use normal care in handling to avoid mechanical damage. Keep clean and dry.

2. INSTALLATION

Mounting:
The outline dimensions and panel drilling and cutout information is given in Fig. 1.

Connections:
Typical external connections are shown in Figure 2. Internal connections and contact logic are shown in Figure 3. Control power must be connected in the proper polarity.

For relays with dual-rated control power: before energizing, withdraw the relay from its case and inspect that the movable link on the lower printed circuit board is in the correct position for the system control voltage. (For units rated 110vdc, the link should be placed in the position marked 125vdc.)

These relays have an external resistor wired to terminals 1 and 9 which must be in place for normal operation. The resistor is supplied mounted on the relay.

These relays have metal front panels which are connected through printed circuit board runs and connector wiring to a terminal at the rear of the relay case. The terminal is marked "G". In all applications this terminal should be wired to ground.

3. SETTINGS

PICKUP
The pickup voltage taps identify the voltage level which the relay will cause the output contacts to transfer.

DROPOUT
The dropout voltage taps are identified as a percentage of the pickup voltage. Taps are provided for 70%, 80%, 90%, and 99% of pickup, or, 30%, 40%, 50%, and 60% of pickup.

Note: operating voltage values other than the specific values provided by the taps can be obtained by means of an internal adjustment potentiometer. See section on testing for setting procedure.

TIME DIAL
The time dial taps are identified as 1,2,3,4,5,6. Refer to the time-voltage characteristic curves in the Application section. Time dial selection is not provided on relays with an Instantaneous operating characteristic. The time delay may also be varied from that provided by the fixed tap by using the internal calibration adjustment.

4. OPERATION INDICATORS

The types 27N and 59N provide a target indicator that is electronically actuated at the time the output contacts transfer to the trip condition. The target must be manually reset. The target can be reset only if control power is available, AND if the input voltage to the relay returns to the "normal" condition.

An led indicator is provided for convenience in testing and calibrating the relay and to give operating personnel information on the status of the relay. See Figure 4 for the operation of this indicator.

Units with a "-L" suffix on the catalog number provide a green led to indicate the presence of control power and internal power supply voltage.

APPLICATION DATA

Single-phase undervoltage relays and overvoltage relays are used to provide a wide range of protective functions, including the protection of motors and generators, and to initiate bus transfer. The type 27N undervoltage relay and type 59N overvoltage relay are designed for those applications where exceptional accuracy, repeatability, and long-term stability are required.

Tolerances and repeatability are given in the Ratings section. Remember that the accuracy of the pickup and dropout settings with respect to the printed dial markings is generally not a factor, as these relays are usually calibrated in the field to obtain the particular operating values for the application. At the time of field calibration, the accuracy of the instruments used to set the relays is the important factor. Multiturn internal calibration potentiometers provide means for accurate adjustment of the relay operating points, and allow the difference between pickup and dropout to be set as low as 0.5%. X

The relays are supplied with instantaneous operating time, or with definite-time delay characteristic. The definite-time units are offered in two time delay ranges: 1-10 seconds, or 0.1-1 second.

An accurate peak detector is used in the types 27N and 59N. Harmonic distortion in the AC waveform can have a noticible effect on the relay operating point and on measuring instruments used to set the relay. An internal harmonic filter is available as an option for those applications where waveform distortion is a factor. The harmonic filter attenuates all harmonics of the 50/60 Hz. input. The relay then basically operates on the fundamental component of the input voltage signal. See figure 5 for the typical filter response curve. To specify the harmonic filter add the suffix "-HF" to the catalog number. Note in the section on ratings that the addition of the harmonic filter does reduce somewhat the repeatability of the relay vs. temperature variation. In applications where waveform distortion is a factor, it may be desirable to operate on the peak voltage. In these cases, the harmonic filter would not be used.

CHARACTERISTICS OF COMMON UNITS

Type	Pickup Range	Dropout Range	Time Delay Pickup	Time Delay Dropout	Catalog Numbers Std Case	Catalog Numbers Test Case
27N	60 - 110 v	70% - 99%	Inst	Inst	211T01x5	411T01x5
			Inst	1 - 10 sec	211T41x5	411T41x5
			Inst	0.1 - 1 sec	211T61x5	411T61x5
	70 - 120 v	70% - 99%	Inst	Inst	211T03x5	411T03x5
			Inst	1 - 10 sec	211T43x5	411T43x5
			Inst	0.1 - 1 sec	211T63x5	411T63x5
	60 - 110 v	30% - 60%	Inst	Inst	211T02x5	411T02x5
			Inst	1 - 10 sec	211T42x5	411T42x5
			Inst	0.1 - 1 sec	211T62x5	411T62x5
59N	100 - 150 v	70% - 99%	Inst	Inst	211U01x5	411U01x5
			1 - 10 s	Inst	211U41x5	411U41x5
			0.1 - 1 s	Inst	211U61x5	411U61x5

IMPORTANT NOTES:

1. Each of the listed catalog numbers for the types 27N and 59N contains an "x" for the control voltage designation. To complete the catalog number, replace the "x" with the proper control voltage code digit:

   48/125 vdc 7
   250 vdc 5
   220 vdc 2
   48/110 vdc 0

2. To specify the addition of the harmonic filter module, add the suffix "-HF". For example: 411T4175-HF. Harmonic filter not available on type 27N with instantaneous delay timing characteristic.

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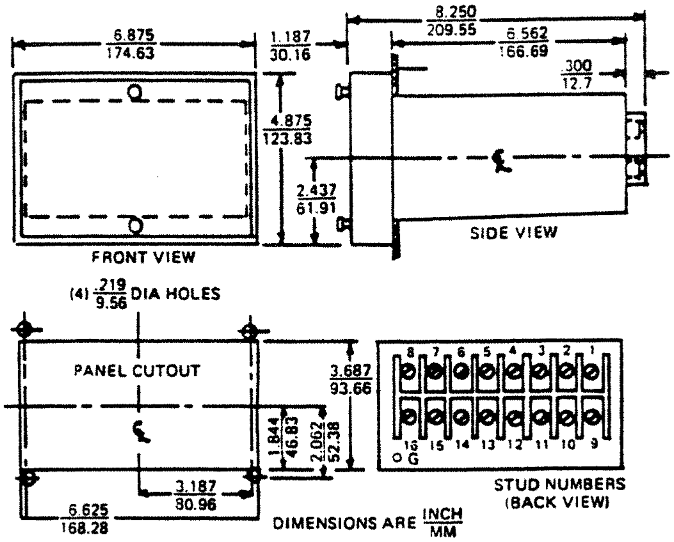


Figure 1: Relay Outline and Panel Drilling

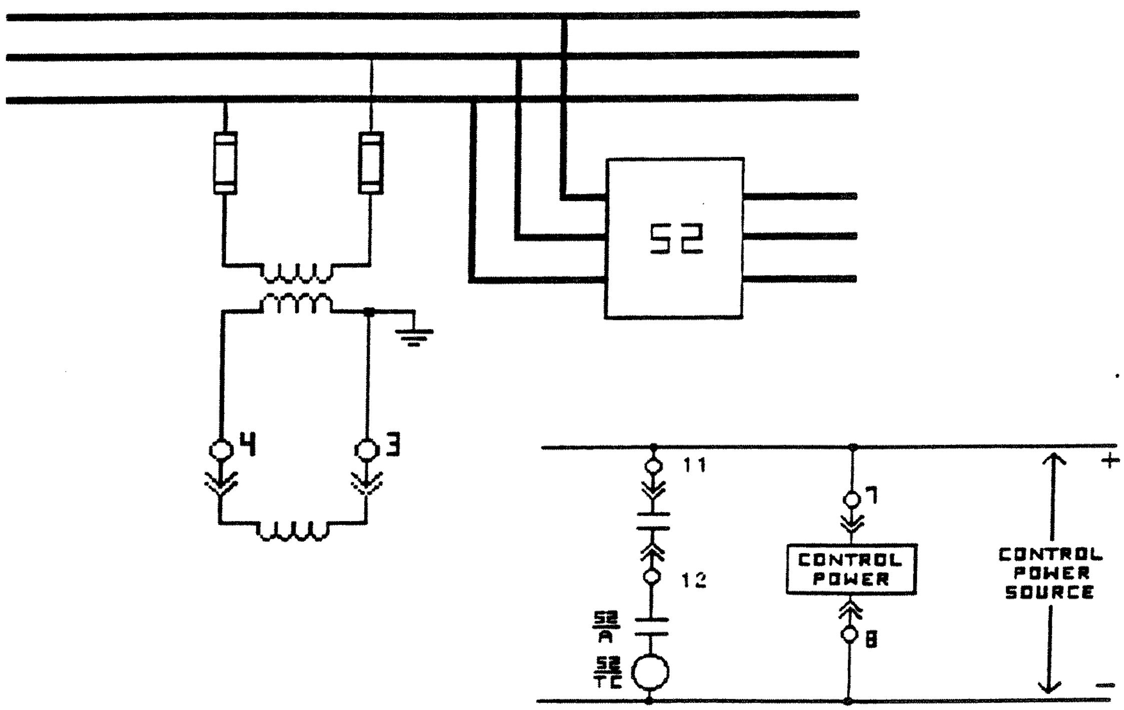
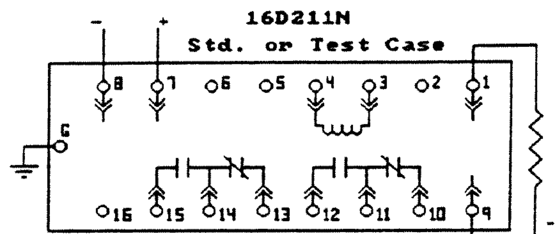


Figure 2: Typical External Connections

Figure 3: **INTERNAL CONNECTION DIAGRAM AND OUTPUT CONTACT LOGIC**

The following table and diagram define the output contact states under all possible conditions of the measured input voltage and the control power supply. "AS SHOWN" means that the contacts are in the state shown on the internal connection diagram for the relay being considered. "TRANSFERRED" means the contacts are in the opposite state to that shown on the internal connection diagram.

Condition	Contact State Type 27N	Contact State Type 59N
Normal Control Power AC Input Voltage Below Setting	Transferred	As Shown
Normal Control Power AC Input Voltage Above Setting	As Shown	Transferred
No Control Voltage	As Shown	As Shown



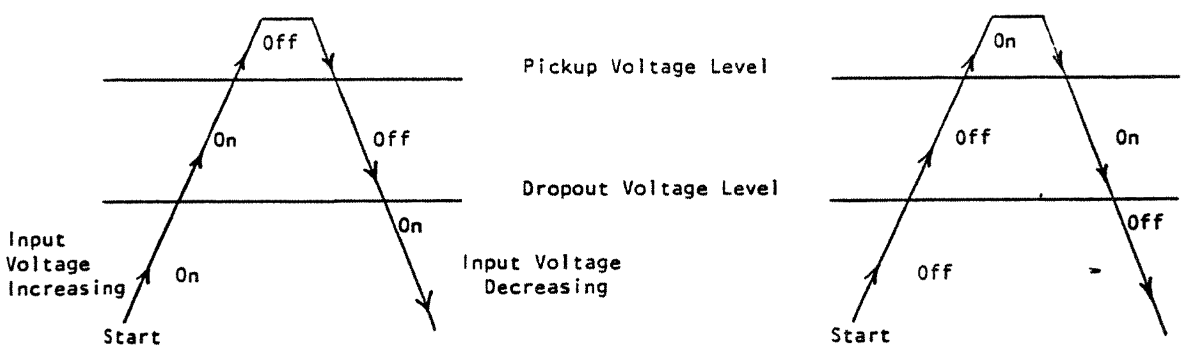
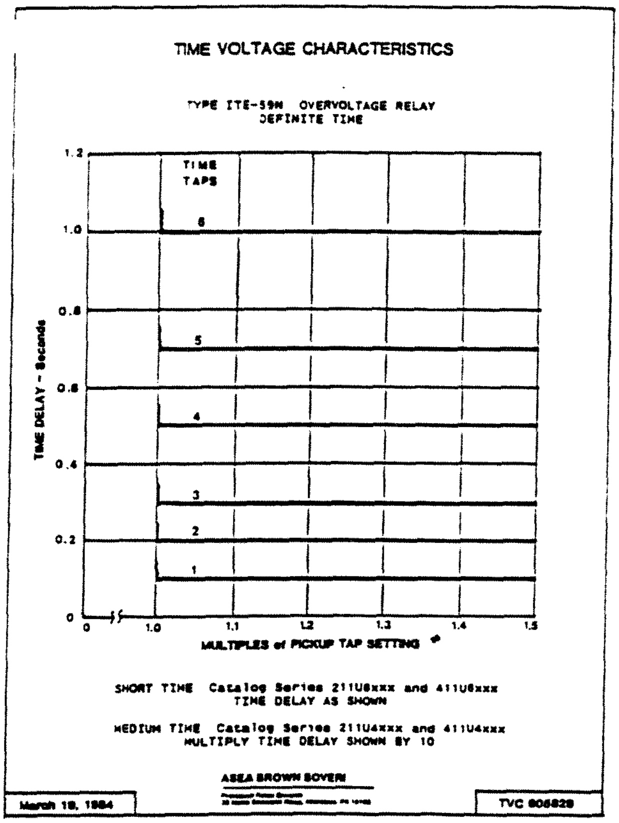
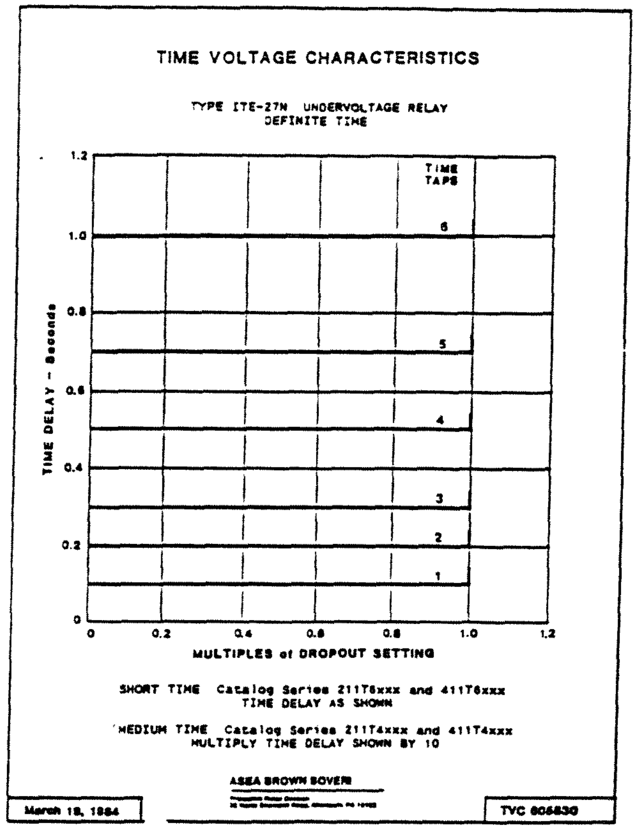


Figure 4a: ITE-27N Operation of Dropout Indicating Light

Figure 4b: ITE-59N Operation of Pickup Indicating Light

Figure 4: **Operation of Pickup/Dropout Light-Emitting-Diode Indicator**





* NOT TO EXCEED INPUT RATING

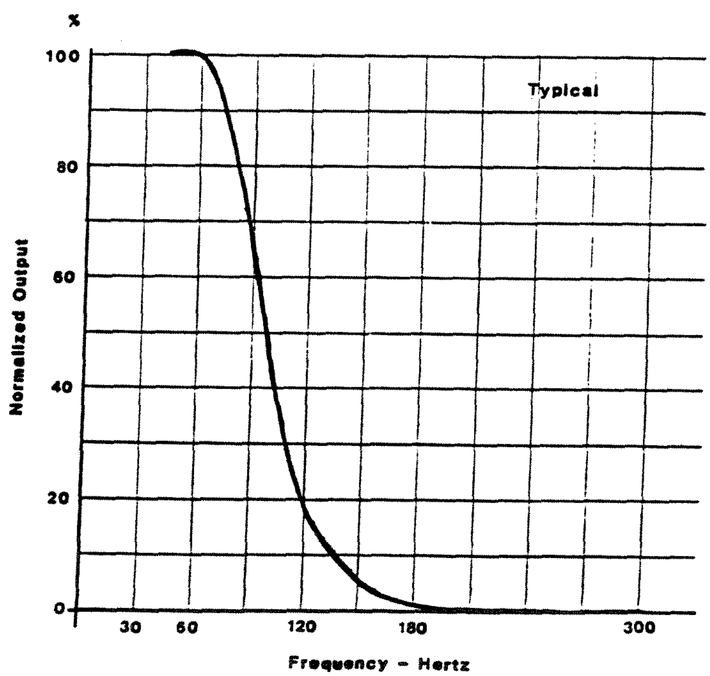


Figure 5: Normalized Frequency Response - Optional Harmonic Filter Module

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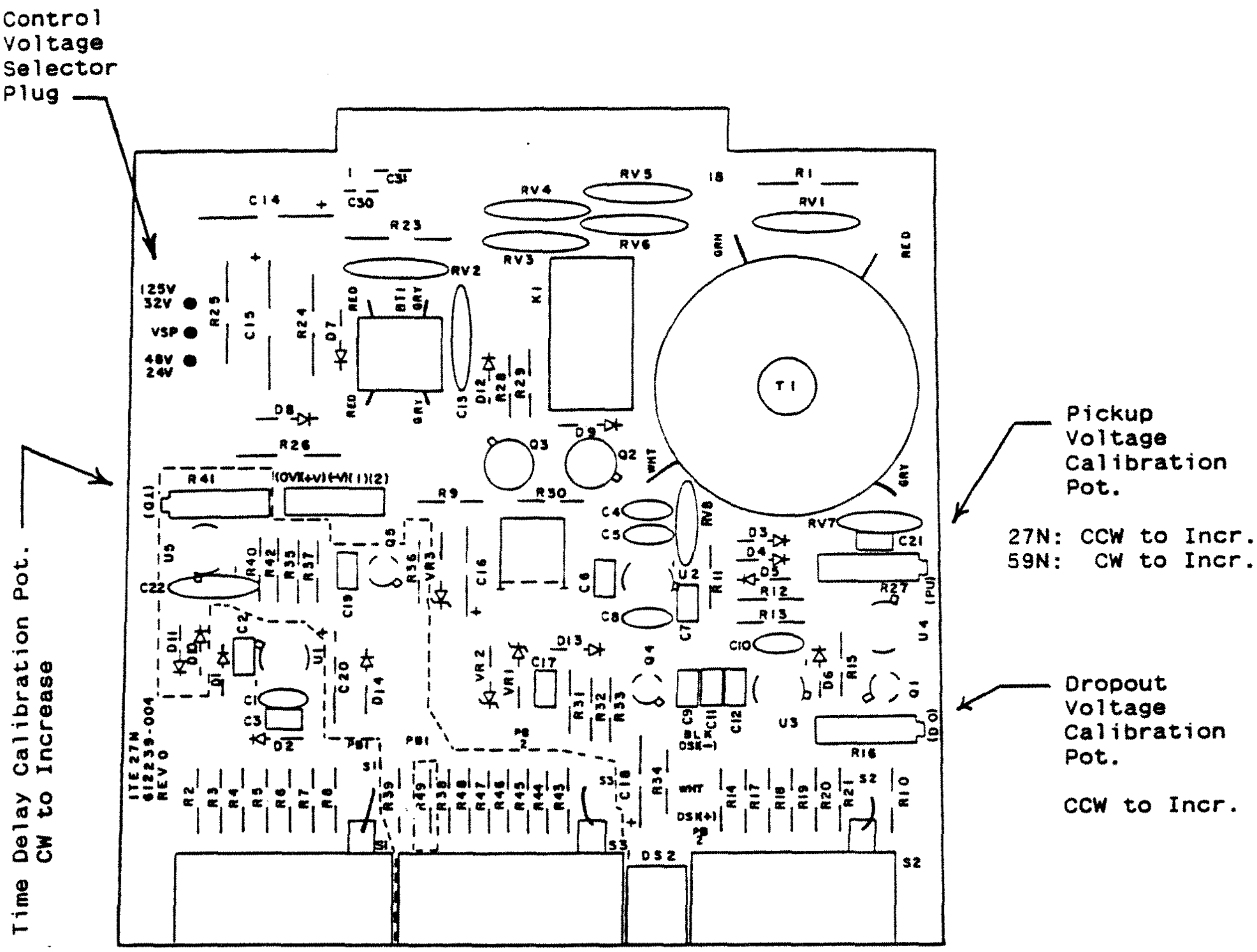

Figure 6: Typical Circuit Board Layouts, types 27N and 59N

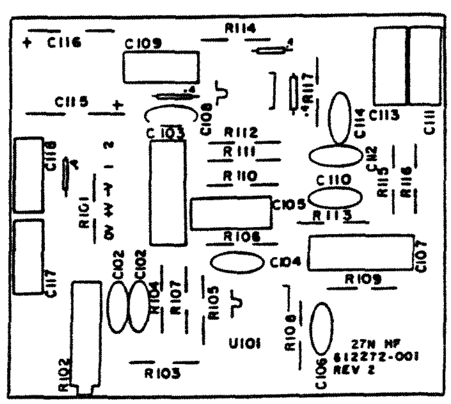

Figure 7: Typical Circuit Board Layout - Harmonic Filter Module

TESTING

1. MAINTENANCE AND RENEWAL PARTS

No routine maintenance is required on these relays. Follow test instructions to verify that the relay is in proper working order. We recommend that an inoperative relay be returned to the factory for repair; however, a circuit description booklet CD7.4.1.7-7 which includes schematic diagrams, can be provided on request. Renewal parts will be quoted by the factory on request.

211 Series Units

Drawout circuit boards of the same catalog number are interchangible. A unit is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom side of the drawout circuit board.

The board is removed by using the metal pull knobs on the front panel. *Removing the board with the unit in service may cause an undesired operation.*

An 18 point extender board (cat 200X0018) is available for use in troubleshooting and calibration of the relay.

411 Series Units

Metal handles provide leverage to withdraw the relay assembly from the case. Removing the unit in an application that uses a normally closed contact will cause an operation. The assembly is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom of the circuit board.

Test connections are readily made to the drawout relay unit by using standard banana plug leads at the rear vertical circuit board. This rear board is marked for easier identification of the connection points.

Important: these relays have an external resistor mounted on rear terminals 1 and 9. In order to test the 'rawout unit an equivilent resistor must be connected to terminals 1 & 9 on the rear vertical circuit board of the drawout unit. The resistance value must be the same as the resistor used on the relay. A 25 or 50 watt resistor will be sufficient for testing. If no resistor is available, the resistor assembly mounted on the relay case could be removed and used. ***If the resistor from the case is used, be sure to remount it on the case at the conclusion of testing.***

Test Plug:

A test plug assembly, catalog number 400X0002 is available for use with the 410 series units. This device plugs into the relay case on the switchboard and allows access to all external circuits wired to the case. See Instruction Book IB 7.7.1.7-8 for details on the use of this device.

2. HIGH POTENTIAL TESTS

High potential tests are not recommended. A hi-pot test was performed at the factory before shipping. If a control wiring insulation test is required, partially withdraw the relay unit from its case sufficient to break the rear connections before applying the test voltage.

3. BUILT-IN TEST FUNCTION

Be sure to take all necessary precautions if the tests are run with the main circuit energized.

The built-in test is provided as a convenient functional test of the relay and associated circuit. When you depress the button labelled TRIP, the measuring and timing circuits of the relay are actuated. When the relay times out, the output contacts transfer to trip the circuit breaker or other associated circuitry, and the target is displayed. The test button must be held down continuously until operation is obtained.

4. ACCEPTANCE TESTS

Follow the test procedures under paragraph 5. For definite-time units, select Time Dial #3. For the type 27N, check timing by dropping the voltage to 50% of the dropout voltage set (or to zero volts if preferred for simplification of the test). For the type 59N check timing by switching the voltage to 105% of pickup (do not exceed max. input voltage rating.) Tolerances should be within those shown on page 5. If the settings required for the particular application are known, use the procedures in paragraph 5 to make the final adjustments.

5. CALIBRATION TESTS

<u>Test Connections and Test Sources:</u>
Typical test circuit connections are shown in Figure 8. Connect the relay to a proper source of dc control voltage to match its nameplate rating (and internal plug setting for dual-rated units). Generally the types 27N and 59N are used in applications where high accuracy is required. The ac test source must be stable and free of harmonics. A test source with less than 0.3% harmonic distortion, such as a "line-corrector" is recommended. Do not use a voltage source that employs a ferroresonant transformer as the stabilizing and regulating device, as these usually have high harmonic content in their output. The accuracy of the voltage measuring instruments used must also be considered when calibrating these relays.

If the resolution of the ac test source adjustment means is not adequate, the arrangement using two variable transformers shown in Figure 9 to give "coarse" and "fine" adjustments is recommended.

When adjusting the ac test source do not exceed the maximum input voltage rating of the relay.

<u>LED Indicator:</u>
A light emitting diode is provided on the front panel for convenience in determining the pickup and dropout voltages. The action of the indicator depends on the voltage level and the direction of voltage change, and is best explained by referring to Figure 4.

The calibration potentiometers mentioned in the following procedures are of the multi-turn type for excellent resolution and ease of setting. For catalog series 211 units, the 18 point extender board provides easier access to the calibration pots. If desired, the calibration potentiometers can be resealed with a drop of nail polish at the completion of the calibration procedure.

<u>Setting Pickup and Dropout Voltages:</u>
Pickup may be varied between the fixed taps by adjusting the pickup calibration potentiometer R27. Pickup should be set first, with the dropout tap set at 99% (60% on "low dropout units"). Set the pickup tap to the nearest value to the desired setting. The calibration potentiometer has approximately a +/-5% range. Decrease the voltage until dropout occurs, then check pickup by increasing the voltage. Re-adjust and repeat until pickup occurs at precisely the desired voltage.

Potentiometer R16 is provided to adjust dropout. Set the dropout tap to the next lower tap to the desired value. Increase the input voltage to above pickup, and then lower the voltage until dropout occurs. Readjust R16 and repeat until the required setting has been made.

<u>Setting Time Delay:</u>
Similarly, the time delay may be adjusted higher or lower than the values shown on the time-voltage curves by means of the time delay calibration potentiometer R41. On the type 27N, time delay is initiated when the voltage drops from above the pickup value to below the dropout value. On the type 59N, timing is initiated when the voltage increases from below dropout to above the pickup value. Referring to Fig. 4, the relay is "timing out" when the led indicator is lighted.

<u>External Resistor Values:</u> The following resistor values may be used when testing 411 series units. Connect to rear connection points 1 & 9.

Relays rated	48/125 vdc:	5000 ohms;	(-HF models with harmonic filter 4000 ohms)
	48/110 vdc:	4000 ohms;	(-HF models with harmonic filter 3200 ohms)
	250 vdc:	10000 ohms;	(-HF models with harmonic filter 9000 ohms)
	220 vdc:	10000 ohms;	(-HF models with harmonic filter 9000 ohms)

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ABB Power Transmission Inc.
Protective Relay Division
35 N. Snowdrift Rd.
Allentown, Pa. 18106
215-395-7333

Issue D (2/89)
Supersedes Issue C

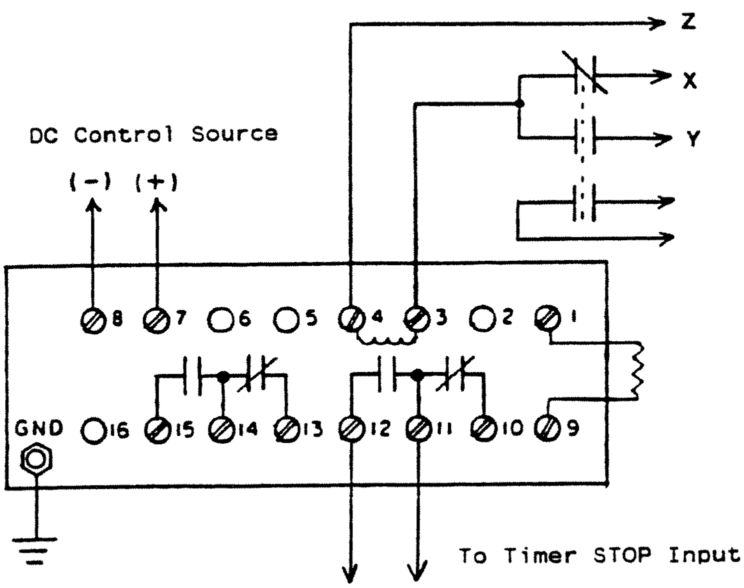


Figure 8: Typical Test Connections

T1, T2	Variable Autotransformers	(1.5 amp rating)
T3	Filament Transformer	(1 amp secondary)
V	Accurate AC Voltmeter	

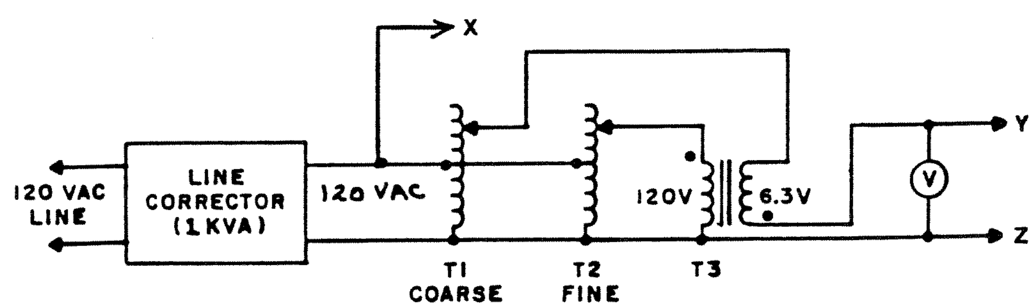


Figure 9: AC Test Source Arrangement

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in conjunction with installation, operation, or maintenance. Should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to Asea Brown Boveri.

ATTACHMENT B

Fluke 45 Dual Display Multimeter User's Manual, Appendix A

FLUKE®

45

Dual Display Multimeter

Users Manual

PN 855981
January 1989, Rev. 4, 7/97

Calculation No. 8982-13-19-6
Revision 005
Attachment: B
Page B2 of B12

Appendix A
Specifications

Introduction

Appendix A contains the specifications of the Fluke 45 Dual Display Multimeter.

These specifications assume:

- A 1-year calibration cycle
- An operating temperature of 18 °C to 28 °C (64.4 °F to 82.4 °F)
- Relative humidity not exceeding 90 % (non-condensing) (70 % for 1,000 kΩ range

Accuracy is expressed as +(percentage of reading + digits).

Display Counts and Reading Rates

Rate	Readings per Second	Full Range Display Counts
Slow	2.5	99,999*
Medium	5	30,000
Fast	20	3,000

* Ohms full range will typically be 98,000 counts

RS-232 and IEEE-488 Reading Transfer Rates

Rate	Reading Per Second		
	Internal Trigger Operation (TRIGGER 1)	Internal Trigger Operation (TRIGGER 4)	Print Mode Operation (Print set at 1)
Slow	2.5	1.5	2.5
Medium	4.5	2.4	5.0
Fast	4.5	3.8	13.5

Response Times

Refer to Section 4 for detailed information.

DC Voltage

Range	Resolution			Accuracy	
	Slow	Medium	Fast	(6 Months)	(1 Year)
300 mV	—	10 μV	100 μV	002 % + 2	0.025 % + 2
3 V	—	100 μV	1 mV	0.02 % + 2	0.025 % + 2
30 V	—	1 mV	10 mV	0.02 % + 2	0.025 % + 2
300 V	—	10 mV	100 mV	0.02 % + 2	0.025 % + 2
1000 V	—	100 mV	1 V	0.02 % + 2	0.025 % + 2
100 mV	1 μV	—	—	0.02 % + 6	0.025 % + 6
1000 mV	10 μV	—	—	0.02 % + 6	0.025 % + 6
10 V	100 μV	—	—	0.02 % + 6	0.025 % + 6
100 V	1 mV	—	—	0.02 % + 6	0.025 % + 6
1000 V	10 mV	—	—	0.02 % + 6	0.025 % + 6

Input Impedance

10 MΩ in parallel with <100 pF

Note

In the dual display mode, when the volts ac and volts dc functions are selected, the 10 MΩ dc input divider is in parallel with the 1 MΩ ac divider.

Normal Mode Rejection Ratio

>80 dB at 50 Hz or 60 Hz, slow and medium rates

>54 dB for frequencies between 50-440 Hz, slow and medium rates

>60 dB at 50 Hz, fast rate (Note: Fast rate has no filtering)

Maximum Allowable AC Voltage While Measuring DC Voltage or (AC + DC) Voltages

Range		Max Allowable Peak AC Voltage	Peak Normal Mode Signal	
			NMRR* >80 dB†	NMRR >60 dB†
300 mV	100 mV	15 V	15 V	15 V
3 V	1000 mV	15 V	15 V	15 V
30 V	10 V	1000 V	50 V	300 V
300 V	100 V	1000 V	50 V	300 V
1000 V	1000 V	1000 V	200 V	1000 V

* NMRR is the Normal Mode Rejection Ratio
† Normal Mode Rejection Ratio at 50 Hz or 60 Hz ±0.1 %

Common Mode Rejection Ratio

>90 dB at do, 50 or 60 Hz, (1 kΩ unbalanced, medium and slow rates)

Maximum Input

1000V dc or peak ac on any range

True RMS AC Voltage, AC-Coupled

Range	Resolution		
	Slow	Medium	Fast
300 mV	—	10 μV	100 μV
3 V	—	100μV	1 mV
30 V	—	1 mV	10 mV
300 V	—	10 mV	100 mV
750 V	—	100 mV	1 V
100 mV	1 μV	—	—
1000 mV	10 μV	—	—
10 V	100 μV	—	—
100 V	1 mV	—	—
750 V	10 mV	—	—

Accuracy

Frequency	Linear Accuracy			dB Accuracy		Power*	Max Input at Upper Freq
	Slow	Medium	Fast	Slow/Med	Fast		
20-50 Hz	1 % + 100	1 % + 10	7 % + 2	0.15	0.72	2 % + 10	750 V
50 Hz-10 kHz	0.2 % + 100	0.2 % + 10	0.5 % + 2	0.08	0.17	0.4 % + 10	750 V
10-20 kHz	0.5 % + 100	0.5 % + 10	0.5 % + 2	0.11	0.17	1 % + 10	750 V
20-50 kHz	2 % + 200	2 % + 20	2 % + 3	0.29	0.34	4 % + 20	400 V
50-100 kHz	5 % + 500	5 % + 50	5 % + 6	0.70	0.78	10 % + 50	200 V
* Error in power mode will not exceed twice the linear accuracy specification							

Accuracy specifications apply within the following limits, based on reading rate:

Slow Reading Rate: Between 15,000 and 99,999 counts (full range)
Medium Reading Rate: Between 1,500 and 30,000 counts (full range)
Fast Reading Rate: Between 150 and 3,000 counts (full range)

Decibel Resolution

Resolution	
Slow & Medium	Fast
0.01 dB	0.1 dB

Decibel Reference Resistance

8000 Ω	500 Ω	124 Ω	8 Ω†
1200 Ω	300 Ω	110 Ω	4 Ω†
1000 Ω	250 Ω	93 Ω	2 Ω†
900 Ω	150 Ω	75 Ω	
800 Ω	135 Ω	50 Ω	
600 Ω*	125 Ω	16 Ω†	

* Default resistance
† Reading displayed in watts (POWER)

Input Impedance

1 MΩ in parallel with <100 pF

Maximum Crest Factor

3.0

Common Mode Rejection Ratio

>60 dB at 50 Hz or 60 Hz (1 kΩ unbalanced medium rate)

Maximum Input

750 V rms, 1000 V peak

2 X 107 Volt-Hertz product on any range, normal mode input

1 x 106 Volt-Hertz product on any range, common mode input

(AC + DC) Voltage Accuracy

Total Measurement Error will not exceed the sum of the separate ac and dc accuracy specifications, plus 1 display count. Refer to the table under "Maximum Allowable AC Voltage while Measuring DC Voltage or (AC + DC) Voltages" located on page A3.

Note

When measuring ac + dc, (or any dual display combination of ac and dc) in the fast reading rate, the Fluke 45 may show significant reading errors. This results from a lack of filtering on the dc portion of the measurement for the fast reading rate. To avoid this problem, use only the "slow" and "medium" reading rates for ac + dc or ac and dc combinations.

Maximum Frequency of AC Voltage Input While Measuring AC Current

When the meter makes ac current and ac voltage measurements using the dual display, the maximum frequency of the voltage input is limited to the maximum frequency of the current function. For example, if you are making an ac current measurement on the 10 A range, the maximum frequency of the voltage input must be less than 2 kHz.

DC Current

Range	Resolution			Accuracy	Burden Voltage
	Slow	Medium	Fast		
30 mA	—	1 μA	10 μA	0.05 % + 3	0.45 V
100 mA	—	10 μA	100 μA	0.05 % + 2	1.4 V
10 A	—	1 mA	10 mA	0.2 % + 5	0.25 V
10 mA	100 nA	—	—	0.05 % +	0.14 V
100 mA	1 μA	—	—	50.05 % + 5	1.4 V
10 A	100 μA	—	—	0.2 % + 7	0.25 V
* Typical at full range					

Maximum Input

To be used in protected, low energy circuits only, not to exceed 250 V or 4800 Volt-Amps. (IEC 664 Installation Category II.)

mA 300 mA dc or ac rms. Protected with a 500 mA, 250V, IEC 127-sheet 1, fast blow fuse

A 10 A dc or ac rms continuous, or 20 A dc or ac rms for 30 seconds maximum. Protected with a 15 A, 250 V, 10,000 A interrupt rating, fast blow fuse.

Note

Resistance between the COM binding post and the meter's internal measuring circuits is approximately .003 Ω.

AC Current

Range	Resolution			Burden Voltage*
	Slow	Medium	Fast	
10 mA	100 nA	—	—	0.14 V
30 mA	—	1 μA	10 μA	0.45 V
100 mA	1 μA	10 μA	100 μA	1.4 V
10 A	100 μA	1 mA	10 mA	0.25 V
* Typical at full range				

Accuracy

Range	Frequency	Accuracy		
		Slow	**Medium**	**Fast**
mA (To 100 mA)	20-50 Hz	2 % + 100	2 % + 10	7 % + 2
mA (To 100 mA)	50 Hz-10 kHz	0.5 % + 100	0.5 % + 10	0.8 % + 2
mA (To 100 mA)	10 -20 kHz	2 % + 200	2 % + 20	2 % + 3
A (1-10A)	20-50 Hz	2 % + 100	2 % + 10	7 % + 2
A (1-10A)	50 Hz-2 kHz	1 % + 100	1 % + 10	1.3 % + 2
A (0.5 to 1A)	20-50 Hz	2 % + 300	2 % + 30	7 % + 4
A (0.5 to 1A)	50Hz-2 kHz	1 % + 300	1 % + 30	1.3 % + 4

mA accuracy specifications apply within the following limits, based on reading rate:

Slow Reading Rate:	Between 15,000 and 99,999 counts (full range)
Medium Reading Rate:	Between 1,500 and 30,000 counts (full range)
Fast Reading Rate:	Between 150 and 3,000 counts (full range)

Maximum Crest Factor

3.0

Maximum Input

To be used in protected, low energy circuits only, not to exceed 250 V or 4800 Volt-Amps. (IEC 664 Installation Category II.)

mA 300 mA dc or ac rms. Protected with a 500 mA, 250 V, IEC 127-sheet 1, fast blow fuse

A 10 A dc or ac rms continuous, or 20 A dc or ac rms for 30 seconds maximum. Protected with a 15 A, 250 V, 10,000 A interrupt rating, fast blow fuse.

Note

Resistance between the COM binding post and the meter's internal measuring circuits is approximately .003Ω.

Ohms

Range	Resolution			Accuracy	Typical Full Scale Voltage	Max Current Through the Unknown
	Slow	Medium	Fast			
300 Ω	—	10 mΩ	100 MΩ	0.05 % + 2 + 0.02Ω	0.25	1 mA
3 kΩ	—	100 MΩ	1 Ω	0.05 % + 2	0.24	120μA
30 kΩ	—	1 Ω	10 Ω	0.05 % + 2	0.29	14 μA
300 kΩ	—	10 Ω	100 Ω	0.05 % + 2	0.29	1.5 μA
3 MΩ	—	100 Ω	1 kΩ	0.06 % + 2	0.3	150 μA
30 MΩ	—	1 kΩ	10 kΩ	0.25 % + 3	2.25	320 μA
300 MΩ*	—	100 kΩ	1 MΩ	2 %	2.9	320 μA
100 Ω	1 mΩ	—	—	0.05 % + 8 + 0.02 Ω	0.09	1 mA
1000 Ω	10 mΩ	—	—	0.05 % + 8 + 0.02Ω	0.10	120 μA
10 kΩ	100 mΩ	—	—	0.05 %+8	0.11	14 μA
100 kΩ	1 Ω	—	—	0.05 % + 8	0.11	1.5 μA
1000 kΩ	10 Ω	—	—	0.06 % +_8	0.12	150 μA
10 MΩ	100 Ω	—	—	0.25 % + 6	1.5	150 μA
100 MΩ*	100 kΩ	—	—	2 % + 2	2.75	320 μA

*Because of the method used to measure resistance, the 100 MΩ (slow) and 300 MΩ (medium and fast) ranges cannot measure below 3.2 MΩ and 20 MΩ, respectively. "UL" (underload) is shown on the display for resistances below these nominal points, and the computer interface outputs "+1 E-9".

Open Circuit Voltage

3.2 V maximum on the 100 Ω, 300 Ω, 30 MΩ, 100 MΩ, and 300 MΩ ranges, 1.5 V maximum on all other ranges.

Input Protection

500 V dc or rms ac on all ranges

Diode Test/Continuity

	Maximum Reading	Resolution
Slow	999.99 mV	10 μV
Medium	2.5 V	100 μV
Fast	2.5 V	1 mV

Test Current

Approximately 0.7 mA when measuring a forward biased junction.

Audible Tone

Continuous tone for continuity. Brief tone for normal forward biased diode or semiconductor junction.

Open Circuit Voltage

3.2 V maximum

Continuity Capture Time

50 us maximum, 10 us typical

Input Protection

500 volts dc or rms ac

Note

When the meter is set to measure frequency and there is no input signal (i.e., input terminals are open), the meter may read approximately 25 kHz (rather than the expected zero). This is due to internal capacitive pickup of the inverter power supply into the high-impedance, input circuitry. With source impedance of <2 kΩ, this pickup will not affect the accuracy or stability of the frequency a reading.

Frequency

Frequency Range

5 Hz to >1 MHz

Applicable Functions

Volts ac and Current AC

Range	Resolution		Accuracy
	Slow & Medium	Fast	
1000 Hz	.01 Hz	.1 Hz	05% + 2
10 kHz	.1 Hz	1 Hz	.05% + 1
100 kHz	1 Hz	10 Hz	.05% + 1
1000 kHz	10 Hz	100 Hz	.05% + 1
1 MHz*	100 Hz	1 kHz	Not Specified
* Specified to 1 MHz, but will measure above 1 MHz.			

Sensitivity of AC Voltage

Frequency	Level (sine wave)
5 Hz-100 kHz	30 mV rms
100 kHz - 300 kHz	100 mV rms
300 kHz - 1 MHz	1 V V rms
Above 1 MHz	Not specified

Sensitivity Level of AC Current

Frequency	Input	Level
5 Hz-20 kHz	100 mA	>3 mA rms
45 Hz-2 kHz	10 A	>3 A rms

Note

When the meter is set to measure frequency and there is no input signal (i.e., the input terminals are open), the meter may read approximately 25 kHz (rather than zero). This is due to internal capacitive pickup of the inverter power supply into the high-impedance, input circuitry. With source impedance of <2 kΩ, this pickup will not affect the accuracy or stability of the frequency reading.

Environmental

Warmup time	1 hour to rated specifications for warmup < 1 hour, add 0.005 % to all accuracy specifications.
Temperature Coefficient	<0.1 times the applicable accuracy specification per degree C for 0 °C to 18 °C and 28 °C to 50 °C (32 °F to 64.4 °F and 82.4 °F to 122 °F)
Operating Temperature	0 °C to 50 °C (32 °F to 122°F)
Storage Temperature	-40 °C to + 70 °C (-40 °F to 158°F) Elevated temperature storage of battery will accelerate battery self-discharge. Maximum storage time before battery must be recharged: 20 °C – 25 °C 1000 days 50 °C 180 days 70 °C 40 days
Relative Humidity (non-condensing)	To 90 % at 0 °C to 28 °C (32-82.4 °F), To 80 % at 28 °C to 35 °C (82.4-95 °F), To 70 % at 35 ° C to 50 °C (95 °F -122 ° F) except to 70 % at 0 °C to 50 °C (32 °F -122 °F) for the1000 kΩ, 3 MΩ, 10 MΩ, 30 MΩ, 100 MΩ,and 300 MΩ ranges.
Altitude	Operating 0 to 10,000 feet Non-operating 0 to 40,000 feet
Electromagnetic Compatibility	In an RF field of 1 V/m on all ranges and functions: Total Accuracy = Specified Accuracy +0.4% of range. Performance above 1 V/m is not specified
Vibration	3 G @ 55 Hz
Shock	Half sine 40 G. Per Mil-T- 28800D, Class 3, Style E. Bench Handling. Per Mil-T-28800D, Class 3.

General

Common Mode Voltage	1000 V dc or peak ac maximum from any input to earth
Size	9.3 cm high, 21.6 cm wide, 28.6 cm deep (3.67 in high,8.5 in wide, 11.27 in deep)
Weight	Net, 2.4 kg (5.2 lbs) without battery; 3.2 kg (7.0 lbs) with battery; Shipping, 4.0 kg (8.7 lbs) without battery; 4.8 (10.5 lbs) with battery
Power	90 V to 264 V ac (no switching required), 50 Hz and 60 Hz < 15 VA maximum
Standards	Complies with: IEC 348, UL1244, CSA Bulletin 566B EMC: Part 15 subpart J of FCC Rules, and VDE 0871.
RS-232-C	Baud rates: 300, 600,1200,2400,4800 and 9600 Odd, even or no parity One stop bit

Options

Battery (Option -01 K)	Type	8 V, Lead-Acid
	Operating Time	8 hours (typical). [battery symbol] lights when less than 1/2 hour of battery operation remains. Meter still meets specifications.
	Recharge Time	16 hours (typical) with meter turned off and plugged into line power. Battery will not charge when meter is turned on.
IEEE-488 (Option -05K)	Capability codes	SH1, AH1, T5, L4, SRI, RL1, PP0, DC1, DT1, E1, TED, LEO and C0
	External Trigger Input	
	VIH	1.35 V minimum
	VIL	1.25 V maximum
	Input Threshold Hysteresis	0.6 V minimum

ATTACHMENT C

S&L Interoffice Memorandum from J. F. White

"Seismic Qualification of ITE/ABB Undervoltage Relay Model 27N, Series 411T"

S A R G E N T & L U N D Y

INTEROFFICE MEMORANDUM

Zof ~~
'115 ~~

From J. F. White - 22 x-3172

Dept./Div. Mech./Component Qualification

Date August 14, 1991

Project No. 8900-03

Spec. No.

File No. CQD-052214 Rev. 01

Page No. 1 of 1

Client Commonwealth Edison Co. Stn. Dresden Unit 2 & 3

Subject Seismic Qualification of ITE/ABB Undervoltage Relay Model 27N, Series 411T

To: J. Sinnappan - 22 (1/0)

CC: K. L. Adlon - 22 (1/0)
R. W. Fermier - 22 (1/0)
~~E. Zacharias - 22 (1/1)~~
CQD File - 22 (1/1)

Reference: Asea Brown Boveri (ABB) Equipment Performance Specification RC-5039-A, dated 1-10-90, including Qualification Report Summary RC-5139-A, dated 1-10-90 for Undervoltage Relay Type 27N.

CQD has reviewed the Referenced Test Report and found it to be acceptable. This revision is being made to add a reference from the vendor that clarifies identification of the tested model. The seismic test levels meet the requirements for the intended application of the relay, and the test requirements of IEEE 344-1975. Therefore, the relay is seismically qualified for use in panels 2252(3)-83(4), at elevation 545'-6" in the Reactor Building at the Dresden Station.

By copy of this memorandum, the Checklist for Dynamic Qualification of Mechanical and Electrical Equipment, supporting documents, are being sent to the CQD file.

John F White

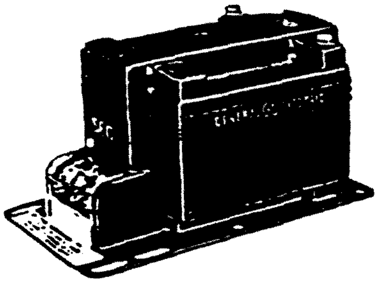
ATTACHMENT D

GE Document 7910 Dated 6-20-77

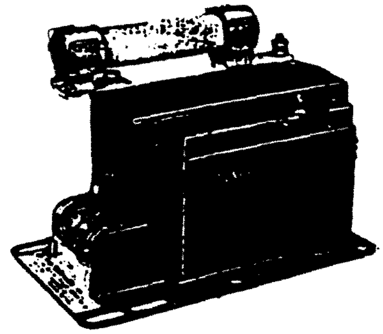
Ref
H

Type JVM-3

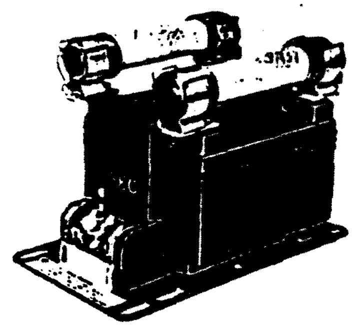
2400 to 4800 Volts **50-60 Hz** **BIL—60 Kv**



(Photo 1234873)
Fig. 1. Type JVM-3 voltage transformer (unfused)



(Photo 1234874)
Fig. 2. Type JVM-3 voltage transformer (one-fuse design)



(Photo 1234875)
Fig. 3. Type JVM-3 voltage transformer (two-fuse design)

APPLICATION—The Type JVM-3 voltage transformer is designed for indoor service and is suitable for operating meters, instruments, relays and control devices.

CONSTRUCTION AND INSULATION—See Section 7907, item 1.4.

CORE—See Section 7907, item 2.3.

COILS—Enamel insulated wire is used in the primary and secondary coils. The primary is wound and cast in epoxy resin. The secondary is inside the primary next to the core.

DIMENSIONS

Description	Dimensions in Inches		
	Height	Length	Width
Unfused	5 13/16	10 7/8	6 5/8
With one primary fuse	7 3/4	10 7/8	6 5/8
With two primary fuses	7 3/4	10 7/8	6 13/16

DATA TABLE (For Pricing Information, see Section 7901)

Transformer Rating ⊖ Primary Voltage	Transformer Rating ⊖ Ratio	Cat. No.	Thermal Rating in Volt-amperes: 55 C Rise above 30 C Ambient	Thermal Rating in Volt-amperes: 30 C Rise above 55 C Ambient	ANSI Accuracy Classification, 60 Hz: Burden Per ANSI, Operated at Rated Voltage	ANSI Accuracy Classification, 60 Hz: Burden Per ANSI, Operated at 58% Rated Voltage	ANSI Accuracy Classification, 60 Hz: Burden Impedance as at Rated Voltage, but Operated at 58% Rated Voltage*	Application: Circuit Voltage, Line-to-line	Application: Permissible Transformer Primary Connection	Primary Fuses: Voltage Rating	Primary Fuses: Amp	Primary Fuses: Fuse Cat. No.	Appro Wt in L…: Ship.	Appro Wt in L…: N…
UNFUSED														
2400	20:1	643X83	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	2400 / 4160	Δ or Y / Y only	...	...	....	35	[illegible]
4200	35:1	643X90	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4200	Δ or Y	...	...	....	35	[illegible]
4800	40:1	643X95	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4800	Δ or Y	...	...	....	35	[illegible]
WITH ONE PRIMARY FUSE (Neutral terminal insulation to ground—2.5 Kv)¶														
2400	20:1	763X21G42	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	2400	Y only	2400	1	9F60AAB001	37	[illegible]
2400	20:1	643X85	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4160	Y only	4800	1	9F60BBD001	37	[illegible]
4200	35:1	643X91	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4200	Y only	4800	0.5	9F60BBD905	37	[illegible]
4800	40:1	643X96	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4800	Y only	4800	0.5	9F60BBD905	37	[illegible]
WITH TWO PRIMARY FUSES														
2400	20:1	763X21G40	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	2400	Δ or Y‡	2400	1	9F60AAB001	38	[illegible]
4200	35:1	643X92	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4200	Δ or Y‡	4800	0.5	9F60BBD905	38	[illegible]
4800	40:1	643X97	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4800	Δ or Y‡	4800	0.5	9F60BBD905	38	[illegible]

* The prime symbol (') is used to signify that these burdens do not correspond to standard ANSI definitions.

¶ On transformers with one primary fuse the neutral terminal insulation to ground is 2500 volts.

⊖ For continuous operation, the transformer-rated primary voltage should not be exceeded by more than 10%. Under emergency conditions, overvoltage must be limited to 1.25 times the transform primary-voltage rating.

‡ For Y connections, it is preferred practice to connect one lead from eac voltage transformer directly to the grounded neutral, using a fuse on in the line side of the primary. By this connection a transformer c never be "alive" from the line side by reason of a blown fuse on t grounded side.

Calculation No. 8982-13-19-6
Revision 005
Attachment: D
Page D2 of D3

Type JVM-3

June 20, 1977 — **2400 to 4800 Volts** — **50-60 Hz** — **BIL—60 Kv**

RY TERMINALS—The primary ter-...inals on the *unfused* models consist of tapped holes in the center of a flat boss with lock washer and screw. On the *two-fuse* models, both terminals are bolts attached directly to the fuse supports and provided with lock washers and nuts. On the *one-fuse* design the line terminal is on the fuse support and the neutral terminal is a stud protruding from the back a short distance above the base plate. This stud is insulated from the base plate to permit primary insulation-resistance testing at voltages up to 2500 volts.

FUSES—Current-limiting fuses, Type EJ-1, are used.

SECONDARY TERMINALS—The secondary terminals are solderless clamp type. The terminal cover is made of transparent plastic. Provision is made for sealing the cover.

POLARITY—See Section 7907, item 6.2.

NAMEPLATE—See Section 7907, item 5.3.

BASE AND MOUNTING—The base is made of heavy steel plate and is provided with holes and slots adapting it for mounting by either bolts or pipe clamps.

DIMENSIONS

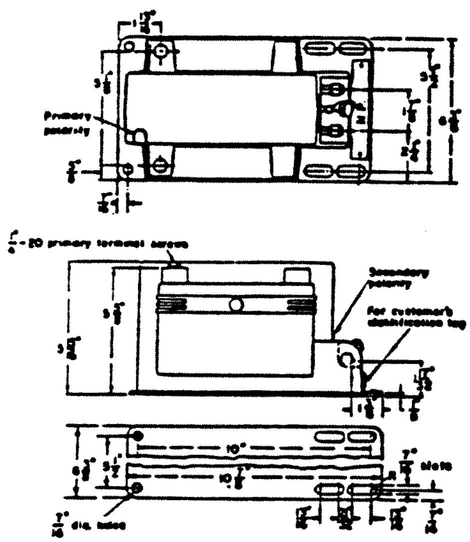


Fig. 4. Dimensions of JVM-3 (unfused)

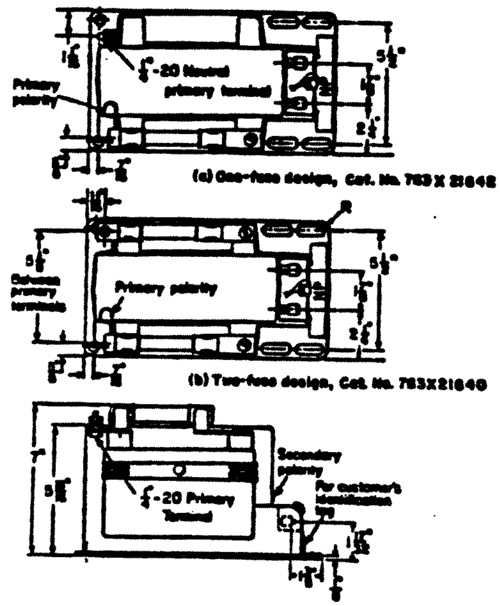


Fig. 5. Dimensions of JVM-3 Cat. No's. 763X21G42 and 763X21G40. (See Fig. 4 for base)

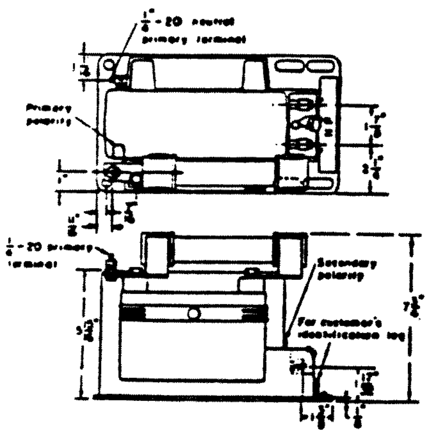


Fig. 6. Dimensions of JVM-3 (one-fuse design), Cat. No's. 643X85, 643X91, and 643X96. (See Fig. 4 for base)

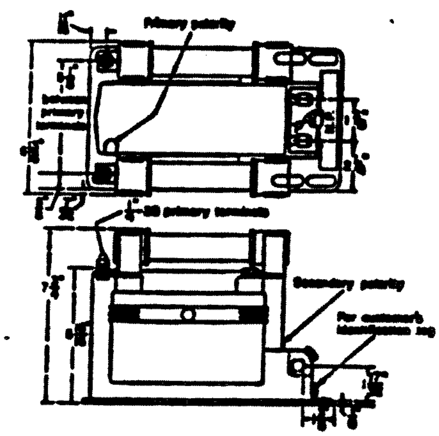


Fig. 7. Dimensions of JVM-3 (two-fuse design), Cat. No's. 643X92 and 643X97. (See Fig. 4 for base)

Calculation No. 8982-13-19-6
Revision 005
Attachment: D
Page D3 of D3

ATTACHMENT E

Telecon Between S. Hoats (ABB) and A. Runde (S&L)

AJR/chrono Ref-

Memorandum of Telephone Conversation SARGENT & LUND

	Date 1-23-92 Time 9:30 A
Person Called Steve Hoats	Company ABB (215) 395-7333
Person Calling A. J. Runde	Company S&L EAD (312) 269 6799
Project Dresden Unit 2	Project No. 8982-64

Subject Discussed

Repeatability of the ITE-27N Undervoltage Relay

Mr. Hoats provided the following information:

- The tolerances listed in IB 7.4.1.7-7 Issue D do not include an considerations for instrument drift. However, no drift error i. expected if the relay is calibrated at reasonable intervals.
- The absolute range of repeatability over temperature range is twice the published values. For example, the absolute range of repeatability over a temperature range of 0° to 55°C for a relay with a harmonic filter is 2 X 0.75% or 1.5% based on the published data.
- The published tolerances are generally twice the tested tolerances, so they are quite conservative.
- The information on the attached sheets from Cliff Downs of ABB concerning the linearity of the published tolerances over the identified ranges is applicable to both the 27D and the 27N relay.
- Al Wetter of CECo may have further information regarding the 27N relay tolerances by test methods.

NOTE: THIS CONSTITUTES OUR UNDERSTANDING OF THE DISCUSSIONS. IF WRITTEN COMMENTS ARE NOT RECEIVED WITHIN FIVE WORKING DAYS, THE ABOVE WILL BE ASSUMED CORRECT.

cc:
Steve Hoats - ABB

File

Andrew J Runde
A. J. Runde

AJR:lsc
C:\EAD\MS-TELE-AJR

Calculation No. 8982-13-19-6
Revision 005
Attachment: E
Page E2 of E2

ATTACHMENT F

Telecon Between C. Downs (ABB) and H. Ashrafi (S&L)

March 21, 1992

Memorandum of Telephone Conversation — SARGENT & LUNDY

Date 3/30/92 — Time 11:15 a.m.

Person Called	Cliff Downs	Company	FAX (215) 395-1055 ABB (215) 395-7333
Person Calling	H. Ashrafi	Company	S&L (312) 269-2041
Project	Quad Cities	Project No.	8913-73 - DVPM01

Subject Discussed: Effect of Temperature on the ITE-27N Relays with Harmonic Filter Units

Summary of Discussion, Decisions, and Commitments:

Based on earlier conversations, it was understood by S&L that the deviation in the relay set point of ITE 27N Relays (from the calibration point) is linear over an operating temperature range of 0-55°C. It was also understood that the actual pickup or dropout voltage is lower than the set point value if the operating temperature is lower than the temperature at which the relay was calibrated. Similarly, the actual pickup or dropout voltage is higher with higher than calibration temperature.

It was later noted from the type test report (Page 6 of RC-6004) that this trend is not true for ITE 27N Relays with Harmonic Filter Units. The actual pickup or dropout voltage decreased with increased operating temperature and vice versa.

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He suggested that, while it can be assumed that the deviation is linear over the operating temperature range of 0-55°C, the inverse relationship between pickup or dropout voltage and operative temperature should be considered in any calculation where ITE 27N Relays with Harmonic Filters are involved.

Note: THIS CONSTITUTES MY UNDERSTANDING OF OUR DISCUSSION. PLEASE CONTACT ME AT 312/269-2041 IF YOU HAVE ANY COMMENTS PERTAINING TO THE ACCURACY OF THE ABOVE SUMMARY.

cc: C. Downs-ABB
File: Relays

HA:kam
A:\Relays.HA

H. Ashrafi

TRANSMISSION REPORT

THIS DOCUMENT (REDUCED SAMPLE ABOVE) WAS SENT

** COUNT **
# 3

*** SEND ***

NO	REMOTE STATION I. D.	START TIME	DURATION	#PAGES	COMMENT
1	917085157181	4- 1-92 12:41PM	1'39"	3	
		TOTAL	0:01'39"	3	

XEROX TELECOPIER 7021

March 21, 1992

Memorandum of Telephone Conversation **SARGENT & LUNDY**

		Date 3/30/92	Time 11:15 a.m.
Person Called	Cliff Downs	Company	FAX (215) 395-1055 ABB (215) 395-7333
Person Calling	H. Ashrafi	Company	S&L (312) 269-2041
Project	Quad Cities	Project No.	8913-73 - DVPM01

Subject Discussed: Effect of Temperature on the ITE-27N Relays with Harmonic Filter Units

Summary of Discussion, Decisions, and Commitments:

Based on earlier conversations, it was understood by S&L that the deviation in the relay set point of ITE 27N Relays (from the calibration point) is linear over an operating temperature range of 0-55°C. It was also understood that the actual pickup or dropout voltage is lower than the set point value if the operating temperature is lower than the temperature at which the relay was calibrated. Similarly, the actual pickup or dropout voltage is higher with higher than calibration temperature.

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cc: C. Downs-ABB
File: Relays

HA:kam JBW
A:\Relays.HA

H. Ashrafi

Calculation No. 8982-13-19-6
Revision 005
Attachment: F
Page F3 of F6

ABB

ASEA BROWN BOVERI

From: STEVEN E. HOATS

ABB Power T&D Co.
Protective Relay Div.
7036 Snowdrift Rd.
Allentown, PA 18106
Telephone 215 395 7333
Telefax 215 395 1055

Date: 3 / 16 / 92 Total Pages: 2

To: Andy Runde

cc:

Reference: 27N Relay performance

Andy,

Please find in the attachment the TYPE TEST certificate for our 27N relay. These are the actual test results from our laboratory tests. as you can see the results of these tests are typically Doubled when published in our I.L.'s

I hope this document will Help satisfy your problems.

Best Regards

[signature]

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Temperature Tests:

Temperature	Pickup Voltage	Variation from Room Temperature	Dropout Voltage	Variation from Room Temperature
25°C	100.04v	---	99.95v	---
0	100.04	0.00 %	99.94	-0.01%
-20	100.04	0.00 %	99.94	-0.01%
40	100.11	+0.07 %	99.93	-0.02%
55	100.15	+0.11 %	99.96	+0.01%
70	100.21	+0.17 %	100.10	+0.15%

Temperature	Time Delay	Variation from Room Temperature
25°C	0.997 sec	-----
0	0.996	-0.1%
-20	0.993	-0.4%
+40	0.998	+0.1%
+55	1.007	+1.0%
+70	1.013	+1.6%

Results of Test: relay characteristics are stable with temperature and within published specifications.

Relay Tested: 211T6175

Date of Test: 10/15/82
Tester: W.C. Martin

Temperature Test with Harmonic Filter Option:

Temperature	Pickup Voltage	Variation from Room Temperature	Dropout Voltage	Variation from Room Temperature
22°C	100.12v	---	100.03v	---
-3	100.53	+0.41%	100.43	+0.40%
-20	100.90	+0.78%	100.81	+0.78%
+40	100.14	+0.02%	100.05	+0.02%
+55	99.88	-0.24%	99.79	-0.24%
+70	99.30	-0.82%	99.25	-0.78%

Results of Test: relay operation is stable with temperature and within published specifications.

Relay Tested: 211T0175-HF

Date of Test: 3/6/84
Tester: C.L. Downs

TO

March 21, 1992

Memorandum of Telephone Conversation **SARGENT & LUNDY**

		Date 3/30/92	Time 11:15 a.m.
Person Called	Cliff Downs	Company	FAX (215) 395-1055 ABB (215) 395-7333
Person Calling	H. Ashrafi	Company	S&L (312) 269-2041
Project	Quad Cities	Project No.	8913-73 - DVPM01

Subject Discussed: Effect of Temperature on the ITE-27N Relays with Harmonic Filter Units

Summary of Discussion, Decisions, and Commitments:

Based on earlier conversations, it was understood by S&L that the deviation in the relay set point of ITE 27N Relays (from the calibration point) is linear over an operating temperature range of 0-55°C. It was also understood that the actual pickup or dropout voltage is lower than the set point value if the operating temperature is lower than the temperature at which the relay was calibrated. Similarly, the actual pickup or dropout voltage is higher with higher than calibration temperature.

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cc: C. Downs-ABB
File: Relays

HA:kam JBW
\:\Relays.HA

OK
CD 4/2/91

H. Ashrafi

Calculation No. 8982-13-19-6
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Attachment: F
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ATTACHMENT G

Calculation MLEA 91-014

MAIN LINE ENGINEERING ASSOCIATES

January 23, 1992
Serial No. 92-024

Mr. Boris Pikelny
Commonwealth Edison Company
Nuclear Engineering Department
1400 Opus Place, Suite 300
Downers Grove, IL 60515

Subject: Transmittal of Environmental Qualification of Dresden Second Level Undervoltage System and Equipment for RWCU Line Break Environmental Conditions, Dresden Nuclear Power Station Units 2 and 3, MLEA Calculation MLEA-91-014, Revision 0, dated 1/23/92, System Code 6705

Dear Mr. Pikelny:

Attached is the subject document for use. Please contact us if you have any questions.

Prepared by:

Annette M. McHugh
Senior Project Engineer

Approved by:

C. J. Crane
Project Manager/Manager of Engineering

cc: (per DDL C020 and Steve Hunsader)
H. Massin (CECo/NED)(Letter Only)
N. Smith (CECo/NED)(Letter Only)
S. Hunsader (CECo/NED)(Letter Only)
D. Wheeler (CECo/Dresden)(Letter Only)
E. Eenigenburg (CECo/Dresden)(Letter Only)
R. Tyler (CECo/NED)(P.O. Box 767 34FNW)(Letter Only)
CHRON System
B. Wong (CECo/NED)(Letter Only)
F. Petrusich (CECo/Dresden)(Letter Only)
MLEA Project File M0071
MLEA Serial File (Letter Only)

967 East Swedesford Road • Exton, Pennsylvania 19341 • (215) 889-9525 • FAX (215) 889-9419

MAIN LINE ENGINEERING ASSOCIATES	Calculation Cover Sheet	Calculation No. MLEA 91-014 Page 1 of 20 Safety Related ■ Yes ☐ No
Client: Commonwealth Edison Company		Discipline: Environmental Qualification
Project Title: 4KV Second Level Undervoltage Protection Equipment		Project No. M0071

Calculation Title: Environmental Qualification of Dresden Second Level Undervoltage System and Equipment for RWCU Line Break Environmental Conditions

Status ☐ Preliminary ■ Final ☐ Void

Computer Program: NA Version NA Verified ☐ Yes ☐ No

Revision Record

Revision	Description	Signatures	Date
0	Original Issue	Prepared By [signature]	1/23/92
		Reviewed By C. J. Crane	1/23/92
		Approved By C. J. Crane	1/23/92
		Prepared By	
		Reviewed By	
		Approved By	
		Prepared By	
		Reviewed By	
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		Approved By	

MLEF-103/2
Rev 0

Calculation No. 8982-13-19-6
Revision 005
Attachment: G
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		Preparer [signature] Reviewer C/C

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		Preparer [signature] Reviewer [signature]

1.0 Purpose of the Evaluation

The Environmental Qualification (EQ) evaluation contained herein demonstrates qualification for the 4Kvac Second Level Undervoltage Circuitry and Equipment for Dresden Station 4Kvac Buses 23-1, 24-1, 33-1, and 34-1 for the harsh temperature and humidity environmental conditions resulting from RWCU line break.

Dresden Station EQ Binder EQ-44D, General Electric Switchgear Components, Model MC-4.76, Rev. 06 (Ref. 3.16) demonstrates environmental qualification in accordance with References 3.1 and 3.2 of the General Electric 4Kvac switchgear associated with Dresden Station buses 23-1, 24-1, 33-1, and 34-1 for a post LOCA radiation exposure of 3.08E+05 rads. Reference 3.17 established that the switchgear associated with Dresden Station buses 23-1 and 33-1 Located in Environmental Zone 26 (Reference 3.18) are environmentally qualified for the harsh temperature and humidity (212°F/100% RH) conditions resulting from a postulated break in the RWCU piping (Reference 3.5).

The second level undervoltage protection equipment for buses 23-1, 33-1, 24-1 and 34-1 are located in separate panels (2252-83, 2253-83, 2252-84, and 2253-84) in Environmental Zone 26 and are also subject to the harsh temperature and humidity (212°F/100% RH) environment resulting from the RWCU line break (Ref. 3.r). Reference 3.3 established that the second level undervoltage equipment for buses 23-1 and 33-1 must not fail in a manner which would prevent closure of the AC powered RWCU isolation valve in the first 40 seconds after RWCU line break. Reference 3.3 provided a Justification for Continued Operation and determined that failure of the second level undervoltage equipment is unlikely during the first 40 seconds of the RWCU line break accident when the break is isolated but that there is a possibility that the long term performance of the equipment could be adversely affected by the elevated temperature and humidity conditions resulting from RWCU line break (Reference 3.5).

Reference 3.7 provided a test plan for HELB simulation steam testing of the second level undervoltage circuitry and equipment. The acceptance criteria for the test was that the undervoltage relay equipment must not fail by changing state during the first minute of the steam exposure. Reference 3.8 contains the results of steam exposure testing which demonstrate that the second level undervoltage equipment does not fail for the one hour duration of the HELB exposure.

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	Preparer [signature] Reviewer [signature]

2.0 Statement of Qualification and Summary of the Evaluation

This calculation demonstrates the qualification of the Dresden second level undervoltage circuitry and components located in environmental zone 26 for the harsh temperature and humidity conditions (212°F/100% RH) caused by RWCU line break (Reference 3.5). The calculation identifies the specific components which are required to be qualified for the postulated HELB in the RWCU system (see section 6 of this calculation). The installed components are similar (Reference 3.7) to those tested for HELB conditions as described in Wyle Test Report 17199-1 (Reference 3.8). Qualification for radiation conditions is not required (See Section 9.0).

3.0 List of References

* 3.1 IEEE Standard 323-1974," Qualifying Class 1E Equipment for Nuclear Power Generating Stations".

* 3.2 10CFR50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants, January 1, 1987".

3.3 Main Line Engineering Associates Report M0064-11, Justification for Continued Operation Technical Evaluation and Environmental Qualification Deviation, Assessment for RWCU Line Break Scenario for ABB/ITE Type 27D Solid State Undervoltage Relay, Agastat ETR Time Delay Relays, and Agastat Control Relays Contained in the Circuitry for 4 KVac Bus 23-1, Dresden Nuclear Power Station Unit 2, Revision 1, 5-30-91.

* 3.4 S&L Letter No. 890003-0026E, dated 7/5/91; with Attachment: Engineering Change Notices (ECN) 12-00311E, Pages 1 through 7 and ECN 12-00312E, Pages 1 through 8, for Construction. (DIT-71-003)

3.5 Bechtel Letter Chron 13303, dated July 8, 1988, Subject: Equipment Qualification, Reactor Water Cleanup System Line Break Analysis. (DIT-71-016)

3.6 CECo Requisition No. D66469, dated 6/19/91 for 23 ABB ITE-27N Undervoltage Relays. (DIT-71-007)

3.7 Appendix VI to Wyle Nuclear Environmental Qualification Test Report No. 17199-1 dated September 25, 1991, HELB Simulation Test Program on Undervoltage Circuit Components: "MLEA Test Plan M0071-007-TP, Rev. 0 For Use, dated 9/12/91, Test Plan for HELB Simulation Testing of Second Level Undervoltage Circuitry and Equipment Including ABB Type 27D Solid State Undervoltage Relays, ABB Type 27N Solid State Undervoltage Relays, Agastat EGPD002 Control Relays, Agastat ETR14D3N002 Time Delay Relay, Agastat ETR14D3B003 Time Delay Relay, Westinghouse FT-1 Switch and Marathon 1600 Terminal Blocks." (This reference is contained in reference 3.8 below.)

3.8 Wyle Nuclear Environmental Qualification Test Report No. 17199-1 dated September 25, 1991, HELB Simulation Test Program on Undervoltage Circuit Components.

3.9 ABB Drawing No. 611996-003, Revision 003, dated 9/11/90, Schematic, Single Phase Undervoltage Relay, Type 27N (w/Harmonic Filter Mods). (DIT-71-032)

3.10 ABB Drawing No. 611798-001, Revision 0, dated 3/27/86, Harmonic Filter Schematic. (DIT-71-032)

3.11 ASEA Brown Boveri Report RC-5005B with RC-5105-B, dated 11/12/88, Class 1E Electrical Equipment Qualification of 27D/H Undervoltage Relays with Appendix "A", Component Aging Evaluations and Appendix "B", Seismic

Summary Report for Mechanically Equivalent Device Model 47D. (DIT-71-032)

3.12 ASEA Brown Boveri Report RC-5039-A with RC-5139-A, dated 1/10/90, Class IE Electrical Equipment Qualification, 27N undervoltage Relay with Appendix "A", Component Aging Evaluations and Appendix "B", Seismic Summary Report. (DIT-71-032)

*3.13 Agastat Nuclear Environmental Qualification Test Report on Agastat EGP, EML, and ETR Control Relays by Control Products Division Amerace Corporation, Test Report ES-2000, Rev. A dated 7/11/80. (Contained in CECo EQ files, Pages 1, 2, 3, and 7 are attached.) (DIT 71-045)

3.14 Memorandum from C. Collins (CECo/Dresden) to C. Crane (MLEA) dated September 11, 1991, Subject: Replacement of 2nd Level Undervoltage Relays Dresden Unit 2. (DIT-71-034)

3.15 Telecopy from C. Collins (CECo/Dresden) to J. Murphy (MLEA) containing CECo Requisition No. D66469B, dated 10/1/91, Subject: Increase Description of Relay to Better Specify the Green Light Emitting Diode & Dust Proof Bezel & Correction in Part Number. (DIT-71-033)

*3.16 Dresden Station EQ Binder EQ-44D, General Electric Switchgear Components, Model MC-4.76, Rev. 06 dated 11/14/89.

*3.17 MLEA Calculation No. 88011-03, Rev. 1, dated 2/9/90, Environmental Qualification of GE Switchgear, MC-4.76, bus 23-1 (33-1), Dresden Station RWCU Line Break.

*3.18 Bechtel Specification N102, Rev. 3, dated 10/21/88, Response to IE Bulletin 79-01B, Procedure for Use of Environmental Zone Maps for Dresden Nuclear Power Station Units 2 and 3, Commonwealth Edison Company. (DIT-64-007)

3.19 Westinghouse Descriptive Bulletin 41-075C, dated December, 1977, Flexitest Switch Type FT-1.

3.20 Telecopy from Bill Denny (SE Technologies, Inc.) to Joe Murphy (MLEA) dated October 28, 1991, Subject: Thermal Aging Data for Polycarbonate. (DIT-71-035)

*3.21 Main Line Engineering Associates Report M0064-8, Justification for Continued Operation Technical Evaluation and Environmental Qualification Deviation, Assessment for RWCU LOCA Scenario for ABB/ITE Type 27D Solid State Undervoltage Relay, Agastat ETR Time Delay Relays, and Agastat Control Relays Contained in the Circuitry for 4 KVac Bus 23-1, Dresden Nuclear Power Station Unit 2, Revision 2, 5-20-91.

* - Indicates that the referenced document is not attached and controlled within this calculation.

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		Preparer Jan Reviewer C/C

4.0 Qualification Criteria

Criteria used to demonstrate qualification is in accordance with the following (indicate documents which are applicable):

_X_ USNRC DOR-Guidelines, "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors", November 1979.

___ USNRC NUREG-0588, Revision 1, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment", July 1981
Category I ___ Category II ___

___ 10CFR50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants", February 22, 1983.

_X_ USNRC Regulatory Guide 1.89 Revision 1, "Environmental Qualification of Certain Equipment Important to Safety for Nuclear Power Plants", June 1984, Paragraph C.6.e.

_X_ IEEE 323-1974, "IEEE Standard for Qualifying Class 1E Electrical Equipment for Nuclear Power Generating Stations".

___ Other, Specify:

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		Revision: 0
		Preparer Jgn Reviewer c/c

5.0 **Method of Qualification and Test Sequence**

(1) Methodology (Check only one block)

__ Test of Identical Item Under Identical Conditions or Under Similar Conditions with Supporting Analysis

X Test of Similar Items with Supporting Analysis

__ Analysis in Combination with Partial Type Test Data that Supports the Analytical Assumptions and Conclusions

__ Experience with Identical or Similar Equipment Under Similar Conditions with Supporting Analysis

Wyle Laboratories report 17199-1 (Reference 3.8) demonstrates that the circuitry and equipment similar to that used in the Dresden 4Kvac second level undervoltage equipment located in environmental zone 28 was exposed to a steam environment which envelops the harsh temperature and humidity (212°F/100% RH) described in Reference 3.5 and meets the acceptance criteria (i.e. the equipment does not change state as a result of the steam exposure in the first minute of the HELB environment).

(2) Test Sequence: (Reference 3.8 Section 10.0)

- Equipment was inspected for damage and conformity to test plan description by Wyle Labs. (Ref 3.8, 10.1)

- Time delays for Agastat Time delay relay ETR14D3B003 was set at 4.98 seconds and for ETR14D3N002 was set at 5 minutes, 7 seconds. (Ref. 3.8, 10.2)

- Base line functional testing (Ref. 3.8, 10.3):

  (a) With the DC control voltage at 125 Vdc, the 120 Vac voltage was reduced to 107 Vac to verify that the ABB undervoltage relays would change states approximately 7 seconds after the AC input voltage reached 108.1 Vac. In addition, it was also verified that the Agastat ETR14D3N002 relay changed state approximately 5 minutes after the ABB undervoltage relays changed state.

  (b) The on-off switch of the Agastat ETR14D3B003 relay was closed to verify that it would change state after approximately 5 seconds.

  (c) The AC input voltage was increased to 120 Vac to verify that all specimens would return to their initial condition at normal voltage.

  (d) Proper operation of all wired specimen contacts was also verified.

- HELB Test (Ref. 3.8, 10.4.2): Initial ramp to 212°F followed by a gradual reduction to approximately 142°F at one hour after start of the test. The specimens were monitored for any unintended change of state during the HELB test.

- Post HELB Functional Test (Ref. 8, 10.5): The functional tests described in Reference 3.8, paragraph 10.3 were repeated.
- Post Test Inspection (Ref. 3.8, 10.6): The specimens were visually inspected, and the condition of the specimens was recorded.

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		Preparer [signature] Reviewer [initials]

6.0 Equipment Description and Similarity to Tested Equipment

The following table lists the equipment installed in Dresden Station as identified in Reference 3.7 and the Equipment tested as identified in References 3.4, 3.7, 3.8, and 3.15.

Installed Equipment	Tested Equipment
ABB Type 27D Relay Cat. 211R4175	ABB Type 27D Relay Cat. 411R4175
ABB Type 27N Relay Cat. 411T4375-L-HF-DP	ABB Type 27N Relay Cat. 411T4375-HF-DP
Westinghouse FT-1 Switch Style 129A501G01	Westinghouse FT-1 Switch Style 129A501G01
Agastat Time Delay Relay ETR14D3N002	Agastat Time Delay Relay ETR14D3N002
Agastat Time Delay Relay ETR14D3B002	Agastat Time Delay Relay ETR14D3B003
Agastat Control Relays (2) EGPD002	Agastat Control Relays (2) EGPD002
Marathon 1600 Series Terminal Blocks	Marathon 1600 Series Terminal Blocks
Hoffman Junction Box Cat. A302420LP	Hoffman Junction Box Cat. A302420LP
Junction Box Back Panel Cat. A30P24	Junction Box Back Panel Cat. A30P24
Agastat Relay Socket Base ECR0095001	Agastat Relay Socket Base ECR0095001
Agastat Locking Strap ECR0155001	Agastat Locking Strap ECR0155001
Amer-tite 3" Flex Conduit	Anaconda Sealtite 3" Flex Conduit
Top Entry 3" conduit Fitting	Top Entry 3" O-Z/Gedney conduit Fitting
GE Vulkene 14 AWG SIS Wire	Rockbestos 14 AWG SIS Wire
Rockbestos 14 AWG Firewall Wire	Rockbestos 14 AWG SIS Wire

Reference 3.7 establishes that the equipment and circuitry listed above and tested in Reference 3.8 are similar to the equipment and circuitry installed in the Dresden Station Second Level Undervoltage circuits.

Reference 3.15 transmitted a revised CECo purchase requisition for the ABB type 27N solid state undervoltage relays for installation at Dresden Station (Reference 3.4). Reference 3.15, required the installation of the DP Bezel (as in the tested ABB Type 27N undervoltage relay) and also required a green light emitting diode to be added to indicate the presence of DC control power ("L" option) in addition to the red light emitting diode normally installed for indication that the relay has changed state.

The ABB type 27N test specimen did not have the green light emitting diode for indication of DC control power. The test specimen was based on the original CECo purchase requisition, Reference 3.6. However, it was not known that the "L" designator was required to be specified to ABB.

Reference 3.9 shows the green light emitting diode as "L" option, installed in series with a 15 kohm resistor across the positive and negative sides of the DC control power portion of the relay circuit. The green light emitting diode is installed in the same manner as the normally installed red light emitting diode, which is installed in series with a 15 kohm resistor as shown on Reference 3.9.

The normally installed red light emitting diode performed satisfactorily during the HELB exposure testing described in Reference 3.8. Since the green light emitting diode added to the ABB type 27N relays for Dresden Station by Reference 3.15 is installed in the same manner (and is the same device) as the normally installed red light emitting diode (viz., in series with a 15 kohm resistor) and the normally installed red light emitting diode performed satisfactorily under HELB conditions, the green light emitting diode added to the type ABB 27N solid state undervoltage relays by Reference 3.15 is qualified by similarity for HELB exposure.

Therefore, the testing of similar equipment to the Dresden 4KVac Second Level Undervoltage Protection circuitry and equipment establishes that the installed equipment and circuitry are environmentally qualified by Reference 3.8 for the harsh temperature and humidity conditions (212°F/100% RH) resulting from RWCU line break.

7.0 Safety Function and Required Operating Time

During normal plant operation, the function of the second level undervoltage circuitry and equipment is to provide protection against a degraded voltage condition on the safety related 4 KVac buses. A degraded voltage condition will cause induction motors to draw more current and may result in overheating of the motor windings. The second level undervoltage relays are set between 3708 Vac and 3784 Vac. If a degraded condition persists for 7 seconds, an annunciator alerts the operator and a 5 minute time delay is initiated. If the bus voltage is not restored to normal operating voltage within 5 minutes, the diesel generator is started, the incoming breakers are tripped, load shedding is initiated, and the diesel generator breakers close when all permissives are satisfied Ref. 3.3).

In the event of RWCU line break, 4 KVac buses 23-1(33-1) must provide AC power to 480 Vac motor control centers MCC 18-1A(28-1A) for at least 40 seconds after the line break in order to close the AC RWCU isolation valves MO-2(3)-1201-1 and isolate the RWCU line break (Ref. 3.3).

The need to maintain the second level undervoltage protection, coincident with a RWCU line break scenario, is not considered to be necessary and the scenario is not considered to be a credible event ((Ref. 3.7).

Therefore, the second level undervoltage protection circuit must not change state during the first 40 seconds of exposure to the harsh temperature and humidity environment (212°F/100% RH) caused by RWCU line break (Ref. 3.3).

8.0 Qualified Life

8.1 ABB Type 27D and Type 27N solid state undervoltage relays:

In References 3.11 and 3.12, ABB provides analyses of the components used in the Type 27D and 27N solid state undervoltage relays. The method used is a combination of Arrhenius evaluations of insulation materials used in the relays and MIL-HDBK-217 evaluations of the effects of electrical and thermal stresses on the electronic components used in the relays. References 3.11 and 3.12 conclude that the qualified life of the Type 27D and Type 27N solid state undervoltage relays is in excess of 40 years at an average ambient air temperature of 45°C, an internal air temperature of 60°C, and a control voltage of 131 Vdc.

8.2 Agastat ETR Time Delay Relays and EGP Control Relays:

Reference 3.13 identifies the qualified life of the Agastat ETR and EGP relays as 10 years from the date of manufacture or 25,000 operations, whichever comes first.

8.3 Marathon 1600 Series Terminal Blocks:

Dresden EQ Binder EQ48D, Revision 8, establishes a 40 year qualified life of the Marathon 1600 series terminal blocks used in Dresden Station both inside and outside containment. (This binder is located in the CECo Dresden EQ files.)

8.4 Westinghouse FT-1 Switch:

Reference 3.19 identifies the material of construction of the case and cover of the Westinghouse FT-1 switch as polycarbonate. Reference 3.20 lists the life of a typical polycarbonate material as 31,290 years at a temperature of 105°F.

Therefore, it is concluded that, with the exception of the Agastat ETR and EGP relays, the second level undervoltage equipment installed in Dresden Station for the Safety-Related 4 KVac buses is qualified for 40 years at 104°F (the maximum ambient temperature in Zone 28 as identified in Ref. 3.18). The qualified life of the Agastat ETR and EGP relays is 10 years from the date of manufacture or 25,000 operations whichever comes first. The SIS wire used by CECo throughout the plant is environmentally qualified for 40 year lifetime and the information is contained in the CECo Dresden EQ files.

9.0 Qualification for Radiation

The second level undervoltage circuitry and equipment for Dresden Station 4 KVac buses 24-1, 33-1, and 34-1 are located in a mild radiation environment in the event of LOCA. Dresden Station 4 KVac bus 23-1 is subject to a harsh radiation environment in the event of LOCA. Reference 3.21 established that the Agastat ETR time delay relays and EGP control relays, the Marathon 1600 series terminal blocks and the Westinghouse FT-1 switch are qualified for the radiation environment to which they would be subjected in the event of LOCA. Reference 3.21 also established that the ABB Type 27D solid state undervoltage relays are operable in the radiation environment caused by LOCA although the time delay is increased from 7 seconds to approximately 20 seconds.

Reference 3.14 states that the ABB Type 27D relays associated with 4 KVac bus 23-1 will be replaced with ABB Type 27N relays (Reference 3.4) and that the panel containing the second level undervoltage equipment for 4 KVac bus 23-1 will be moved to a location which is mild for radiation in the event of LOCA.

10.0 Qualification for High Temperature Steam Environments

10.1 Plant Accident Profile:

Reference 3.5, Figures 2 and 3, provide the temperature in the mezzanine area of the Dresden Station Reactor Building (environmental zone 26) as a function of time after RWCU line break. The temperature rises to 212°F at approximately 40 seconds after the break (at which time the break is isolated). The temperature then falls off to approximately 140°F at one hour after the RWCU line break occurs. Figures 2 and 3 of Reference 3.5 are reproduced on pages 17 and 18 of this calculation.

Figures 2 and 3 of Reference 3.5 are based on a double ended, guillotine break in the 6 inch RWCU piping in the RWCU heat exchanger room (Reference 3.3).

10.2 Equipment Performance Characteristics:

Reference 3.7, Section 8, and Reference 3.3, Section 8.2, note that the second level undervoltage protection circuitry and equipment are not required to function to mitigate the RWCU line break, but must not fail (viz., change state) during the first minute after RWCU line break in any manner which would prevent closure of the AC RWCU isolation valve (MO-2(3)-1201-1).

10.3 Effects of Humidity:

Reference 3.5 does not specifically identify the relative humidity in the mezzanine area of the reactor building. Therefore, for conservatism, a relative humidity of 100% has been assumed in this calculation.

The ABB Type 27D and Type 27N solid state undervoltage relays and the Agastat ETR relays in the second level undervoltage protection circuitry are electronic devices. Reference 3.3 indicates that moisture intrusion and condensation on the electronics might adversely affect the performance of the equipment. Reference 3.3. concluded that it is unlikely that the electronics would be exposed to moisture during the first forty seconds after RWCU line break.

Reference 3.8 is the report of steam testing (100% RH) of the second level undervoltage protection equipment. The report demonstrates that the equipment is not adversely affected (i.e., does not change state) when exposed to a steam environment for one hour.

10.4 Accident Simulation Testing and Results:

Reference 3.8 describes HELB simulation (steam exposure) testing of the Dresden Second Level Undervoltage relay equipment and circuitry. The test profile shown on pages 41 through 45 of Reference 3.8 envelopes the accident temperature profile shown on Figures 2 and 3 of Reference 3.5. The test was conducted using steam which ensured that the relative humidity was at 100% throughout the test. Page 45 of Reference 3.8 shows that the internal temperature of the junction box which contained the second level undervoltage equipment substantially lags the temperature of the steam environment.

Reference 3.8, pages 46 through 53, demonstrates that the undervoltage equipment did not change state throughout the HELB simulation testing. In addition, post HELB test functional testing (Reference 3.8, page 9) demonstrated that the undervoltage equipment performed within design specification requirements (Reference 3.7, Section 6.0).

10.5 Margin:

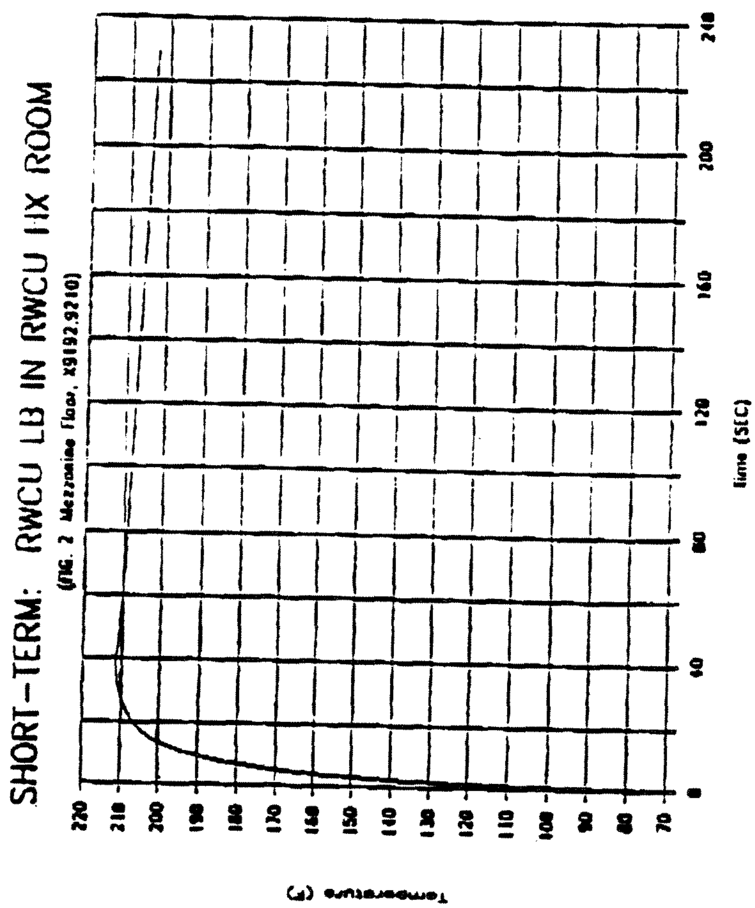
Although Reference 3.8 demonstrates a temperature margin of 4°F to 15°F during the HELB simulation testing, the qualification margin for the Dresden 4KVac Second Level Undervoltage Protection Circuitry and Equipment is a **Time** margin.

The Dresden 4KVac Second Level Undervoltage Protection Circuitry and Equipment must not change state during the first 40 seconds after RWCU line break (Reference 3.3) in order to assure closure of the AC RWCU system isolation valve (MO-2(3)-1201-1). The HELB simulation testing described in Reference 3.8 established that the Dresden 4KVac Second Level Undervoltage Protection Circuitry and Equipment did not change state for one hour after RWCU line break. This time margin meets the recommended time margin of Regulatory Guide 1.89 (1 hour plus operating time).

Calculation Sheet	Calculation No. MLEA-91-014
MAIN LINE ENGINEERING ASSOCIATES	Page 17 of 20
	Revision: 0
	Preparer ___ Reviewer ___

Bechtel Eastern Power Company

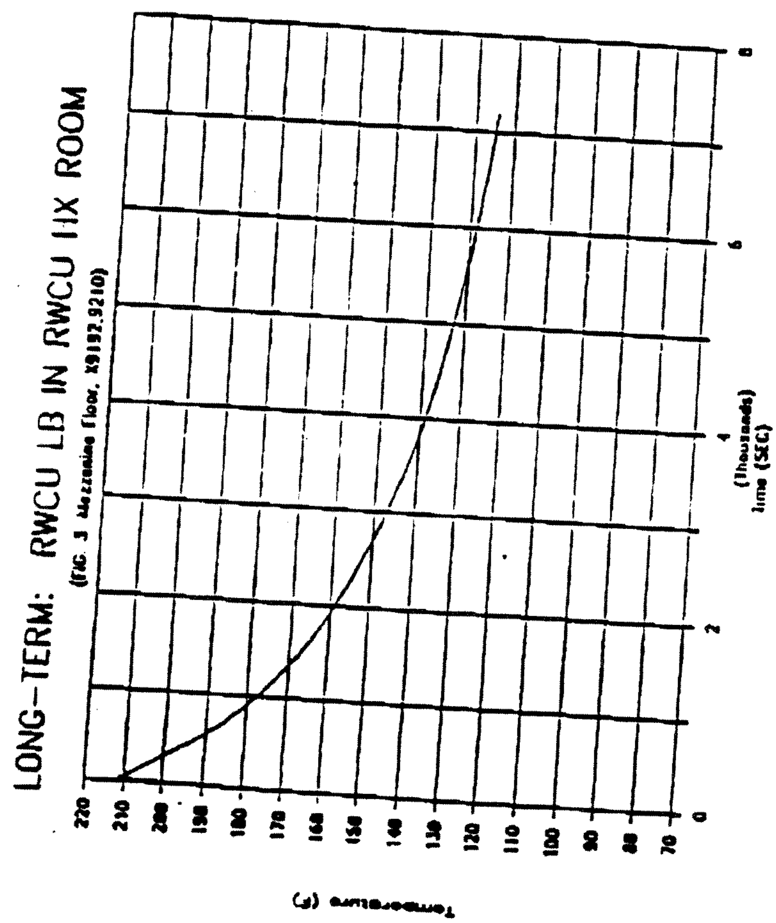
Figure 2



MAIN LINE ENGINEERING ASSOCIATES	Calculation Sheet	Calculation No. MLEA-91-014
		Page 18 of 20
		Revision: 0
		Preparer JSM Reviewer CJC

Bechtel Eastern Power Company

Figure 3



11.0 **Synergistic Effects**

Synergistic effects are associated with interactions of temperature (Aging) and radiation dose rates. The second level undervoltage circuitry and equipment installed in Dresden Station are located in mild radiation environments and therefore would not exhibit synergistic effects due to ambient temperature and radiation dose rate.

References 3.11 and 3.12 address synergistic effects for the ABB Type 27D and Type 27N solid state undervoltage relays and state that no synergistic effects have been identified for the equipment.

Extensive testing of Agastat ETR and EGP relays described in Reference 3.13 indicate that there are no synergistic effects associated with these relays.

Dresden EQ Binder EQ-48D establishes that there are no synergistic effects for Marathon 1500/1600 Series terminal blocks.

A review of available literature on polycarbonate materials established that there are no identified synergistic effects caused by gamma dose/dose rate and temperature. (Some clear formulations of polycarbonate have shown sensitivity to ultraviolet light and temperature but the Westinghouse FT-1 switch is not constructed of clear polycarbonate and therefore not subject to synergistic effects due to ultraviolet light.)

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		Preparer [signature] Reviewer [signature]

12.0 **Maintenance and Surveillance**

12.1 **ABB Type 27D and Type 27N Solid State Undervoltage Relays:**

In References 3.11 and 3.12, ABB recommends that the testing identified in the ABB instruction manuals for the equipment, which are contained in Appendix B to Reference 3.7, be conducted at two year intervals.

12.2 **Agastat ETR Time Delay Relays and EGPD Control Relays:**

The performance of the Agastat ETR Time Delay Relays and Agastat EGPD Control Relays can be monitored during performance of the ABB Solid State Undervoltage Relays every two years. In Reference 3.13, Amerace Corp. states that the Agastat ETR and EGPD relays must be replaced ten (10) years after the date of manufacture or after 25,000 operations, whichever comes first.

12.3 **Marathon 1600 Series Terminal Blocks:**

Dresden Station EQ Binder, EQ-48D, Tab E, contains the maintenance and surveillance requirements for Marathon 1600 series terminal blocks. No other maintenance or surveillance is required for the Marathon 1600 Series terminal blocks installed in the junction boxes for the second level undervoltage equipment.

12.4 **Westinghouse FT-1 Switch:**

In Reference 3.19, Westinghouse does not provide any requirements for maintenance or surveillance of the FT-1 switch. However, Reference 3.3 established that the FT-1 switch is essentially a terminal block. Therefore, the maintenance and surveillance recommended in Tab E of Dresden EQ Binder EQ-48D for Marathon terminal blocks should be applied to the Westinghouse FT-1 switch.

ATTACHMENT H

DIT DR-EPED-0671-01

REF. P

SARGENT & LUNDY ENGINEERS

DESIGN INFORMATION TRANSMITTAL

☒ SAFETY-RELATED ☐ NON-SAFETY-RELATED

DIT No. - DR-EPED-0671-01

Page 1 of 2

To W. G. BLOETHE

CLIENT CECO

STATION DRESDEN UNIT(S) 2 & 3

PROJECT NO(S). 8982-13

SUBJECT REACTOR BUILDING VENTILATION, MINIMUM TEMPERATURE.

MODIFICATION OR DESIGN CHANGE NUMBER(S)

S. K. SAHA	EPED	S. K. Saha	05-08-'92
Preparer (Please print name)	Division	Preparer's signature	Issue date

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.)

THE DESIGN INFORMATION IS APPROVED FOR USE.

SARGENT & LUNDY
EAD
MAY 12 1992
RECEIVED

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 IS SUPPLEMENT TO DIT # DR-EPED-0671-00

THIS DIT PROVIDE THE MINIMUM REACTOR BUILDING AND THE TURBINE BUILDING ENVIOURNMENTAL TEMPERATURE ACCORDING TO THE DRESDEN UFSAR. (SECTION 10.11.2-1)
PAGE 2 OF THIS DIT IS THE PAGE FROM UFSAR.
PREVIOUS DIT (# DR-EPED-0671-00) DID NOT PROVIDE THE MINIMUM TEMPERATURE.

SOURCE OF INFORMATION

Calc. no. — Rev. and/or date — Report no. — Rev. and/or date —

Other UFSAR (DRESDEN)

DISTRIBUTION

E. SCHUMACHER / R.M. SCHIAVONI / FILE -1077 - 21 ORIGINAL FILE - 15D
R. H. JASON - 21
K. YIP - 21

Form QQ-3.17.1 Rev.2 (01-08-87)

F613A (1/2)
01-87- F3

Calculation No. 8982-13-19-6
Revision 005
Attachment: H
Page H2 of H3

DRESDEN UFSAR.

10.11.2 DESCRIPTION

The plant heating, ventilating and air conditioning system consists of the elements required to effect and control the following space air processes: supply and exhaust; distribution and recirculation; velocity; differential and static pressure control; filtration of particulate contaminates; cooling and heating; complete air conditioning; and area isolation.

Elements necessary to perform and control the space air requirements are filters, dampers, cooling and heating coils, electric duct heaters, air washers, refrigerating equipment, fans, and the necessary control and support equipment.

The overall system is related, but divided into subsystems which are designed to control the air requirements in a particular area (see Figures 10.11.2:1 thru 10.11.2:5). They are as follows:

1. Reactor Building Ventilation; Min 65°F, Max 103°F

2. Turbine Building Ventilation; Min 65°F, Max 120°F

3. Radwaste Building:

   Occupied areas; Min 50°F, Max 103°F

   Cells and Collector Tank Room; Min 50°F, Max 120°F

   Concentrator & Concentrator Waste Tank Cells; Min 50°F, Max 150°F

4. Main Control Room; Min 70°F, Max 80°F

5. Drywell Ventilation:

   Normal; 135°F Average

   8 hrs after Shutdown; 105°F Average

DIT No: DR-EPED-0671-01
PROJECT No. 8982-13
PAGE 2 OF 2

ATTACHMENT I

S&L Interoffice Memorandum from B. Desai

DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

Assumption - 9. 15

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 used near 110 V.

Reference Calculations

8982-13-19-6, Revision 2
8982-17-19-2, Revision 1

Verification Description

The attached relay setting order for Dresden Station Unit 2, Buses 23-1, 24-1, and Unit 3, Buses 33-1 and 34-1 from CECo System Planning already addresses tolerance of ±0.2 V and setpoints are near 110 V. Therefore, this assumption does not require further verification.

Follow Up Action

Incorporate assumption verification in the calculation.

RELAY SETTING ORDER

C.E.CO. 86-4606

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 12-Dresden Bus 23-1 KV 4.16 RELAY TYPE ITE 27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* Second Level Under-Voltage

	Present		Future	
ZONE OR EL. (CHARAC)	UV		UV	For information only
P.T. (P.D.) RATIO	35:1		35:1	
C.T. TURN RATIOS	NA		NA	
RANGE (RATING)	70-120V		70-120V	
PRIMARY SETTING	3820		3835	
SEC. SET'G (OP. VALUE)	109.15 +/- .2V		109.57 +/- .2V	
COMPUTED TAPS	110 Volts		110 Volts	
TEST A-V CUR. LAG DEG	Reset Tap @ 99%		Reset Tap @ 99%	
TIMING	7 secs (Use 5 Tap)		7 secs (Use 5 Tap)	

Reset V. may not exceed 110.12 volts

OAD record Reset V: A-B: 109.58V B-C: 109.60V

Supersedes RSO issued 1-27-92 ISSUE DATE 6-2-92 BY MC COMPLETED SB BY 6/4/92

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

8982-13-19-6 Rev. 2

RELAY SETTING ORDER

C.E.CO. 86-4606 FOR INFORMATION ONLY

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 12-Dresden Bus 24-1 KV 4.16 RELAY TYPE ITE 27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* Second Level Under-Voltage

	Present		Future	
ZONE OR EL. (CHARAC)	UV		UV	
P.T. (P.D.) RATIO	35:1		35:1	
C.T. TURN RATIOS	NA		NA	
RANGE (RATING)	70-120V		70-120V	
PRIMARY SETTING	3784		3820	
SEC. SET'G (OP. VALUE)	108.1		109.15 +/- .2 volts	
COMPUTED TAPS	110 Volts		110 Volts	
TEST A-V CUR LAG DEG	Reset Tap @ 99%		Reset Tap @ 99%	
TIMING	7 secs (Use 5 Tap)		7 secs (Use 5 Tap)	

Reset V. may not exceed 109.7 volts

OAD Record Reset V: AB relay = 109.22 BC relay = 109.19

ISSUE DATE 1-27-92 BY MC COMPLETED 1/20/92 BY WJM

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

Does not ... 2 but ... 23-1

Calculation No. 8982-13-19-6 7/15-2
Revision 005
Attachment: I
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RELAY SETTING ORDER FOR INFORMATION ONLY

C.E.CO. 88-4804 5-83

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ______ DIV. ENG.

STATION 12 - DRESDEN BUS 33-1 KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* SECOND LEVEL UNDER-VOLTAGE

	RESET		PICKUP		
ZONE OR EL.(CHARAC)	UV		UV	FOR INFORMATION ONLY	
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	NA		NA		
RANGE (RATING)	70-120V		70-120V		
PRIMARY SETTING	3870		3884		
SEC. SET'G (OP. VALUE)	110.6V +/- .2V		110.97 +/- .2V		
COMPUTED TAPS	110 VOLTS		110 VOLTS		
TEST A-V CUR. LAG DEG	RESET TAP @ 99%		RESET TAP @ 99%		
TIMING	7 SECS (USE 5 TAP)		7 SECS (USE 5 TAP)		

RESET V MAY NOT EXCEED 111.53 VOLTS

OAD RECORD RESET V: AB = 110.96V BC - 110.99V

SUPERSEDES RSO ISSUED 2-11-92 ISSUE DATE 6-2-92 BY JC COMPLETED GB BY 6/9/92

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

* MATCHES [illegible] 8982 17-19-6 Rev. 1

RELAY SETTING ORDER FOR INFORMATION ONLY

C.E.CO. 88-4804 5-83

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ______ DIV. ENG.

STATION 12 DRESDEN KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* BUS 34-1 SECOND LEVEL UNDERVOLTAGE

ZONE OR EL.(CHARAC)	OLD UV	NEW UV	FOR INFORMATION ONLY		
P.T. (P.D.) RATIO	35/1	35/1			
C.T. TURN RATIOS					
RANGE (RATING)	70-120V	70-120V			
PRIMARY SETTING	3784V	3870V			
SEC. SET'G (OP. VALUE)	108.1V	110.6V (± .2V)		SET R TAP = 99%	
COMPUTED TAPS	110V	110V	110.6V ≤ VRESET ≤ 111.1V		
TEST A-V CUR. LAG DEG	120V→0V	120V→0V			
TIMING	7 SEC (5 TAP)	7 SECS (5 TAP)		Actual Reset = 110.61	

OAD TO RECORD RESET VOLTAGE. SETTINGS BASED ON NED RECOMMENDATION LETTER OF 2/10/92 TUCKER TO HORWATH

CHRON# 180284 ISSUE DATE 2/11/92 BY CRS COMPLETED 2/13/92 BY [illegible]

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

Does not match [illegible] Rev. 1 of calc [illegible]
but matches [illegible] Rev. 0 of calc [illegible]

DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

Assumptions 10 & 16

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

Reference Calculations

(1) 8982-13-19-6, Revision 2

(2) 8982-17-19-2, Revision 1

Verification Description

To verify above assumption calculation 9198-42-19-1 was prepared.

The calculation demonstrates that there are sufficient terminal voltages at the second-level UV relays during the first seven seconds of a LOCA (no LOOP) combined with a degraded voltage condition. The calculation also shows that these relays will not be exposed to terminal voltages exceeding their maximum limit during battery equalization.

Follow-Up Action

Incorporate assumption verification in the calculation

wp: G:\ELEC\DQC\QDC3545.EP

I. The battery chargers are rated at 200A (Reference 16) and are set to curren limit at 100% of the charger rating (Reference 15).

J. The characteristics of the NCX-21 battery cells for the 125-Vdc battery (Reference 5) are the same as those of the NCX-1500 battery cells of the 250-Vdc batteries (References 6 and 21).

IV. **ASSUMPTIONS**

Assumptions not Requiring Verification

A. Fuse resistances are not included in this calculation. The fuses which are upstream of the control circuits where the second-level UV relays are installed, are all 35 A (Reference 10). The resistances of the 35 A fuses are negligible when compared to the resistances of the cables. (ENGINEERING JUDGMENT)

B. Contact resistance for switches, breakers, and relays are assumed negligible. This is based on Dresden Station Design Information Transmitta DR-EPED-0503-00 (Reference 11) which shows that contact resistances vary from 0.0028 to 0.0002 OHMS. (ENGINEERING JUDGMENT)

C. The battery is fully charged at the time of LOCA initiation. The battery voltages are checked daily by personnel from the station operations department (Reference 12).

D. No LOOP condition exists.

E. The new main feed to Panel 903-34 on Bus 3A-2 (Reference 22) has been installed. (ENGINEERING JUDGMENT - This loading is conservative relative to premodification loading on the same bus).

V. **ACCEPTANCE CRITERIA**

The input voltage at the terminals of the second level UV relays must not be below the established minimum value of 95 Vdc or above the maximum value of 140 Vdc as determined by vendor information (References 7 and 19). However, the relay will also tolerate a one second dip in minimum (Reference 19) terminal voltage to 89 Vdc.

Table 1 shows that during the worst interval (Switchgear 24-1, from -6.917 to -6 seconds), the battery is still able to supply the minimum voltage to the UV relay, and would discharge from a fully charged state in about 15 minutes if this load were kept constant. Since the time delay for the UV relays is only seven seconds long, it is evident from the table that all UV relays will have the minimum necessary control voltage to operate during this time period.

The tables in Attachments A and B show the loading during a dual unit LOCA with no LOOP. However, the design basis for the station is a single unit LOCA only. Therefore, the results shown in Table 1 are conservative.

- The maximum battery equalization voltage is 135V when the battery is connected to the bus. Therefore, the maximum voltage of 140V at the terminals of the undervoltage relays will not be exceeded.

VIII. COMPARISON OF RESULTS WITH ACCEPTANCE CRITERIA

From the analysis of Section VII, the terminal voltages of all second level UV relays will be within their minimum and maximum established limits under the postulated conditions.

IX. CONCLUSIONS

The calculation demonstrates that there are sufficient terminal voltages at the second-level UV relays during the first seven seconds of a LOCA (no LOOP) combine with a degraded voltage condition. The calculation also shows that these relays will not be exposed to terminal voltages exceeding their maximum limit during battery equalization.

X. RECOMMENDATIONS

Not Applicable.

XI. REFERENCES

1. Sargent & Lundy Standard ESA-102, Revision 04-14-93
2. Sargent & Lundy Standard ESI-253, Revision 12-06-91
3. Sargent & Lundy Standard ESC-291, Revision 05-23-91
4. Design Information Transmittal DR-EDD-0086-00, dated 08-02-93 (attached)
5. Sargent & Lundy Calculation 7056-00-19-5, Revision 23, dated 08-27-93

ABB
ASEA BROWN BOVERI

Calc. No. 8982-17-19-2
Rev. 2
Page R25 of
Project No. 8982-64

Telephone: 215-395-7333
Telecopy: 215-395-1055

DATE: 10/14/93 PAGES INCLUDING COVER SHEET: 1

TO: JIM KULAGA S+L

FROM: CLIFF DOWNS - PRODUCT MGR

REFERENCE: 27N

MESSAGE: PER YOUR REQUEST, THIS IS TO CONFIRM THAT THE ALLOWABLE DC CONTROL VOLTAGE RANGE FOR TYPE 27N WITH HARMONIC FILTER IS 95-140V AND THAT A 1 SECOND EXCURSION TO 89VDC WILL NOT AFFECT ITS OPERATION. THIS ASSUMES THE RESISTOR INSTALLED BETWEEN TERMINALS 1 AND 9 HAS A VALUE OF 4000 OHMS.

Cliff Downs

DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

Assumptions - 11, 17

"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."

Assumptions - 12, 18

"It is assumed that the multimeter is calculated 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°. This assumption is necessary to limit the conservatism in the error due to relay temperature effect to a reasonable level."

Reference Calculations

8982-13-19-6, Revision 2
8982-17-19-2, Revision 1

Verification Description

Dresden Relay Setting Procedure DOS 6600-09, Revision 8, specify to: a) use calibrated model Fluke 45 digital multimeter b) relays must be calibrated to an ambient temperature between 70° and 75°F.

Commonwealth Edison Company will revise Procedure DOS 6600-09 to include the use of Fluke 45 Digital Multimeter with user-selected reading rate of five (medium) readings per second.

Follow Up Action

Incorporate assumption verification in calculation.

To: J.J. Horwath

Subject: Second Level Degraded Voltage Relay Settings
Switchgear 23-1(Div. I) & Switchgear 33-1(Div. I)
Dresden Station, Unit 2 & 3

Ref.: 1. S&L Calculation Number 8982-13-19-6, Rev.2, entitled "Calc. for Second-Level Undervoltage Relay Setpoint", Dresden Unit 2, CHRON # 186718.

Ref.: 2. S&L Calculation Number 8982-17-19-2, Rev.1, entitled "Calc. for Second-Level Undervoltage Relay Setpoint", Dresden Unit 3, CHRON # 186716.

Ref.: 3. Operability Determination of Safety Related Equipment Affected by the Second Level Undervoltage Relay Setpoint Change on Division I of Units 2 and 3, Dresden Station, CHRON # 186841.

The above listed references are for your files. Reference 1 and 2 establish the design basis for the setpoints of the subject relays. In order to expedite issuing new Relay Setting Orders reference 1 and 2 were previously sent to you and discussed via phone on June 2, 1992. The need to adjust the existing settings is due to incorrectly applied vendor information which changed the ambient temperature effect tolerance in the original calculations. This setpoint adjustment will restore margin to the level established in our current setpoint methodology. It is our understanding that Relay Setting Orders for the subject relays have been issued as follows:

Dresden Unit 2 - Division I
Primary Trip Setting : 3835 volts nominal
Secondary Trip Setting : 109.57 volts +/- .2 volts
Reset Bandwidth : set to minimum achievable by device, approximately .5% (.55 volts) above trip setpoint i.e. 110.12 volts
Timing : 7 seconds +/- 20%

Dresden Unit 3 - Division I
Primary Trip Setting : 3884 volts nominal
Secondary Trip Setting : 110.97 volts +/- .2 volts
Reset Bandwidth : set to minimum achievable by device, approximately .5% (.56 volts) above trip setpoint i.e. 111.53 volts
Timing : 7 seconds +/- 20%

It should be noted that the existing setpoints on the Division II second level undervoltage relays are conservatively set above the values indicated in the revised S&L calculations (see Ref. 3). Therefore it is not required at this time to adjust the Division II settings.

The setpoint calculation has several stipulations for setting these relays which must be adhered to by the Operational Analysis Department. They are as follows:

1. A Fluke Model 45 multimeter, must be used to set the relay and have been calibrated within the manufacturer's specified tolerance range of 18 to 28 degrees Centigrade. The Fluke 45 must be set for a 60 Hz signal and at the medium sampling rate. If another voltmeter is to be used then it must have an accuracy equal to or better than the Model 45 in the appropriate volt range and be approved for use in this application by the Nuclear Engineering Department.

2. The relay must be set (calibrated) at a temperature between 21 to 24 degrees Centigrade (70 to 75 degrees Fahrenheit).

3. Utilize ABB instruction bulletin I.B.7.4.1.7-7 Issue D when setting the ABB/ITE, type 27N undervoltage relay with harmonic filter.

A copy of this letter has been sent to the station for appropriate setpoint control review. If you have any questions or concerns regarding this matter please call Stan Gaconis, X7644 or Mike Tucker, X7648.

M/Reed

M.L. Reed
Superintendent
NED-E/I&C Design

Attachment

cc: H.L. Terhune w/o attachment
G.P. Wagner w/o attachment
C.W. Schroeder w/o attachment
H.L. Massin w/o attachment
K.E. Faber w/o attachment
M.S. Tucker w/o attachment
S.L. Gaconis w/o attachment

In Reply, Refer to

CHRON # 190945

Subject: Second Level Undervoltage Protection
Relay Setting Orders
Dresden and Quad Cities Stations

Mr. T.T. Clark:

Please provide copies of the Second Level Undervoltage (Degraded Voltage Protection) Relay Setting orders for the ABB 27N relays installed for 4160 Volt buses 13-1, 14-1, 23-1 and 24-1 for Station 4, Quad Cities, and for 4160 Volt buses 23-1, 24-1, 33-1 and 34-1 for Station 12, Dresden. NED requires copies of the actual relay setting orders to close out some of the assumptions made in the degraded voltage calculations and for the FSAR rebaseline project.

We would appreciate copies of the subject Relay Setting orders by August 31, 1992. If you have any questions, please call me on extension 7648 at Downers Grove.

Prepared: [signature] Date: 8/26/92
M.S. Tucker

Approved: M. Pietraszewski Date: 8-26-92
M.F. Pietraszewski
E/I&C Design Supervisor

8-31-92

cc: M.L. Reed
T.S. Kriz
D. VanPelt
H.S. Mirchandani

MIKE - PER YOUR REQUEST - Tom Clark SYS PROVING X2768

12 17 92

InterOffice Memo

To: Bipin Desai

From: Mike Tucker

Date: September 2, 1992

Subject: Calculation Assumptions, Relay Setting Orders Degraded Voltage

---

Tom Clark of System Planning has sent copies of the Second Level Undervoltage Relay Settings as you requested. However, note that the new RSO for Quad Cities Unit 1 has not been issued at this time. Therefore, only the relay setting orders for Quad Cities Unit 2, Dresden Unit 2 and Unit 3 are attached.

The relay setting order does not address the type of meter to be used, much less specify that the medium sampling rate only be user selected. Therefore, we[1] are going to have to determine an alternate course of action.

If you have any questions, please call me on ext. 7648.

CC: M.L Reed

---

[1]The term "we" in this context should be best interpreted to mean "you."

RELAY SETTING ORDER
C.E.CO. 88-4804 5-83

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 4 Quad Cities KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☒ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

• Bus 23-1 2ND Level Undervoltage

ZONE OR EL.(CHARAC)					
P.T. (P.D.) RATIO	35:1		FOR INFORMATION ONLY		
C.T. TURN RATIOS	N/A				
RANGE (RATING)	70-120V				
PRIMARY SETTING	3886				
SEC. SET'G (OP. VALUE)	111.03 V	+/- 0.2 V			
COMPUTED TAPS	110 V Tap				
TEST A-V CUR. LAG DEG					
TIMING	7.0 Sec - Tap 5				

Dropout at 99.5% use 99% Tap

Per Calc. 8913-73-19-4 Rev. 0 ISSUE DATE 4-10-92 BY GMK COMPLETED 4-16-92 BY DEW/BAW

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

RELAY SETTING ORDER
C.E.CO. 88-4804 5-83

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 4 Quad Cities KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☒ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

• Bus 24-1 2ND Level Undervoltage

ZONE OR EL.(CHARAC)					
P.T. (P.D.) RATIO	35:1				
C.T. TURN RATIOS	N/A				
RANGE (RATING)	70-120V		FOR INFORMATION ONLY		
PRIMARY SETTING	3886				
SEC. SET'G (OP. VALUE)	111.03 V	+/- 0.2 V			
COMPUTED TAPS	110 V Tap				
TEST A-V CUR. LAG DEG					
TIMING	7.0 Sec - Tap 5				

Dropout at 99.5% use 99% Tap

Per Calc. 8913-73-19-4 Rev. 0 ISSUE DATE 4-10-92 BY GMK COMPLETED 4-16-92 BY DEW/BAW

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

RELAY SETTING ORDER FOR INFORMATION ONLY FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ______ DIV. ENG.

C.E.CO. 86-4804 5-83

STATION 12 - DRESDEN BUS 33-1 KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL ☐ IN-STALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* SECOND LEVEL UNDER-VOLTAGE

ZONE OR EL.(CHARAC)	UV		UV	FOR INFORMATION ONLY	
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	NA		NA		
RANGE (RATING)	RELAY 52 70-120V		BC 10 70-120V		
PRIMARY SETTING	3870		3884		
SEC. SET'G (OP. VALUE)	110.6V +/- .2V		110.97 +/- .2V		
COMPUTED TAPS	110 VOLTS		110 VOLTS		
TEST A-V CUR. LAG DEG	RESET TAP @ 99%		RESET TAP @ 99%		
TIMING	7 SECS (USE 5 TAP)		7 SECS (USE 5 TAP)		

RESET V MAY NOT EXCEED 111.53 VOLTS

OAD RECORD RESET V: AB - 110.96V BC - 110.99V

SUPERSEDES RSO ISSUED 2-11-92 ISSUE DATE 6-2-92 BY JJC COMPLETED GB BY 6/8/92

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

RELAY SETTING ORDER FOR INFORMATION ONLY FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ______ DIV. ENG.

C.E.CO. 86-4804 5-83

STATION 12 DRESDEN KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL ☐ IN-STALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* BUS 34-1 SECOND LEVEL UNDERVOLTAGE

ZONE OR EL.(CHARAC)	OLD UV	NEW UV	FOR INFORMATION ONLY		
P.T. (P.D.) RATIO	35/1	35/1			
C.T. TURN RATIOS					
RANGE (RATING)	70-120V	70-120V			
PRIMARY SETTING	3784V	3870V			
SEC. SET'G (OP. VALUE)	108.1V	110.6V (± .2V)		SET R TAP = 99%	
COMPUTED TAPS	110V	110V	110.6V	≤ VRESET ≤	111.1V
TEST A-V CUR. LAG DEG	120V→0V	120V→0V			
TIMING	7 SECS (5 TAP)	7 SECS (5 TAP)		Actual Reset	= 110.61

OAD TO RECORD RESET VOLTAGE. SETTINGS BASED ON NED RECOMMENDATION LETTER OF 2/10/92 TUCKER TO HORWATH

CHRON# 180284 ISSUE DATE 2/11/92 BY CRS COMPLETED 2/13/92 BY [illegible]

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

RELAY SETTING ORDER

C.E.CO. ~~55-4880-7-83~~

FROM ☐ STA. ELEC. ☒ SYST. PLAN.

STATION 12-DRESDEN BUS 23-1 KV 4.16 RELAY TYPE ITE 27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* SECOND LEVEL UNDER-VOLTAGE

FOR INFORMATION ONLY

	RESET		TO BE		
ZONE OR EL.(CHARAC)	UV		UV		
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	NA		NA		
RANGE (RATING)	70-120V		70-120V		
PRIMARY SETTING	3820		3835		
SEC. SET'G (OP. VALUE)	109.15 +/-.2V		109.57 +/-.2V		
COMPUTED TAPS	110 VOLTS		110 VOLTS		
TEST A-V CUR. LAG DEG	RESET TAP @ 99%		RESET TAP @ 99%		
TIMING	7 SECS (USE 5 TAP)		7 SECS (USE 5 TAP)		

RESET V. MAY NOT EXCEED 110.12 VOLTS

OAD RECORD RESET V: A-B: 109.58V B-C: 109.60V

SUPERSEDES RSO ISSUED 1-27-92 ISSUE DATE 6-2-92 BY MC COMPLETED GB BY 6/4/92

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

RELAY SETTING ORDER

C.E.CO. ~~55-4880-7-83~~ FOR INFORMATION ONLY

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ______ DIV. ENG.

STATION 12-DRESDEN BUS 24-1 KV 4.16 RELAY TYPE ITE 27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* SECOND LEVEL UNDER-VOLTAGE

	RESET		TO BE		
ZONE OR EL.(CHARAC)	UV		UV		
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	NA		NA		
RANGE (RATING)	70-120V		70-120V		
PRIMARY SETTING	3784		3820		
SEC. SET'G (OP. VALUE)	108.1		109.15 +/-.1 VOLTS		
COMPUTED TAPS	110 VOLTS		110 VOLTS		
TEST A-V CUR. LAG DEG	RESET TAP @ 99%		RESET TAP @ 99%		
TIMING	7 SECS (USE 5 TAP)		7 SECS (USE 5 TAP)		

RESET V. MAY NOT EXCEED 109.7 VOLTS

OAD RECORD RESET V: AB relay = 109.22 BC relay = 109.19

ISSUE DATE 1-27-92 BY MC COMPLETED 1/20/92 BY WJM

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

Commonwealth Edison
Dresden Nuclear Power Station
R.R. #1
Morris, Illinois 60450
Telephone 815/942-2920

FACSIMILE TRANSMITTAL SHEET

DATE: 9/3/92

TO: Mike Tucker

TELECOPIER NUMBER: 7299

FROM: J. Gates

COVER SHEET PLUS 8 PAGE(S)

DO YOU WANT TELECOPY BACK? ~~NO~~ YES ~~NO~~

IF YOU HAVE ANY PROBLEMS RECEIVING YOUR TELECOPY,
PLEASE CALL (815) 942-2920 EXT. -0-

Telecopy # 815-942-2920
Extension 2265

N O T E S

Mike,
I'll look for the appropriate CAM/ACAD procedures and fax them

Sent: ________

Time: ________

By: ________

11, 12, 17, 18-

TESTING OF ECCS UNDERVOLTAGE
AND DEGRADED VOLTAGE RELAYS

Requirements:

Technical Specifications Section 4.2, Table 4.2.1

Special Controls/Reviews:

NONE.

I. Rivera
Originator

S. Rhee
Independent Reviewer/Verifier (If Applicable)

J. Fiedler
Department Procedure Writer

M. Korchynsky
Department Supervisor

APPROVED

AUG 05 '92

D.O.S.R.

ZDOS/137
ZW/198

Calculation No. 8982-13-19-6
Revision 005
Attachment: I

TESTING OF ECCS UNDERVOLTAGE
AND DEGRADED VOLTAGE RELAYS

A. PURPOSE:

This procedure verifies the undervoltage relay settings for Emergency Core Cooling System (ECCS) Buses 23-1, 24-1, 28 and 29 (33-1, 34-1, 38 and 39) and assures calibration of related Diesel Generator power instruments.

B. USER REFERENCES:

1. Technical Specifications:

a. Section 4.2, Table 4.2.1, Minimum Test and Calibration Frequency for Core and Containment Cooling Systems Instrumentation, Rod Blocks and Isolations.

2. Procedures:

a. Relay Calibration Procedure (Supplied by Operational Analysis Department).

3. Prints:

a. 12E-2334, Relaying and Metering Diagram - 4160 V Switch Group 23-1 & 24-1.

b. 12E-2335, Relay and Metering Diagram - 480 V Switch Groups 25, 26, 27, 28 & 29.

c. 12E-2344, Schematic Control Diagram, 4160 V Buses 23-1 & 24-1 Main Feed BKRS.

d. 12E-2345, Schematic Control Diagram, 4160 V Bus 23-1 4KV SWGR Bus 40 Feed BKR.

e. 12E-2346, Schematic Control Diagram, 4160 V Bus 24-1 Standby Diesel 2 Feed & 34-1 Tie Breaker.

f. 12E-3334, Relaying and Metering Diagram - 4160 V Switch Group 33-1 & 34-1.

g. 12E-3335, Relay and Metering Diagram - 480 V Switch Groups 35, 36, 37, 38, 39, & 30 and 4160 V SWGR CUB 15.

h. 12E-3344, Schematic Control Diagram, 4160 V Buses 33-1 & 34-1 Main Feed BKRS.

i. 12E-3345, Schematic Control Diagram, 4160 V Bus 33-1 4KV SWGR Bus 40 Feed BKR.

j. 12E-3346, Schematic Control Diagram, 4160 V Bus 34-1 Standby Diesel 3 Feed & 24-1 Tie Breaker.

C. SUPPLEMENTS:

1. Checklist A, ECCS Bus Relay Test.

D. EQUIPMENT REQUIRED:

1. Timer (Calibrated per DAP 11-12). Record Serial Number and Calibration Due Date on Checklist A.

2. •Fluke Model 45 Multimeter. Record Serial Number and Calibration Due Date on Checklist A. • (W-2, W-3, W-4)

3. Digital Thermometer. Record Serial Number and Calibration Due Date on Checklist A.

E. PREREQUISITES:

> **NOTE**
>
> Indicate completion of the prerequisites on Checklist A.

1. Reactor in Cold Shutdown or Refuel.

2. Bus being tested is out of service for the Operational Analysis Department (OAD).

3. Operational Analysis Department (OAD) has verified the relay settings for the relays listed in Checklist A.

4. Permission to start the undervoltage test on each bus (Bus 23-1, 24-1, 33-1 or 34-1) has been obtained from the Shift Engineer.

F. PRECAUTIONS:

1. Use proper sequences when disconnecting or reconnecting the relays to avoid spurious bus trips.

G. LIMITATIONS AND ACTIONS:

1. A Fluke Model 45 Multimeter must be used to calibrate the ECCS degraded voltage relays. IF another voltmeter is to be used, THEN the Nuclear Engineering Department must approve it's use.

H. ACCEPTANCE CRITERIA:

1. All operating voltages and trip times shall be within the tolerances listed in Checklist A.

2. IF any of the AS FOUND values fall outside of the Checklist A tolerances, THEN notify the Operations Shift Supervisor and submit an out-of-tolerance notification sheet to the Technical Staff Supervisor.

H. 3. Acceptance criteria is annotated by acceptance criteria (AC) before the step.

I. PROCEDURE:

> **NOTE**
>
> Indication of completion of the relay tests is accomplished by completing Checklist A.

1. Remove the undervoltage relays as follows:

   a. Isolate the trips by removing the LOWER paddle.

   b. Isolate the voltage sensing circuits by removing the UPPER paddle.

   c. Remove the relay.

2. Remove the degraded voltage relays as follows:

   a. Isolate the trips by opening Test Switch E in the Test Switch Group TS 23-1 UV (TS 33-1 UV) and TS 24-1 UV (TS 34-1 UV) directly below the relay.

   b. Isolate the voltage sensing circuits by opening Test Switches A, B, C, and D in the Test Switch Group TS 23-1 UV (TS 33-1 UV) or TS 24-1 UV (TS 34-1 UV) directly below the relay.

   c. Remove the relay.

3. Complete the following on each relay:

   a. Verify relay settings.

   b. Clean the relay.

   c. Note anything abnormal.

   d. Complete Checklist A, ECCS Bus Relay Test.

4. Install the degraded voltage relays as follows:

   a. Install the relay.

   b. Connect the voltage sensing circuits by closing Test Switches A, B, C, and D in the Test Switch Group TS 23-1 UV (TS 33-1 UV) or TS 24-1 UV (TS 34-1 UV) directly below the relay.

I. 4. c. Connect the trips by closing Test S Switch Group TS 23-1 UV (TS 33-1 UV) or TS 24-1 UV (TS 34-1 UV) directly below the relay.

5. Install the undervoltage relays as follows:

   a. Install the relay.

   b. Connect the voltage sensing circuits by installing the UPPER paddle.

   c. Connect the trips by installing the LOWER paddle.

6. (AC) All operating voltages and trip times are within the tolerances listed on Checklist A.

   (Initial or N/A)________.

   a. IF any of the as found values fall outside of the Checklist A tolerances, THEN notify the Operations Shift Supervisor and submit an out-of-tolerance notification sheet to the Technical Staff Supervisor.

   (Initial or N/A)________.

7. Notify the Operations Shift Supervisor of test completion and give him the completed checklist.

J. DISCUSSION:

These tests are based on a nominal Bus voltage of 4160 volts and a potential transformer ratio of 35 (4200 volts/120 volts). The nominal voltage at the relay is 118.86 volts.

W. WRITER'S REFERENCES:

1. Response to IE Information Notice 84-02, dated June 20, 1984.

2. Electrical Distribution System Functional Inspection, July 1991.

3. S & L Calculation 8982-13-19-6 Rev. 2, Second-Level Undervoltage Relay Setpoint.

4. S & L Calculation 8982-17-19-2 Rev. 1, Second-Level Undervoltage Relay Setpoint.

CHECKLIST A
ECCS BUS RELAY TEST

Prerequisites Complete: Unit ____________
Initial/Date ___/___

ECCS Bus Undervoltage Relay Test
(Tap setting is 93)

Relay	Lever Setting 1.0 Nominal		Contact Closure Voltage (UV) 79.6 to 87.9 volts		Time to Contact Closure 120 to 0V 1.89 to 2.31 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-1-23-1(33-1)						
127-2-23-1(33-1)						
227-1-2B (3B)						
227-2-2B (3B)						

ECCS Bus Degraded Voltage Relay Tests*
Ambient Temperature ________°F

Relay	Lever Setting 5.0 Nominal		Contact Closure Voltage (UV) 109.37 to 109.77 V		Time to Contact Closure 120 to 0V 5.6 to 8.4 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-3-23-1						
127-4-23-1						

Relay	Lever Setting 5.0 Nominal		Contact Closure Voltage (UV) 110.77 to 111.17 V		Time to Contact Closure 120 to 0V 5.6 to 8.4 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-3-33-1						
127-4-33-1						

		Time to Contact Closure 5 min to 5 min. 15 sec	
TDR 23-1 (33-1)			

		Time to Contact Closure 1.8 to 2.2 sec	
27XTD 23-1(33-1)			

* These relays must be calibrated at an ambient temperature between 70 and 75°F, utilizing ABB Instruction Bulletin I.B. 7.4.1.7-7 Issue D.

ZD06/137
ZW/198

12.17.12

CHECKLIST A (Continued)
ECCS BUS RELAY TEST

Prerequisites Complete: Unit ________
Initial/Date ___/___

ECCS Bus Undervoltage Relay Test
(Tap setting is 93)

Relay	Lever Setting 1.0 Nominal		Contact Closure Voltage (UV) 79.6 to 87.9 volts		Time to Contact Closure 120 to 0V 1.89 to 2.31 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-1-24-1(34-1)						
127-2-24-1(34-1)						
227-1-29 (39)						
227-1-29 (39)						

ECCS Bus Degraded Voltage Relay Tests*
Ambient Temperature ________°F

Relay	Lever Setting 5.0 Nominal		Contact Closure Voltage (UV) 108.95 to 109.35 V		Time to Contact Closure 120 to 0V 5.6 to 8.4 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-3-24-1						
127-4-24-1						
Relay	**Lever Setting 5.0 Nominal**		**Contact Closure Voltage (UV) 110.4 to 110.8 V**		**Time to Contact Closure 120 to 0V 5.6 to 8.4 sec**	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-3-34-1						
127-4-34-1						

		Time to Contact Closure 5 min to 5 min. 15 sec	
TDR 24-1 (34-1)			

		Time to Contact Closure 1.8 to 2.2 sec	
27XTD 24-1(34-1)			

* These relays must be calibrated at an ambient temperature between 70 and 75°F, utilizing ABB Instruction Bulletin I.B. 7.4.1.7-7 Issue D.

ZDOS/137
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CHECKLIST A (Continued)

ECCS BUS RELAY TEST

Abnormal Findings and Comments: ____________________

____

____

____

____

Timer Serial Number ____________

Calibration Due Date ____________

OAD Representative ____________

Voltmeter Serial Number ____________

Calibration Due Date ____________

Digital Thermometer Serial Number ____________

Calibration Due Date ____________

ZDOS/137
ZW/198

Calculation No. 8982-10-19-6

Revision 005

Attachment: I

DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

Assumptions - 13, 19

The Containment Cooling Service Water System (CCSW) pump cubicle cooler fans and the Diesel Generator 2/3 starting air compressor need not be considered in determining the minimum allowable 4.16-kV system voltage.

The CCSW pump cubicle cooler fans need not be considered in determining the minimum allowable 4.16-kV system voltage.

Reference Calculations

8982-13-19-6, Revision 2, and 8982-17-19-2, Revision 1.

Verification Description

See the attached CECo CHRON 179857 for swing diesel starting air compressor assessment.

The existing CCSW cubicle cooler fan motors are acceptable. The Calculation No. 9215-99-19-1, Rev. 1 (calculation for evaluation of 3 H.P.; 460 Volt CCSW motor minimum voltage starting requirements) demonstrates that the existing 460 Volt CCSW cooler fan motors will start during degraded voltage conditions without tripping their protective devices or exceeding their thermal capability limits.

Follow Up Action

Incorporate assumption verification in the calculation.

Febr
In Reply, Refer to

CHRON # 179857

FOR DRESDEN
ASSUMPTION ... OF
...

Mr. C.W. Schroeder
Station Manager
Dresden

Subject: Safety Assessment
Degraded Voltage
Dresden Unit 2

Reference: Safety Assessment of Degraded Voltage
Dresden Unit 2
M.F. Pietraszewski to C.W. Schroeder dated 1/30/92
CHRON 179582

Dear Mr. Schroeder:

The Electrical/I&C group of the Nuclear Engineering Department has revised the assessment of degraded voltage previously issued under the referenced letter. These assessments addressed the swing diesel generator starting air compressor, CCSW cubicle cooling fans and the battery chargers. Additional assessments have been performed on the affect of 120V contactors being subjected to a lower voltage than the manufacturer's recommended value and the use of test data to determine the minimum starting voltage required for the diesel generator cooling water pumps. Copies of the safety assessments are attached. Nuclear Engineering has concluded that this equipment is capable of performing all intended safety functions and is currently operable.

Attachment B contains actions required to be completed by March 31, 1992 to ensure equipment operability during the summer months.

If you have any questions, please call Mike Tucker on extension 7648 at Downers Grove.

Prepared: M.S. Tucker (signature) Date: 2/2/92
M.S. Tucker
Senior Engineer

Approved: M.L. Reed (signature) Date: 2/2/92
M.L. Reed
E/I&C Design Superintendent

DRSDN EDSFI\SADVA.DOC
MT:mst
attachments

cc:		
C.A. Grier	H.L. Massin	M.F. Pietraszewski
R. Radtke	D. Taylor	M.H. Richter
B.M. Viehl	M.C. Strait	G.A. Gates
S.A. Lawson	NEDCC	

Attachment A

<u>Affects of Degraded Voltage on Non-Safety Equipment</u>

Certain non-safety related equipment is shown in the critical voltage analysis below the NEMA acceptance criteria. These are the 2/3 diesel generator starting air compressor, the 250V battery charger 2 and the 250V battery charger 2/3.

<u>Swing Diesel Starting Air Compressor</u>

The diesel generator starting air compressor 2/3A would have 408.6 Volts at the motor terminals at the new second level undervoltage relay setpoint, slightly less than the NEMA required 414 Volts. To assure the NEMA criteria is met for this motor, the relay would have to be set to assure 3827 Volts at Bus 23-1 as compared to the 3784 required to assure operation of the 2/3 diesel generator cooling water pump. The safety related portion of the air start system relies on accumulators of stored air, and would be fully charged prior to starting the diesel generator. The air compressor would have adequate voltage when it would normally be expected to charge the receiver tank. The air compressor may start after the diesel has started due to low receiver pressure; however, as the diesel has already started, recharging the accumulator is not required. Therefore, low voltage at the 2/3A starting air compressor is not a concern. Starting air compressor 2A and 2B have adequate voltage at the new relay setpoint.

<u>250 Volt Battery Chargers</u>

The 250 Volt battery chargers are indicated as non-safety related in the Master Equipment List. The batteries were sized based on a loss of offsite power with no credit from the chargers. Unlike induction motors, the battery chargers are rated for 480 Volts nominal. Therefore, to meet the NEMA criteria of 90% terminal voltage, 432V is required. Further, the manufacturer of the battery charger, Power Conversion Products, specifies output voltage regulation and output current capability based on an input of 480V +15, -10%. To assure 432 Volts at the charger terminals, an operationally unacceptable setpoint would be required for the Second Level Undervoltage Relay.

NED has assessed the effect on the charger output at 414 Volts (86.25% of 480 Volt rating) and has concluded there would be less than a 4% reduction in output voltage. This would be sufficient to prevent a discharge of the 250V battery. The charger maximum current output capability is also reduced; however, with off-site power available the load demand on the DC system would be less than the design basis loading. Therefore the small reduction in charger output is acceptable.

Attachment B

Affects of Degraded Voltage on Safety-Related Equipment

Certain safety related electrical equipment is shown in the degraded voltage analysis with available terminal voltage below the NEMA acceptance criteria. Some of the safety related motors may have lower terminal voltage than vendor recommendations to assure successful starting. An assessment of this condition follows.

CCSW Cubicle Cooling Fans

The Containment Cooling Service Water System (CCSW) provides long term decay heat removal. This system has a total of four pumps. CCSW pump A and B are ESS Division I and pumps C and D are Division II. Two of the CCSW pumps, B and C, are in vaults to provide protection against local flooding. Each of these two pumps have four cooling fans fed by the respective ESS division power source. See Table 1 below. CCSW Pumps A and D are not in vaults. Therefore, these pumps do not require cooling fans. Only one CCSW pump is required per the FSAR.

Table 1

CCSW Pump	ESS Division	In Vault?	CCSW Cubicle Cooling Fans
A	Division I	No	None
B	Division I	Yes	A Fan 1, A Fan 2, B Fan 1 and B Fan 2
C	Division II	Yes	C Fan 1, C Fan 2, D Fan 1 and D Fan 2
D	Division II	No	None

The voltage available to the Division II fans (C and D) is adequate for starting and running these motors at the second level undervoltage relay setpoint issued per calculation 8982-13-19-6 Revision 1. However, setting the relay to assure starting of the Division I fans (A and B) would result in an unacceptably high relay setpoint.

The simultaneous events of flood, LOCA and degraded voltage with off site power available is not considered to be credible. This event is estimated to be on the order of 9.9×10^{-12} per year (see 1/20/92 C.A. Grier memo). Therefore, the potential low voltage at the Division I cooling fans is not a concern.

Diesel Generator Cooling Water Pump Minimum Starting Voltage

The purpose of this assessment is to evaluate the voltage available for starting the Diesel Generator Cooling Water Pumps (DGCWP). The critical voltage calculations used to determine the second level undervoltage relay setpoint have determined that the swing DGCWP has an available terminal voltage of 370.6 Volts under starting conditions. This is 80.6% of rated. The Unit 2 Division I critical voltage was determined in calculation 8982-13-19-1 Rev. 0 dated 1/8/92 (CHRON # 179302). Division I bounds Division II as shown by calculation 8982-15-19-3 Rev. 0 dated 1/14/92 (Unit 2 Division II, CHRON # 179755); this calcultation determined that DGCWP 2 has 372.3 Volts available for starting.

The vendor of the Diesel Generator Cooling Water Pumps (DGCWP), Chempump Division of Crane Company, does not specify a minimum starting voltage requirement. In response to a request by CECo for a minimum starting voltage requirement, the vendor responded that the motor was guaranteed to start and run at 90% of the 460 Volt rating (or 414 Volts) and may not start if the line voltage dips by more than 15% (85% of rated or 391 Volts). However, the 85% number was based on engineering judgement, and no actual testing was performed under degraded voltage conditions (under 90% of rated voltage). The vendor was unable to provide a motor torque-speed curve applicable to this pump. This specific motor is no longer used by Crane, and they no longer have one available for testing.

Crane obtained a standard motor for each of Dresden's DGCWPs. The pump vendor modified each motor to allow for use in a submerged location. To accomplish this, the vendor machined the rotor to increase air gap and installed a liner in the motor. This liner protects the windings from moisture, thus creating a submersible combination pump/motor in a common enclosure. A water cooling jacket was also provided integral with the housing. Machining the rotor and providing a custom enclosure is standard practice for the vendor. The pumps were supplied to CECo in 1973.

A test of the Unit 3 Diesel Generator Cooling Water pump was performed to obtain the torque - speed characteristic curve by developing an analytical model of the motor. Torque - speed curves would normally be obtained using a dynamometer. Due to the design of the DGCWP, the motor shaft can not be connected to a dynamometer. Dynamometer testing may also result in motor failure. Therefore, this method of testing was impractical for the Dresden DGCWP.

Alternate analytical methods are available to determine torque - speed characteristics of induction motors. Generally, these methods are not used by manufacturers as potentially destructive dynamometer testing of redundant motors is more economical than the enginerring effort required to develop the analytical model. For the Dresden DGCWP, developing an analytical model of the motor based on test data was the only possible alternative. The test measured the three phase currents and voltage values from the initial inrush current until reaching a steady state value, indicating that the motor had started. Current and potential transformers were installed in the motor circuit to allow the use of a digital fault recorder to obtain the required data. The DGCWP was then started in accordance with normal station operating procedures. The testing accurately monitored the motor and pump as it is installed in the plant with the actual mechanical load applied to the pump impeller (cooling water flow to the Unit 3 diesel generator).

An analytical model of the motor was developed and benchmarked against the test data for validity. This type of model can be used to predict motor behavior under all conditions. This type of motor model accurately represents the motor speed - torque curve, the changing rotor impedance with time and allows assessment of machine capability in response to available voltage. The motor circuit model developed is independent of starting voltage actually present during the test. The minimum starting voltage required to start and accelerate the motor was then calculated from the motor analytical circuit model. The test data, methodology and the torque - speed curve developed are documented in calculation 8982-13-19-4, Revision 0, dated 1/6/92.

Two requirements must be met at the minimum acceptable starting voltage. Adequate torque must be provided at reduced voltage and the protective devices must not trip on overcurrent before the inrush drops to the steady state value. The torque - speed curve determined by the testing shows that the motor will successfully start at 70% of rated voltage. The overload relay will not trip during a degraded voltage start, and the maximum current drawn by the motor is below the trip curve of the breaker.

The motor develops adequate breakdown and pull-up torque at 70% of rated voltage to assure successful starting. The critical factor in this application, by the test data, is net accelerating torque available. A minimum value of 25% of load torque must be provided to accelerate the load in a reasonable time, or about 50 lb.-ft. in this application; an accelerating torque of 73.8 lb.-ft. is available at 70% voltage, providing a

conservative margin in the calculated result. This will accelerate the pump to operating speed in 1.65 seconds.

At locked rotor current, the overload relay will trip in 13 to 21 seconds, assuring that the thermal rating of the motor is not compromised. As the motor will start in less than two seconds, the overload will not trip the motor under starting conditions at 70% of rated voltage. The maximum current will be drawn when the motor starts under the highest expected voltage, which causes a locked rotor current of 626 Amperes at 110% of rated voltage. The 200 Amp TFJ breaker will take 27 seconds to trip at this current.

Therefore, at 70% voltage,the motor has adequate torque to start and no undesired protective trip will occur.

125 Volt Battery Chargers

The 125 Volt Battery Chargers are rated 480V, not 460V as most motors. Therefore, to meet the NEMA criteria of 90% voltage, 432V is required at the charger terminals. Further, the manufacturer of the chargers (Power Conversion Products) has a published specification of 130V ±1% output voltage from no load to 200 Amperes with an input of 480V +15, -10%. To assure 432 Volts to the charger would require an operationally unacceptable setpoint for the Second Level Undervoltage Relay.

NED has assessed the effect on the charger output at 414 Volts (86.25% of 480 Volt rating) and has concluded there would be less than a 4% reduction in output voltage. This would be sufficient to prevent a discharge of the 125Vbattery. The charger maximum current output capability is also reduced; however, with off-site power available the load demand on the DC system would be less than the design basis loading (e.g. fewer breaker and solenoid operations; inverters remain on AC power). Therefore the small reduction in charger output is acceptable. Additionally it should be noted that the batteries were sized based on a loss of off site power with no credit from the battery chargers.

120 Volt Contactors

Five safety related 120 Volt contactors on Dresden Unit 2 do not meet the vendor stipulated minimum voltage requirement of 75% of the 120 Volt rating at the new second level relay setpoint. These contactors control motor operated valves required for LPCI injection. These valves are:

Reactor Recirculation Pump 2A Discharge Valve, 2-202-5A
Reactor Recirculation Pump 2B Discharge Valve, 2-202-5B
LPCI Injection Valve 2A, 2-1501-22A
LPCI Injection Valve 2B, 2-1501-22B
LPCI Full Flow Test Valve 2C, 2-1501-38B

At the new relay setpoint of 3820 ± 7 Volts, a minimum critical voltage of 3784 Volts is assured on the 4kV bus. This critical voltage is based on the minimum acceptable running voltage on all required safety related equipment under the highest auxiliary power system loading condition. The setpoint includes a tolerance for the lower analytical limit of the potential transformer, undervoltage relay and calibration equipment. The relay setpoint was determined in calculation 8982-13-19-6, dated 1-29-92 (CHRON # 179508). The critical voltage used was based on Unit 2 Division I (calculation 8982-13-19-1 Rev. 0 dated 1/8/92, CHRON # 179302). This value of critical voltage bounds the Unit 2 Division II analysis.

The worst case valve, LPCI Injection Valve 1501-22B, has 72.7% of rated voltage available at the contactor under these conditions. Raising the relay setpoint to meet the conservative vendor voltage requirement these contactors would result in an unacceptable relay setpoint. A higher relay setpoint would trip the preferred power source when it is still capable of supplying critical loads. This would challenge the diesel generators unnecessarily. Therefore, the higher relay setpoint is unacceptable, both from an operating perspective and considering overall plant safety.

The five contactors for the valves listed above were replaced during the fall 1991 outage with safety-related, environmentally qualified General Electric (GE) Series 300 contactors. CECo has tested the minimum pickup of a 300 Series contactor. The test data shows that the GE Series 300 contactor minimum pickup is 58% of rated voltage when new. The GE value for pickup of 75% is to allow aging over the useful life of the device (40 years) and to provide a margin for conservatism.

The minimum expected voltage on the 4kV bus is 3840 Volts. This is an extreme condition which would only occur at the highest off site power system loading condition with two transmission system contingences and a LOCA on Unit 2. CECo is a summer peaking utility, and the highest off site power system loading condition occurs on the hottest day of the year. Lower loading conditions of both the transmission system and the station auxiliary power system will provide higher available voltage during spring, 1992. This will assure pickup of the contactors under worst case loading conditions.

Based on; 1) the qualified GE Series contactor design which assures 75% voltage pickup at the end of its 40 year life; 2) the demonstrated 58% of rated pickup voltage of a new Series 300 contactor through testing; 3) the installation of new Series 300 contactors in all five safety related circuits in question; and 4) the minimum expected voltages during the Spring '92 time period, all contactors will properly perform their safety function.

Modifications will be completed by March 31, 1992 to assure that there is adequate voltage for contactor pickup at the new second level relay setpoint.

In Reply, Refer to

CHRON # 180914

Mr. C.W. Schroeder
Station Manager
Dresden

Subject: Safety Assessment
Degraded Voltage
Dresden Unit 3

Dear Mr. Schroeder:

The Electrical/I&C group of the Nuclear Engineering Department has assessed the affects of degraded voltage on plant equipment not bounded by the setpoint of the Second Level Under Voltage relay. These assessments address the Division II CCSW cubicle cooling fans, the battery chargers, certain 120V contactors being subjected to a lower voltage than the manufacturer's recommended value and the use of test data to determine the minimum starting voltage required for the diesel generator cooling water pumps. Copies of the safety assessments are attached. Nuclear Engineering has concluded that this equipment is capable of performing all intended safety functions and is currently operable.

The attachment to this letter contains actions required to be completed by March 31, 1992 to ensure equipment operability during the summer months.

If you have any questions, please call Mike Tucker on extension 7648 at Downers Grove.

Prepared: [signature] Date: 2/12/92
M.S. Tucker
Senior Engineer

Approved: [signature] Date: 2/13/92
M.L. Reed
E/I&C Design Superintendent

DRSDN NDMFT\U3SADVA.DOC
MT:mst
attachments
cc: C.A. Grier, R.M. Radtke, B.M. Viehl, S.A. Lawson, E.L. Massin, D.L. Taylor, M.C. Strait, NEDCC, M.F. Pietraszewski, M.H. Richter, G.A. Gates

Affects of Degraded Voltage Electrical Equipment

Certain electrical equipment is shown in the degraded voltage analysis with available terminal voltage below the NEMA acceptance criteria. Some of the safety related motors may have lower terminal voltage than vendor recommendations to assure successful starting. An assessment of this condition follows.

CCSW Cubicle Cooling Fans

The Containment Cooling Service Water System (CCSW) provides long term decay heat removal. This system has a total of four pumps. CCSW pump A and B are ESS Division I and pumps C and D are Division II. Two of the CCSW pumps, B and C, are in vaults to provide protection against local flooding. Each of these two pumps have four cooling fans fed by the respective ESS division power source. See Table 1 below. CCSW Pumps A and D are not in vaults. Therefore, these pumps do not require cooling fans. Only one CCSW pump is required per the FSAR.

Table 1

CCSW Pump	ESS Division	In Vault?	CCSW Cubicle Cooling Fans
A	Division I	No	None
B	Division I	Yes	A Fan 1, A Fan 2, B Fan 1 and B Fan 2
C	Division II	Yes	C Fan 1, C Fan 2, D Fan 1 and D Fan 2
D	Division II	No	None

The voltage available to the Division I fans (A and B) is adequate for starting and running these motors at the second level undervoltage relay setpoint issued per calculation 8982-17-19-2 Revision 0. However, setting the relay to assure starting of the Division II fans (C and D) would result in an unacceptably high relay setpoint.

The simultaneous events of flood, LOCA and degraded voltage with off site power available is not considered to be credible. This event is estimated to be on the order of 9.9×10^{-12} per year (see 1/20/92 C.A. Grier memo). Therefore, the potential low voltage at the Division II cooling fans is not a concern.

Diesel Generator Cooling Water Pump Minimum Starting Voltage

The purpose of this assessment is to evaluate the voltage available for starting the Diesel Generator Cooling Water Pumps (DGCWP). The critical voltage calculations used to determine the second level undervoltage relay setpoint have determined that the swing DGCWP has an available terminal voltage of 342.7 Volts under starting conditions. This is 74½% of rated. The Unit 3 Division I critical voltage was determined in calculation 8982-17-19-1 Rev. 0 dated 1/21/92 (CHRON # 179719). Division I bounds Division II as shown by calculation 8982-19-19-1 Rev. 1 dated 2/3/92 (Unit 3 Division II, CHRON # 180265); this calculation determined that DGCWP 3 has 349.6 Volts available for starting (76% of rated).

The vendor of the Diesel Generator Cooling Water Pumps (DGCWP), Chempump Division of Crane Company, does not specify a minimum starting voltage requirement. In response to a request by CECo for a minimum starting voltage requirement, the vendor responded that the motor was guaranteed to start and run at 90% of the 460 Volt rating (or 414 Volts) and may not start if the line voltage dips by more than 15% (85% of rated or 391 Volts). However, the 85% number was based on engineering judgement, and no actual testing was performed under degraded voltage conditions (under 90% of rated voltage). The vendor was unable to provide a motor torque-speed curve applicable to this pump. This specific motor is no longer used by Crane, and they no longer have one available for testing.

Crane obtained a standard motor for each of Dresden's DGCWPs. The pump vendor modified each motor to allow for use in a submerged location. To accomplish this, the vendor machined the rotor to increase air gap and installed a liner in the motor. This liner protects the windings from moisture, thus creating a submersible combination pump/motor in a common enclosure. A water cooling jacket was also provided integral with the housing. Machining the rotor and providing a custom enclosure is standard practice for the vendor. The pumps were supplied to CECo in 1973.

A test of the Unit 3 Diesel Generator Cooling Water pump was performed to obtain the torque - speed characteristic curve by developing an analytical model of the motor. Torque - speed curves would normally be obtained using a dynamometer. Due to the design of the DGCWP, the motor shaft can not be connected to a dynamometer. Dynamometer testing may also result in motor failure. Therefore, this method of testing was impractical for the Dresden DGCWP.

Alternate analytical methods are available to determine torque - speed characteristics of induction motors. Generally, these methods are not used by manufacturers as potentially destructive dynamometer testing of redundant motors is more economical than the enginerring effort required to develop the analytical model. For the Dresden DGCWP, developing an analytical model of the motor based on test data was the only possible alternative. The test measured the three phase currents and voltage values from the initial inrush current until reaching a steady state value, indicating that the motor had started. Current and potential transformers were installed in the motor circuit to allow the use of a digital fault recorder to obtain the required data. The DGCWP was then started in accordance with normal station operating procedures. The testing accurately monitored the motor and pump as it is installed in the plant with the actual mechanical load applied to the pump impeller (cooling water flow to the Unit 3 diesel generator).

An analytical model of the motor was developed and benchmarked against the test data for validity. This type of model can be used to predict motor behavior under all conditions. This type of motor model accurately represents the motor speed - torque curve, the changing rotor impedance with time and allows assessment of machine capability in response to available voltage. The motor circuit model developed is independent of starting voltage actually present during the test. The minimum starting voltage required to start and accelerate the motor was then calculated from the motor analytical circuit model. The test data, methodology and the torque - speed curve developed are documented in calculation 8982-13-19-4, Revision 0, dated 1/6/92.

Two requirements must be met at the minimum acceptable starting voltage. Adequate torque must be provided at reduced voltage and the protective devices must not trip on overcurrent before the inrush drops to the steady state value. The torque - speed curve determined by the testing shows that the motor will successfully start at 70% of rated voltage. The overload relay will not trip during a degraded voltage start, and the maximum current drawn by the motor is below the trip curve of the breaker.

The motor develops adequate breakdown and pull-up torque at 70% of rated voltage to assure successful starting. The critical factor in this application, by the test data, is net accelerating torque available. A minimum value of 25% of load torque must be provided to accelerate the load in a reasonable time, or about 50 lb.-ft. in this application; an accelerating torque of 73.8 lb.-ft. is available at 70% voltage, providing a

conservative margin in the calculated result. This will accelerate the pump to operating speed in 1.65 seconds.

At locked rotor current, the overload relay will trip in 13 to 21 seconds, assuring that the thermal rating of the motor is not compromised. As the motor will start in less than two seconds, the overload will not trip the motor under starting conditions at 70% of rated voltage. The maximum current will be drawn when the motor starts under the highest expected voltage, which causes a locked rotor current of 628 Amperes at 110% of rated voltage. The 200 Amp TFJ breaker will take 27 seconds to trip at this current.

Therefore, at 70% voltage,the motor has adequate torque to start and no undesired protective trip will occur.

<u>125 and 250 Volt Battery Chargers</u>

The Battery Chargers are rated 480V, not 460V as most motors. Therefore, to meet the NEMA criteria of 90% voltage, 432V is required at the charger terminals. Further, the manufacturer of the chargers (Power Conversion Products) has a published specification of 130V ±1% output voltage from no load to 200 Amperes with an input of 480V +15, -10%. To assure 432 Volts to the charger would require an operationally unacceptable setpoint for the Second Level Undervoltage Relay.

The worst case battery charger is 125 V Battery Charger 3 which has 410.9 Volts at the terminals during summer LOCA steady state conditions. All other chargers have greater than 420V available.

NED has assessed the effect on the charger output at 410.9 Volts (85.6% of 480 Volt rating) and has concluded there would be less than a 6% reduction in output voltage. This would be sufficient to prevent a discharge of the batteries. The charger maximum current output capability is also reduced; however, with off-site power available the load demand on the DC system would be less than the design basis loading (e.g. fewer breaker and solenoid operations; inverters remain on AC power). Therefore the small reduction in charger output is acceptable. Additionally it should be noted that the batteries were sized based on a loss of off site power with no credit from the battery chargers.

120 Volt Contactors

Five safety related 120 Volt contactors on Dresden Unit 3 do not meet the vendor stipulated minimum voltage requirement of 75% of the 120 Volt rating at the new second level relay setpoint. These contactors control motor operated valves required for LPCI injection. These valves are:

Reactor Recirculation Pump 3A Discharge Valve, 3-202-5A
Reactor Recirculation Pump 3B Discharge Valve, 3-202-5B
LPCI Injection Valve 3A, 3-1501-22A
LPCI Injection Valve 3B, 3-1501-22B
LPCI Full Flow Test Valve 3A, 3-1501-38A

At the new relay setpoint of 3870 ± 7 Volts, a minimum critical voltage of 3832 Volts is assured on the 4kV bus. This critical voltage is based on the minimum acceptable running voltage on all required safety related equipment under the highest auxiliary power system loading condition. The setpoint includes a tolerance for the lower analytical limit of the potential transformer, undervoltage relay and calibration equipment. The relay setpoint was determined in calculation 8982-17-19-2, dated 2-6-92. The critical voltage used was based on Unit 3 Division I (calculation 8982-17-19-1 Rev. 0 dated 1/21/92, CHRON # 179719). This value of critical voltage bounds the Unit 3 Division II analysis (Calculation 8982-19-19-1 Rev. 1 dated 2/3/92, CHRON # 180265)..

The worst case valve, LPCI Injection Valve 1501-22A, has 68.47% of rated voltage available at the contactor under these conditions. Raising the relay setpoint to meet the conservative vendor voltage requirement these contactors would result in an unacceptable relay setpoint. A higher relay setpoint would trip the preferred power source when it is still capable of supplying critical loads. This would challenge the diesel generators unnecessarily. Therefore, the higher relay setpoint is unacceptable, both from an operating perspective and considering overall plant safety.

The five contactors for the valves listed above were replaced during the fall 1991 outage with safety-related, environmentally qualified General Electric (GE) Series 300 contactors. CECo has tested the minimum pickup of a 300 Series contactor. The test data shows that the GE Series 300 contactor minimum pickup is 58% of rated voltage when new. The GE value for pickup of 75% is to allow aging over the useful life of the device (40 years) and to provide a margin for conservatism.

The minimum expected voltage on the 4kV bus is 3924 Volts (M.L. Reed, Evaluation of Dresden Station Unit 2 & 3 Degraded Voltage Condition, dated 2/3/92, CHRON 179942). This is an extreme condition which would only occur at the highest off site power system loading condition with two transmission system contingences and a LOCA on Unit 3. CECo is a summer peaking utility, and the highest off site power system loading condition occurs on the hottest day of the year. Lower loading conditions of both the transmission system and the station auxiliary power system will provide higher available voltage during spring, 1992. This will assure pickup of the contactors under worst case loading conditions.

Based on; 1) the qualified GE Series contactor design which assures 75% voltage pickup at the end of its 40 year life; 2) the demonstrated 58% of rated pickup voltage of a new Series 300 contactor through testing; 3) the installation of new Series 300 contactors in all five safety related circuits in question; and 4) the minimum expected voltages during the Spring '92 time period, all contactors will properly perform their safety function.

Modifications will be completed by March 31, 1992 to assure that there is adequate voltage for contactor pickup at the new second level relay setpoint.

DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

Assumption - 14

"The existing location of Panel 2252-83, which will contain one of the undervoltage relays is too close to the core spray pipe to be within the relays acceptable radiation level. Therefore, it is assumed that the panel has been relocated as planned such that the radiation level experienced by the relay is acceptable."

Reference Calculation

8982-13-19-6, Revision 2

Verification Description

Panel 2252-83 has been relocated.
Reference ECN 12-00470E ← To check this?
W.R. No.: D-97548

Follow Up Action

Incorporate assumption verification in calculation.

ATTACHMENT J

RSOs for 2nd Level UV Relays

RELAY SETTING ORDER

C.E.CO. [illegible] 3-83

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 12 DRESDEN KV 4.16 RELAY TYPE ITE27N

A ☒ B ☐ C ☒ ES ☐ ± ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* BUS 23-1 SECOND LEVEL UNDERVOLTAGE

ZONE OR EL. (CHARAC)	EXISTING		TO BE		
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	—		—		
RANGE (RATING)	70-120 V		70-120 V	70% - 99% OF PICKUP	
PRIMARY SETTING	3835 V		3872 V	DROPOUT	
SEC. SET'G (OP. VALUE)	109.57 V		110.63 V	(±0.2 V)	DROPOUT
COMPUTED TAPS			110 V PICKUP	99% DROPOUT	
TEST. A-V CUR. LAG DEG			ADJUST DROPOUT/PICKUP RATIO ≥ 0.995		
TIMING	INST		INST *		

PER CALCULATION # 8982-13-19-6

OAD RECORD RESET VALUE ________. * SET EXTERNAL TIMER TO 7 SEC (±20%) ISSUE DATE 6-27-96 BY TJM COMPLETED ________ BY ________

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

NOTE:

The setpoint calculation has several stipulations for setting (calibrating) these relays which must be adhered to by the Station and the Operational Analysis Department. They are as follows:

1. A Fluke Model 45 multimeter, must be used to set the relay and have been calibrated within the manufacturer's specified tolerance range of 18 to 28 degrees Centigrade. Furthermore, the Fluke 45 must be set to a user selected reading rate of 5 (medium) readings per second. If another voltmeter is to be used then it must have an accuracy equal to or better than the Model 45 in the appropriate volt range and be approved for use in this application by the Nuclear Engineering Department.

2. The relay must be set (calibrated) at a temperature between 21 to 24 degrees Centigrade (70 to 75 degrees Fahrenheit).

3. ABB instruction bulletin I.B.7.4.1.7-7 Issue D can be referenced when setting the ABB/ITE, type 27N-R undervoltage relay with harmonic filter.

RELAY SETTING ORDER
C.E.CO. 88-4804 5-63

FROM [X] STA. ELEC. / [X] SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 12 DRESDEN KV 4.16 RELAY TYPE ITE27NR

A [X] B ☐ C [X] RES. ☐ = ☐ BL. ☐ INSTALL ☐ REPL. ☐ CHG. [X] DEACTIVATE ☐

* BUS 24-1 SECOND LEVEL UNDERVOLTAGE

ZONE OR EL. (CHARAC)	EXISTING		TO BE		
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	—		—		
RANGE (RATING)	70-120V		70-120V.		
PRIMARY SETTING	3820 V		3872 V DROPOUT		
SEC. SET'G (OP. VALUE)	109.15 V		110.63V (± 0.2V) DROPOUT		
COMPUTED TAPS			110V PICKUP, 99% DROPOUT		
TEST A-V CUR. LAG DEG			ADJUST DROPOUT/PICKUP RATIO ≥ 0.995		
TIMING	TAP 5, 7SEC (±20%)		TAP 5, 7 SEC (±20%)		

PER CALCULATION # 8932-13-19-6

AND RECORD RESET VALUE ________.

SUPERSEDES RSO DATED 6/27/96 ISSUE DATE 7-11-96 BY TJM COMPLETED ________ BY ________

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

C.E. CO. — SYS. PLANNING DEPT.
RELAY SETTING ORDER
REVIEW PER:

[X] CONCURRENCE WITH A.E. RECOMMEND...

☐ R.P.S.-TG-S ______ REV. ______ DATE ______

☐ OTHER ______

Barry L. Goodfriend 7-11-96
REVIEW ENGR. DATE

G. S. Taylor 7-11-96
SUPV. ENGR. DATE

ATTACHMENT K

DOC ID 0006191944

ComEd

Dresden Station
Design Information Transmittal

[X]Safety-Related [ ]Non-Safety-Related [ ]Augmented Quality	**Design Information Transmittal** **Dresden Station** **Unit(s): 2 and 3**	**DOC ID _0006191944_____** **Revision – 05** **Page _1__ of _3_**

|RS

To: Mr. William A. Barasa

Organization: Sargent & Lundy LLC

Address/Location: 55 E. Monroe, Chicago, IL 60603-5780

Subject: Improved Technical Specification (ITS) Analytical Limits

Status of Information: ☒ Verified ☐ Unverified

For Unverified DITs, include the Method and Schedule of Verification in the "Description of Information."
List Action Tracking # assigned for verification of "Unverified" information: ____________

Description of Information: The attached table identifies the Analytical Limits, Allowable Values and References for the Timer, Time Delay Relay, Limit Switch, Displacer Switch, and Protective Relay functions identified in the Technical Specifications for use in the preparation of calculations to support the ITS submittal. For many of these functions, the actual Analytical Limits are unknown or unavailable (* Actual AL available). As such, "The Analytical Limits (AL) for these functions and devices shall be conservatively set equal to the current Technical Specification LCO values". This statement shall also be included in the Methodology section of each calculation prepared. Rev. 2 change 4160V ESS Bus Undervoltage (Degraded Voltage) value to 3820 volts per Calc. # 9198-18-19-1 Rev.3, 9198-18-19-2 Rev.3, 9198-18-19-3 Rev. 3 & 9198-18-19-4 Rev.3. Rev. 3 of this DIT changes 4160V ESS Time Delay (No LOCA) Setpoint and Tolerance per page 3. Rev. 4 of this DIT changes device type and calibration frequency for Condensate Storage Tank Level. Rev. 5 of this DIT changes the calibration frequency of calc.#8982-13-19-6 (DCR# 990552) and 8982-17-19-2 (DCR# 990560) due to not having valid site specific and vendor data. |RS

Purpose of Issuance: This Design Information Transmittal supersedes Revision 03 dated 7/05/00 in its entirety. For use in determining Allowable Values for the ITS calculations submittal.

Limitations: None

References (Source of Information):
Current Technical Specification/DCR#990552 & 990560 |RS

Prepared by:	Sujal J. Patel / [signature] Printed Name / Signature	**Date:**	9/5/00
Reviewed by:	Dale R. Eaman / [signature] Printed Name / Signature	**Date:**	9-6-00
Approved by:	Steve V. Tutich / [signature] Printed Name / Signature	**Date:**	9-6-00

Distribution: Doc ID File, R. Peak, DG Central File, D. Eaman, T. Thorsell, T.Loch, D. Ugorcak,

This form has been reviewed against the requirements of CC-AA-310, Rev. 0 and Site Engineering Policy Statement No. 6

Station	Function	ITS Table	ITS Line Item	Current Tech. Specification LCO Value	Device Type	Cal Freq
Dresden	MS Isolation Valve Closure	3.3.1.1-1	5	≤ 10% closed	Limit Switch	24M
Dresden	Turbine Stop Valve Closure	3.3.1.1-1	8	≤ 10% closed	Limit Switch	24M
Dresden	Rx Vsl Water Level Low Low Time Delay	3.3.4.1	SR 3.3.4.1.4a	≥ 8 seconds and ≤ 10 seconds	Time Delay Relay	24M
Dresden	CS CS Pump Start Time Delay Relay	3.3.5.1-1	1e	≤ 14 seconds (Note 1)	Time Delay Relay	24M
Dresden	LPCI Pump Start Time Delay Relay	3.3.5.1-1	2e	≤ 9 seconds (Note 1)	Time Delay Relay	24M
Dresden	LPCI Recirc Pump dP Time Delay Relay	3.3.5.1-1	2i	Deleted. See DRE00-0035 for new values.	Time Delay Relay	24M
Dresden	LPCI Rx Vsl Dome Pressure Time Delay Relay	3.3.5.1-1	2j	Deleted. See DRE00-0035 for new values.	Time Delay Relay	24M
Dresden	LPCI Recirc Riser dP Time Delay Relay	3.3.5.1-1	2k	Deleted. See DRE00-0035 for new values.	Time Delay Relay	24M
Dresden	HPCI Condensate Storage Tank Level Low	3.3.5.1-1	3d	10. 8' for A CST and 7.25' for B CST *	Mech. Level Switch	24M
Dresden	HPCI Suppression Pool Water Level High	3.3.5.1-1	3e	≤ 15 feet-8 1/4 inches **	Mech. Displacer Switch	24M
Dresden	ADSA Initiation Timer	3.3.5.1-1	4c	≤ 120 seconds	Timer	24M
Dresden	ADSA Low Low Water Level Actuation Timer	3.3.5.1-1	4f	≤ 10 minutes	Timer	24M
Dresden	ADSB Initiation Timer	3.3.5.1-1	5c	≤ 120 seconds	Timer	24M
Dresden	ADSB Low Low Water Level Actuation Timer	3.3.5.1-1	5f	≤ 10 minutes	Timer	24M
Dresden	HPCI Steam Line Flow Timer	3.3.6.1-1	3b	≥ 3 seconds and ≤ 9 seconds	Time Delay Relay	92D
Dresden	Low Set RV Reactuation Time Delay	3.3.6.3-1	1b	≥ 8.5 seconds and ≤ 11.5 sec.(Note 1)	Time Delay Relay	24M
Dresden	4160V ESS Bus Undervoltage (Loss of Voltage)	3.3.8.1-1	1	≥ 2784 volts and ≤ 3076 volts	Protective Relay	24M
Dresden	4160V ESS Bus Undervoltage Time Delay	3.3.8.1-1	2a	≥ 5.6 seconds and ≤ 8.4 sec.	Time Delay Relay	24M
Dresden	4160V ESS Bus Undervoltage (Degraded Voltage)	3.3.8.1-1	2a	≥ 3820 volts (Note 3)	Protective Relay	Note 4
Dresden	4160V ESS Time Delay (No LOCA)	3.3.8.1-1	2b	≥ 270 seconds and ≤ 330 sec (See page 3)	Time Delay Relay	24M
Dresden	RPS Elec. Power Monitoring - Overvoltage Trip	3.3.8.2	SR 3.3.8.2.2a	≤ 129.6 volts	Protective Relay	24M
Dresden	RPS Elec. Power Monitoring - Undervoltage Trip	3.3.8.2	SR 3.3.8.2.2b	≥ 105.3 volts	Protective Relay	24M
Dresden	RPS Elec. Power Monitoring - Underfrequency Trip	3.3.8.2	SR 3.3.8.2.2c	≥ 55.4 Hz	Protective Relay	24M
Dresden	RPS Elec. Power Monitoring-Overvoltage Time Delay	3.3.8.2	SR 3.3.8.2.2a	≤ 4 seconds (Note 2)	Time Delay Relay	24M
Dresden	RPS Elec. Power Monitoring-Undervoltage Time Delay	3.3.8.2	SR 3.3.8.2.2b	≤ 4 seconds (Note 2)	Time Delay Relay	24M
Dresden	RPS Elec. Power Monitoring-Underfrequency Time	3.3.8.2	SR 3.3.8.2.2c	≤ 4 seconds (Note 2)	Time Delay Relay	24M

** Actual AL Number (Refer to NDIT SEC-DR-00-018)

* Actual AL Number (Refer to DRE98-0030)

Note 3: Calc. # 9198-18-19-1 Rev.3, 9198-18-19-2 Rev.3, 9198-18-19-3 Rev. 3 & 9198-18-19-4 Rev.3

Note 1: Current Specified Value

Note 2: Allowable Value per DOC ID # 0006046402

Note 4: Due to a lack of plant specific data and to be consistent with Quad and LaSalle, a calibration frequency of 18M is selected. See Calc.#8982-13-19-6 (DCR#990552) & 8982-17-19-2 (DCR#990560). R5

Subject: Second Level Degraded Voltage 5-Minute Time Delay
Basis for Setpoint and Tolerance

A reviewed of the UFSAR and historical documentation was performed to determine if a basis exists for the current Time Delay setting of 5-Minutes +/- 15 Seconds. The following description is provided in UFSAR section 8.3.1.7:

"The 7-second time delay prevents circuit initiation due to grid disturbances and motor starting transients, whereas the 5-minute time allows the operator to attempt restoration of normal bus voltage. The 5-minute timer is bypassed on high drywell pressure / low-low reactor water level."

The NRC Staff SER of May 19, 1982 states:

"The five-minute time delay is of sufficient duration to prevent spurious operation of the second level loss of voltage relays during short bus voltage disturbances that may result from starting large motors or short term grid disturbances. Additional, this time delay will allow operator action to attempt restoration of grid voltage by means available to him." 3

This subject was also discussed with several individuals involved with the early-degraded voltage issues. Based on these discussions and the documentation review conducted, it is concluded that there is no analytical basis for the establishment of the specific time delay of 5-minutes with a tolerance of +/- 15 seconds. It is therefore reasonable to accept an increase in the setpoint tolerance (i.e., +/- 30 seconds) as a result of calculated drift errors.

J.G. Kovach
7/3/2000
JOHN G. KOVACH

ATTACHMENT L

Telecon Between J. Kovach (ComEd) and C. Tobias (S&L)

Date: 4/20/00 3:13 PM
Sender: John.G.Kovach@ucm.com
To: craig tobias
Priority: Normal
Receipt requested
Subject: FW: Telecon Documenting RSOs

~~Craig, I concur with the indicated RSO's as being current and~~
the latest on
file for the indicated services. Please note that the
completion date (op
authorization) for both Bus 23-1 and 24-1 Degraded Voltage
RSO's is
08/23/96.

Regards, John

> -----Original Message-----
> From: craig_tobias@mail.sargentlundy.com
> [SMTP:craig_tobias@mail.sargentlundy.com]
> Sent: Thursday, April 20, 2000 9:15 AM
> To: john.g.kovach@ucm.com
> Subject: Telecon Documenting RSOs
>
> John,
>
> As we spoke on the phone, I am creating an email message to
document our
> phone
> call on 4/18/2000. The topic discussed was the confirmation
that the
> relay
> setting orders (RSO) that I obtained at Dresden were the most
recent relay
> setting orders.
>
> Please confirm the relay setting orders that I obtained
from Dresden
> are the
> most recent relay setting orders. The RSOs are identified
below:
>
> Loss of Voltage Relays RSOs
> Bus 23-1 Issued 2/11/86 Completed 3/1/86
> Bus 24-1 Issued 2/11/86 Completed 3/1/86
> Bus 33-1 Issued 2/11/86 Completed 3/1/86
> Bus 34-1 Issued 2/11/86 Completed 3/1/86
>
> Degraded Voltage Relay RSOs
>
> Bus 23-1 Issued 6/27/96
> Bus 24-1 Issued 7/11/96
> Bus 33-1 Issued 3/16/94 Completed 4/28/94
> Bus 34-1 Issued 10/31/96 Completed 11/8/96
>
> Please review this information and verify that it is correct.
If you
> agree with
> the information, please reply to the message and make a
statement to that
> effect. This document will then serve as telecon for the
calculations

> being
> performed.
>
> Thank you for your time and support.
>
> Yours truly,
> Craig Tobias
> Sargent & Lundy, LLC
> 312-269-6577

ATTACHMENT M

DIT BB-EPED-0178

SARGENT & LUNDY
ENGINEERS

DESIGN INFORMATION TRAN

SAFETY-RELATED | ___ NON-SAFETY-RELATED | DIT No. BB-EPED-0178

CLIENT Commonwealth Edison Company

Page 1 of 1

STATION Byron/Braidwood UNIT(S) 1 & 2

To J. B. Wisniewski-25

PROJECT NO(S) 8915-88

SUBJECT Undervoltage Relay Accuracy Calculation Input Data

MODIFICATION OR DESIGN CHANGE NUMBER(S) N/A

J. J. Bojan	EPED	[signature]	5-7-92
Preparer	Division	Preparer's Signature	Issue Date

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 and requires no further verification.

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.)

The following information is for use in the preparation of the Degraded Voltage Relay Accuracy calculation:

Switchgear Room Environmental Conditions
- Minimum Temp. = 65° F = 18.33
- Maximum Temp. = 108° F = 42.22°
- Relative Humidity = 8 to 70%
- Radiation exposure = $\leq 10^4$ rads
- Internal Switchgear Temp. Rise = $\leq$ 5° F

Potential Transformer Data
- Westinghouse 4200 - 120 V; Model 9146D46G02
- Accuracy = 0.3W, X, Y and 1.2 Z

References
1. UFSAR Section
   a) 9.4.5.4.2
   b) 3.11 (Table 3.11-2)
2. Westinghouse Instruction Book, Volume 3A (Dwg. EN018-6A)
3. Specification F/L-2737-01, Amd. 1, dated 3-3-78
4. Byron Station Walkdown Data, dated 5-11-92 (copy attached)

OURCE OF INFORMATION

alc. No. -- N/A -- (Rev. and/or date) Report No. -- N/A -- (Rev. and or date)

her See above

STRIBUTION

. Galanis/File 66 & 41 - 23
Haddad - 25

Q-3.17.1, Rev. 2(01-08-87)

Calculation No. 8982-13-19-6
Revision 005
Attachment: M

BYRON WALKDOWN

DATA COLLECTED USING INSTR# BY 444
_LUKE" 8024B MULTIMETER W/FLUKE 80T-150 TEMP. PROBE

OUTSIDE AIR TEMP (NEAR UNIT 1 TRACKWAY) 79.8° AT 1:25 PM

BUS#	INSIDE SWGR CUB.*	OUTSIDE SWGR CUB
141	89.3°	86.3°
142	85.5°	84.2°
241	88.4°	87.5°
242	89.9°	89.2°

* WITH DOOR CLOSED TO ALLOW TEMPERATURE TO STABILIZE, THEN DOOR WAS OPENED & TEMPERATURE READ IMMEDIATELY. TEMPERATURE TAKEN INSIDE CUBICLE WHICH CONTAINS ITE DEGRADED VOLTAGE RELAY.

NOTE: BOTH UNITS OPERATING AND VENTILATION SYSTEMS IN ALL SWGR BUS ROOMS OPERATING. THE TEMPERATURE OUTSIDE THE CUBICLE WAS MEASURED NEAR THE SUPPLY AIR DUCT TO ENSURE THE COOLEST TEMPERATURE (RESULTING IN THE GREATEST TEMPERATURE DIFFERENTIAL) WAS RECORDED.

PREPARED: [signature] 5-11-92
VERIFIED: [signature] 5-11-92

ATTACHMENT 3

Calculation 8982-17-19-2, "Second Level Undervoltage Relay Setpoint – Unit 3," Revision 004

			Last Page No. 15
Analysis No.	8982-17-19-2 PAU 7-21-04	**Revision**	004
EC/ECR No.	~~349539~~ 350337 & 350338	**Revision**	000
Title:	Second Level Undervoltage Relay Setpoint – Unit 3		

		Component(s)	
Station(s)	Dresden		
Unit No.:	3		
Discipline	E		
Description Code/ Keyword	E07, E13		
Safety Class	Safety Related		
System Code	67		
Structure	N/A		

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# N/A
Is a Supplemental Review Required?	**Yes** ☐	**No** ☒	If yes, complete Attachment 3

	Print Name	Sign Name	Date
Preparer	Patricia A. Ugorcak	Patricia A. Ugorcak	7-16-04
Reviewer	Scott Shephard	[signature]	7/16/04

Method of Review ☒ Detailed Review ☐ Alternate Calculations ☐ Testing

Review Notes:

	Print Name	Sign Name	Date
Approver	R. Murr	[signature]	8.16.04

(For External Analyses Only)

	Print Name	Sign Name	Date
Exelon Reviewer	DALE EAMAN	Dale Eaman	8-16-04
Approver	[illegible]	[signature]	8.18.04

QA COPY MADE

Description of Revision (list affected pages for partials): Incorporate – ITS DCR 990560 (EC 13955) and minor revisions 3A ~~and 3B~~. Apply latest methodology to determine new setpoint, Allowable Values and Expanded Tolerances. Reformat entire calc. Revision bars shown only for content changes, not for format or section numbering changes. PAU 7-19-04

THIS DESIGN ANALYSIS SUPERCEDES: 8982-17-19-02 Revision 3, 3A~~, 3B~~ PAU 7-19-04

ATTACHMENT 2
Owners Acceptance Review Checklist for External Design Analysis
Page 1 of 1

DESIGN ANALYSIS NO. 8982-17-19-2 **REV:** 004

No.	Question	Yes	No	N/A
1.	Do assumptions have sufficient rationale?	☐	☐	☒ (NONE.)
2.	Are assumptions compatible with the way the plant is operated and with the licensing basis?	☐	☐	☒ (NONE.)
3.	Do the design inputs have sufficient rationale?	☒	☐	☐
4.	Are design inputs correct and reasonable?	☒	☐	☐
5.	Are design inputs compatible with the way the plant is operated and with the licensing basis?	☒ *	☐	☐
6.	Are Engineering Judgments clearly documented and justified?	☐	☐	☒ (NONE.)
7.	Are Engineering Judgments compatible with the way the plant is operated and with the licensing basis?	☐	☐	☒ (NONE.)
8.	Do the results and conclusions satisfy the purpose and objective of the design analysis?	☒	☐	☐
9.	Are the results and conclusions compatible with the way the plant is operated and with the licensing basis?	☒ *	☐	☐
10.	Does the design analysis include the applicable design basis documentation?	☒	☐	☐
11.	Have any limitations on the use of the results been identified and transmitted to the appropriate organizations?	☒	☐	☐
12.	Are there any unverified assumptions?	☐	☒	☐
13.	Do all unverified assumptions have a tracking and closure mechanism in place?	☐	☐	☒

EXELON REVIEWER: DALE EAMAN / Dale Eaman **DATE:** 8-16-04
Print / Sign

* REVISION 004 SUPPORTS A LICENSE AMENDMENT REQUEST (LAR). THE DESIGN INPUTS AND THE RESULTS/CONCLUSIONS ARE COMPATIBLE WITH THE LAR.

CALCULATION TABLE OF CONTENTS

CALC NO.: 8982-17-19-2	REV. NO.: 004	PG NO. 2
SECTION	**PAGE NO.:**	**SUB PAGE NO.:**

1. PURPOSE

The purpose of this calculation is to determine a setpoint, the allowable values, and the expanded tolerances for the second-level undervoltage relays at Dresden Unit 3 based on post LOCA voltage analysis.

The setpoint will consider the setpoint error of the circuit that monitors the voltage at the 4.16 kV safety-related switchgears 33-1 (Div. I) and 34-1 (Div. II). The circuit consists of a GE type JVM-3 4200-120 volt potential transformer (PT) and an ITE-27N undervoltage relay (catalog number 411T4375-L-HF).

2. METHODOLOGY

The methodology for determining the loop uncertainties, setpoints, allowable values, and extended tolerances is done in accordance with NES-EIC-20.04 (Ref. 6.15) and the main body of Reference 6.18 with the clarifications as identified below. Appendix 1 of Reference 6.18 does not apply to this calculation because Appendix 1 is a documentation of guidelines for the Exelon calculations prepared under a different scope of work. However, where the setting tolerance (ST) is greater than the drift tolerance interval (DTIc), the methodology identified on page 23 of Reference 6.18 (part of Appendix 1) is used to determine loop random errors. The nomenclature for the relay setpoint terms, such as pickup, dropout, and reset is taken directly from the relay instruction bulletin (Reference 6.9).

2.1. The error associated with the PT will be established. The error for the PT is classified as a random process error and will be based on the accuracy assigned 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.

2.2. 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 control voltage). Per the methodology of Reference 6.15, reference accuracy or repeatability as specified by the manufacturer are taken as 2σ values, unless specified otherwise.
- Calibration instrument error (defined by the mfr). The error due to calibration standards is considered negligible per the methodology of Reference 6.15.
- 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 Input Data Section 5.4)
- Drift error

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

- Seismic error
- Humidity error
- Pressure error
- Radiation error

2.3. Per the methodology of Reference 6.15, the errors identified above will be combined into total error by adding the total random error to the total non-random error, as follows.

All random error are converted to 1σ values and combined by the "Square root of the sum of the squares"(SRSS) method. The outcome of the SRSS is then doubled to a 2σ value.

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

2.4. The nominal dropout for the two relays 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.

2.5. The drift based on vendor specifications (DTIv) is determined by calculating the square root sum of squares of reference accuracy (RA), calibration error (CAL), setting tolerance (ST), and drift (DR).

If specific values for drift are not provided by the vendor, then a default random [2σ] value of ±1% of span per refueling cycle for mechanical components and ±0.5% of span per refueling cycle for electrical components is assigned (Section 3.1 of Ref. 6.15).

2.6. Allowable Value

An allowable value will be determine utilizing the following equations based on Appendix C of Reference 6.15 as applicable:

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

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

Where AV: is the allowable value

SPc is the calculated setpoint

Zav^{+}, Zav^{-} is the total error (positive, negative) applicable during calibration.

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

The errors that are included for the determination of the allowable values (Zav) are only those applicable during calibration. Thus, only reference accuracy (RA), calibration errors (CAL), setting tolerance (ST), drift (DR) and if applicable, the input error (σin) are included. If DTIc is available, then RA, CAL, ST and DR errors will be replaced by the calculated drift (DTIc).

2.7. Expanded Tolerances (ET)

Expanded tolerances are determined as follows:

a. ET = ±[0.7*(Zav – ST) + ST], where ST is used at a 2σ value.

b. If any of the tolerances determined using the equations above result 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 is still utilized as the as-left tolerance.

3. ACCEPTANCE CRITERIA

The relay setpoints will be chosen such that the lowest possible voltage for relay operation, considering setpoint error, will be no lower than the Analytical Limits as identified in Section 5.6 of this calculation:

3820 V or 91.8% of 4160 V at Switchgear 33-1 (Div I)

3820 V or 91.8% of 4160 V at Switchgear 34-1 (Div II)

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 2.7 and are acceptable if the result is greater than or equal to the application setting tolerance and do not result in a violation of an applicable limit.

4. ASSUMPTIONS/ENGINEERING JUDGEMENTS

None

5. INPUT DATA

5.1. Instrument Channel Configuration (per Reference 6.1.1)

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. Per Reference 6.20, the burden on the PT is within the standard test burden of the PT.

5.2. Loop Element Data (per Reference 6.1.2, 6.1.3, 6.5, 6.6, & 6.9)

5.2.1. The PT is a GE, type JVM-3 (See References 6.1.3 and 6.6)

Voltage ratio:	4200-120
Accuracy class:	0.3 W,X,M.Y : 1.2 Z
Frequency:	50 Hz, 60 Hz
Burden:	750 VA @ 55°C rise above 30°C Ambient
	500 VA @ 30°C rise above 55°C Ambient
BIL:	60 kV

5.2.2. The trip unit is an ABB/ITE, type 27N undervoltage relay with a Harmonic Filter (catalog number 411T4375-L-HF, Ref. 6.1.2)

<u>Setpoint Ranges (per Ref. 6.9)</u>

Pickup:	70 V - 120 V (See Reference 6.9)
Dropout:	70% - 99.5% * of Pickup
Dropout Delay:	1 - 10 sec.

* Note: - Difference between pickup and dropout can be set as low as 0.5%. The setting is 99.50% of pickup (References 6.16 and 6.19).

<u>Operating Ranges (per Refs. 6.5, 6.9, and 6.14)</u>

Control Voltage:	38-58 Vdc (48 Vdc nominal)
	95-140 Vdc (125 Vdc nom.) (Reference 6.14)
	89 Vdc for 1 sec. (Reference 6.14)
Temperature:	-20 to +55°C (normal)
	-30 to +70°C (accident)
Seismic:	6g ZPA

Humidity:	0 to 100% no condensation (Reference 6.11, Section 10.3)	
Pressure:	Atmospheric, to 5000 ft	
Radiation:	Gamma 100k rads over 40 yrs	

<u>Repeatability Tolerances (per Reference 6.9)</u>

@ 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 taken as 2σ values per Reference 6.7).

For the tolerance over temperature range, the repeatability effect is linear over the range of 0 to +55°C, as indicated in Reference 6.7.

5.3. Calibration Instrument Data (per References 6.2 and 6.14)

The Fluke 45 Digital Multimeter will be used for the calibration of the trip unit (see Ref. 6.14 included as Attachment J).

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

5.4. Calibration Procedure Data

The setting tolerance when setting the trip unit voltage is ±0.2 V (Ref. 6.14, 6.16 and 6.19 which is taken as a 3σ value per the methodology in Reference 6.15.

5.5. Station Data

The circuits for these two processes are located entirely in the Reactor Building in Environment Zone 26 per Reference 6.1.2. The following are the conditions that the circuits will be subject to:

<u>Normal Conditions</u>

Control Voltage Range:	95-140Vdc (Ref. 6.14)
Temperature Range:	+18.33 - +39.44°C (see Ref. 6.12)
Humidity Range:	0 - 90%
Radiation Level:	<10k rads over 40 years

<u>Accident Conditions</u>

Control Voltage Range:	95-140Vdc; 89 Vdc for 1 sec. (Ref. 6.14)
Temperature Range:	+18.33 - +39 44°C (see Ref. 6.12)
Humidity Range:	0 - 100% non-condensing

As noted in Reference 6.13, 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 relays are installed will be approximately 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 42.22°C.

The relay has already been qualified for humidity variation, seismic events, radiation exposure, and pressure variation as discussed in References 6.1.2, 6.5, and 6.11.

5.6. Analytical Limit of Switchgear Voltage

The minimum voltages required at the 4160 V safety-related switchgear for adequate auxiliary system performance are taken from References 6.3, 6.4 and 6.17 as:

3820 V or 91.8% of 4160 V at Switchgear 33-1 (Div I)

3820 V or 91.8% of 4160 V at Switchgear 34-1 (Div II)

5.7. Per Reference 6.20, the burden on the PT is within the standard test burden of the PT.

6. REFERENCES

6.1. DIT Number DR-EPED-0685-00, entitled,"ITE-27N Undervoltage Relay and Potential Transformer Technical Data", dated 2-3-92 (Attachment A). The following were included in the DIT:

6.1.1. Dresden Unit 3 Drawings:

12E-3301, Sheet 3, Rev. Z

12E-3334, Rev. K

12E-3345, Sheet 2, Rev. AB

12E-3346. Sheet 2, Rev. AF

12E-3655G, Rev. K

6.1.2. Work Request Number D-97546/D-97547, Rev. 0, entitled "Minor Plant Design Change Package for Commonwealth Edison Company, Dresden Unit 3, Replacement of Second-Level Undervoltage Relays," dated 6-26-91.

6.1.3. 4160 V Switchgear Proposal Data Sheet (page 6) of Specification number K-2175 R.

6.2. User's Manual for Fluke 45 Dual Display Multimeter, Appendix A, Rev. 4, dated 7/97 (Attachment B).

6.3. S&L Calculation Number 9198-18-19-3, Rev. 3, entitled "Calc. for Dresden 3/I Safety-related Continuous Loads - Running/Starting Voltages"

6.4. S&L Calculation Number 9198-18-19-4, Rev. 3, entitled "Calc. for Dresden 3/II Safety-related Continuous Loads - Running/Starting Voltages"

6.5. S&L Interoffice Memorandum from J. F. White, entitled "Seismic Qualification of ITE/ABB Undervoltage Relay Model 27N, Series 411T," which references ABB document number RC-5039-A, entitled "Equipment Performance Specifications, 27N Undervoltage Relay." (Attachment C)

6.6. GE document 7910, page 131, providing information for type JVM-3 Potential Transformer, dated 6-20-77 (Attachment D).

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

6.8. Dresden Unit 3 Technical Specification Number DPR-25, Amendment number 103, specifically table 3.2.2, page 3/4.2-10. This reference provides the second-level undervoltage relay time delay requirement (See Attachment A Page A27).

6.9. ABB Instruction Bulletin Number I.B. 7.4.1.7-7: Issue D for ITE-27N relays and others (Attachment F).

6.10. 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 (Attachment G).

6.11. 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 (Attachment H).

6.12. DIT Number DR-EPED-0671-01, "Reactor Building Ventilation, Minimum Temperature," dated 5-08-92 (Attachment I).

6.13. DIT Number BB-EPED-0178, "Undervoltage Relay Accuracy Calculation Input Data," dated 5-07-92 (Attachment N).

6.14. Interoffice Memorandum from Bipin Desai (EPED), dated December 1, 1993 to R. M. Higdon (EAD) which contains information required for assumption verification (Attachment J).

6.15. NES-EIC-20.04, Revision 3, "Analysis of Instrument Channel Setpoint Error and Instrument Loop Accuracy" (Not Attached)

6.16. Current Relay Setting Orders for the Second Level Undervoltage Relays plus e-mail memo from John G, Kovach to Craig Tobias dated 07/14/00, which discussed the RSO for the second-level undervoltage relay for Bus 33-1 (Attachment K).

6.17. DOC ID 0006191944, Rev. 5-DIT transmitting Improved Technical Specification (ITS) Analytical Limits (Attachment L).

6.18. "Improved Technical Specifications and 24-Month Technical Specification Project Technical Plan", Revision 2 dated 04/28/2000

6.19. Telecon between John Kovach of ComEd and Craig Tobias of Sargent & Lundy dated 4/20/2000 verifying the relay setting orders for the degraded voltage and loss of voltage relays (Attachment M).

6.20. EC 8229, ITS Disconnect U3 Watt-Hr Meter At 33-1 & 34-1, Rev. 0

7. CALCULATIONS

7.1. Per inputs 5.1 and 5.2.1, the PT has a standard published error of ± 0.3% and the burden of 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 random 2σ error. Therefore the PT 1σ error value is ± 0.15%.

7.2. Second Level Undervoltage Relay Random Errors:

7.2.1. Reference accuracy (RA):

Per Input 5.2.2, repeatability at constant temperature and control voltage is ± 0.1% of voltage reading [2σ]. Dividing by 2 to take to a 1σ value:

RA = 0.05% of reading [1σ].

7.2.2. Calibration Instrument error (CAL):

The reference accuracy at medium sampling rate (Reference 6.14) of a 60 Hz voltage signal is ± (0.2% of reading + 10 least significant digits), to a 2σ value per the methodology of Reference 6.15. 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 2σ reference accuracy is ± (0.2% of reading + 10*0.01 V).

Conservatively taking this at a reading 112 V, which is slightly larger than the existing relay setpoint value, and dividing by 2 to get a 1σ value:

$$CALv = \pm(0.2\% * 112\ V + 10 * 0.01V)/2 = 0.162\ V \quad [1\sigma]$$

In terms of % of reading (taken at a reading of 112 V):

$$CAL = CALv/112\ V = 0.162\ V / 112\ V = 0.145\% \text{ of reading} \quad [1\sigma]$$

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 Input Data Section 5.3)

7.2.3. Setting Tolerance (ST)

Per Input Section 5.4, the relay setting tolerance is a random error of ± 0.2 V [3σ]. Converting this to terms of % of reading, for a 112V reading, and dividing by 3 to get the 1σ value:

$$ST = \pm(0.2\ V) / ((112\ V) * 3) = \pm 0.060\% \text{ of reading} \quad [1\sigma]$$

7.2.4. Drift (DR)

According to Reference 6.7, no drift error is expected for the relay as long as the relay is calibrated at reasonable intervals. Thus, DR = 0. However, this is not the case. From operating experience it is known that these relays do drift some. Unfortunately, there is not enough data to perform a drift uncertainty calculation.

Based on the above discussion, a drift value is needed. It is considered conservative to use the default drift effect of 0.5% of span per refueling cycle (reference 6.15). This specification conservatively encompasses the 18 month calibration interval plus 25% late factor (22.5 months) considered in this calculation. The 0.5% of span is a 2σ value. Per Section 5.2.2, the relay functions over a voltage range of 70 V to 120 V, for a span of 50 V. Converting the drift to % of reading, by conservatively setting the reading at 112V, and taking to a 1σ value:

DR = (± 0.5% of span) * (120 V – 70 V) / (112 V) / 2 = ± 0.112% of reading

7.2.5. Random Input Error (σin)

The random input error present at the relay is the random error from the PT, which per Section 7.1 is 0.15%. Thus:

σin = 0.15% of reading [1σ]

7.2.6. Drift Tolerance Interval (DTIv)

$DTIv = \pm (RA^2 + CAL^2 + ST^2 + DR^2)^{1/2}$

Where
- RA = reference accuracy = 0.050% per Section 7.2.1
- CAL = calibration error = 0.145% per Section 7.2.2
- ST = setting tolerance = 0.060% per Section 7.2.3
- DR = drift = 0.112% per Section 7.2.4

Thus:

$DTIv = \pm [(0.050\%)^2 + (0.145\%)^2 + (0.060\%)^2 + (0.112\%)^2)^{1/2}$

DTIv = ± 0.199% of reading [1σ]

7.2.7. Total Random Error (σ)

The total random error is the SRSS of the random errors from Sections 7.2.1 through 7.2.6. Therefore:

$\sigma = \pm (RA^2 + CAL^2 + ST^2 + DR^2 + \sigma in^2)^{1/2}$

$\sigma = \pm [(0.050\%)^2 + (0.145\%)^2 + (0.060\%)^2 + (0.112\%)^2 + (0.150\%)^2)^{1/2}$

σ = ± 0.249% of reading [1σ]

7.3. Relay Non-Random Errors

7.3.1. Temperature effect (eT):

Per Input 5.2, the temperature effect is ±0.75%, and the absolute effect is 1.5% over the temperature range of 0 to +55°C. Per References 6.7 and 6.10, the relay operating voltage increases or decreases approximately linearly with temperature. Applying the 1.5% linearly across the 0 to 55°C range results in a rate of 1.5% / (55 – 0)°C = 0.0273% / °C.

The actual pickup or dropout voltage is lower than the setpoint value if the operating temperature is higher than the temperature at which the relay was calibrated.

Similarly the pickup or dropout voltage is higher than the setpoint value if the operating temperature is lower than the calibration temperature.

Then, for a temperature range of +18.72 to +42.22°C and a relay calibration temperature range of 21 to 24°C (per Reference 6.14), 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 (per Reference 6.14). 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. At 24°C, a larger portion of the error used in the calculation for relay temperature effect will be negative, which will provide a conservative nominal dropout.

Neg. Temp. Effect:

-eT = (24-18.72°C)*0.0273%/°C = 0.144%

<u>Positive Temperature Effect:</u>

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 (per Reference 6.14). 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 21°C rather than 24°C, a larger portion of the error used in the calculation for relay temperature effect will be positive, which will provide a conservative determination of the relay maximum dropout.

Pos. Temp. Effect:

+eT = (42.22-21°C)*0.0273%/°C = 0.579%

Thus, the temperature effect is -0.579%/+0.144%.

This is classified as a non-random error.

7.3.2. Control Voltage Effect (CV)

Per Input 5.2, control voltage effect is ± 0.1% over the dc control voltage range of 100-140 Vdc. This is classified as a non-random error.

CV = ± 0.1% of reading

7.3.3. Environmental Effects

By comparison of the acceptable relay conditions provided in Section 5.2.2 with the expected station conditions provided in Section 5.5, it is evident that no effect on functional capability is introduced as a result of pressure variation or humidity variation.

7.3.4. Seismic Effects

As discussed in Reference 6.1.2, section 1.7, 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.

7.3.5. Total Non-Random Error

The total non-random error is the sum of the non-random errors from sections 7.3.1 through 7.3.2. Therefore:

Negative non-random error is the addition of the negative relay temperature effect (-eT) from Section 7.3.1 and the negative control voltage effect (CV) from Section 7.3.2:

Σe- = -eT + (-CV) = (- 0.579%) + (- 0.1%) = - 0.679% of reading

Positive non-random error is the addition of the positive relay temperature effect (+eT) from Section 7.3.1 and the positive control voltage effect (CV) from Section 7.3.2:

Σe+ = +eT + (+CV) = (+ 0.144%) + (+ 0.1%) = + 0.244% of reading

7.4. Total Error

It should be noted that this calculation utilizes the methodology defined in Sections 2.3 and 2.4 to calculate the dropout setpoint. The calculation uses the Total Negative Error (TNE) in determining the dropout setpoint and the Total Positive Error (TPE) in determining the maximum dropout value. These definitions of error do not follow the methodology defined in Sections 2.6 and 2.7 for calculating the Allowable Values and Expanded Tolerances. Thus, TNE and TPE are used in the determination of the dropout setpoint and maximum dropout value, and Z+, Z-, Zav+ and Zav- are used in the determination of the Allowable Values and Expanded Tolerances.

The total error present at the relay is the combination of the random and non-random errors determined in Sections 7.2.7 and 7.3.5.

Total Error = $2\sigma + \Sigma e$

Total Negative Error (TNE) = 2 * (0.249%) + (0.679%) = 1.177% of reading

Total Positive Error (TPE) = 2 * (0.249%) + (0.244%) = 0.742% of reading

Converting to 4kV voltage process units, by conservatively taking the relay voltage reading at 112V, and then multiplying by the voltage ratio:

TNE = 1.177% * (112 V) * (4200 V/ 120 V) = 46 V (in the 4kV process)

TPE = 0.742% * (112 V) * (4200 V/ 120 V) = 29 V (in the 4kV process)

In this calculation, the terms of Total Positive Error (TPE) and Total Negative Error (TNE) are used for calculating the setpoint. A positive error is one that would cause the actual trip value to be higher than the setpoint value. Using this definition when the errors are applied to calculating the Allowable Values and Expanded Tolerances results in the following relationships:

Z+ = TNE

Z- = TPE

$\Sigma e+$ = Negative Non-Random Errors = 0.679% of reading

$\Sigma e-$ = Positive Non-Random Errors = 0.244 % of reading

Per Section 2.6, Z_{AV} will be used to determine the allowable value random errors. Because the relay is bench calibrated, Z_{AV} includes only the contributions of DTIv, which from Section 7.2.6, is ± 0.199% of reading. Therefore,

σ_{AV} = DTIv = ±0.199% of reading

Per Section 2.6, the total errors for determining allowable values are:

$Z_{AV}+ = 2\sigma_{AV}+$ = 2 * (+ 0.199%) = + 0.398% of reading

$Z_{AV}- = 2\sigma_{AV}-$ = 2 * (- 0.199%) = - 0.398% of reading

Converting to voltage at relay, by using a reading at 112V:

Z_{AV} = (0.398% of reading) * (112 V) = 0.45 V at relay

7.5. Setpoint Determination

The setpoints for 4160 V Switchgear 33-1 (Div. I) and 34-1 (Div. 2) are calculated as:

Nominal Trip Setpoint for Dropout ($NTSP_{DO}$)= Analytical Limit (AL) + TNE

$NTSP_{DO}$ = AL + TNE (Using values from Sections 5.6 and 7.4)

= 3820 V + 46 V = 3866 V at 4.19 kV bus

Converting to voltage read at the relay by multiplying by the voltage ratio:

$NTSP_{DO-R}$ = $NTSP_{DO}$ * (120 V) / (4200 V) = (3866 V) * (120 V)/(4200 V)
= 110.46 V ≈ 110.5 V at relay

$NTSP_{PU-R}$ = $NTSP_{DO-R}$ / 0.995 = 110.5 V / 0.995
= 111.06 V ≈ 111.1 V at relay

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

Maximum Dropout = $NTSP_{DO}$ + TPE = (3866 V) + (0.74% * 3866)
= 3895 V at 4.16 kV bus

Converting to terms of voltage at the relay: (3895 V) * (120 V)/(4200 V) = 111.3 V

Maximum Pickup = Maximum Dropout / (dropout/pickup ratio) = 3895 V / 0.995
= 3915 V at 4.16 kV bus

Converting to terms of voltage at the relay: (3915 V) * (120 V)/(4200 V) = 111.9 V

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

7.6. Allowable Value Determination

Per Section 2.6, the Allowable Value is determined.

The lower allowable value for the dropout setpoint is determined as:

$AV_{DOL} \geq SPc - |Z_{AV}+|$ [lower limit]

SPc_{DO} = 3866 V at 4.16 kV bus (Section 7.5)

$Z_{AV}+$ = 0.398% of reading (Section 7.4)

$AV_{DOL} \geq$ (3866 V) – (0.398% * (3866 V)) = 3851 V

Converting to voltage at the relay, by multiplying by the voltage ratio:

$AV_{DOL-R} \geq$ (3851 V) * (120 V) / (4200 V) = 110.029 V ≈ 110.0 V

Applying the applicable uncertainties to determine the upper dropout AV:

$AV_{DOU} \leq SPc + |Z_{AV}+|$ [lower limit]

$AV_{DOU} \leq$ (3866 V) + (0.398% * (3866 V)) = 3881 V

Converting to voltage at the relay, by multiplying by the voltage ratio:

$AV_{DOU-R} \leq$ (3881 V) * (120 V) / (4200 V) = 110.886 V ≈ 110.9 V

7.7. Expanded Tolerance Determination

Per Section 2.7, the Expanded Tolerance is determined as:

$ET = \pm [0.7 * (|Z_{AV}+| - ST) + ST]$ where ST is taken to a 2σ value

$Z_{AV}+$ = 0.398% of reading (Section 7.4)

ST = 0.2 V [3σ] (Section 5.4)

Taking the ET at a reading of 112V at the relay:

ET = ± [(0.7 * ((0.398% of reading) * (112 V) – (0.2 V *2/3)) + (0.2 V *2/3) = ± 0.352 V at relay

ET ≈ ± 0.35 V at relay

The ET is now checked to ensure that the applicable limits are maintained:

Check 1:	ET	≥	ST ?	
	± 0.35 V	≥	± 0.2 V	PASS
Check 2:	SPc – ET	≥	AV ? [lower limit]	
	110.5 – 0.35 V	≥	110.0 V	
	110.15 V	≥	110.0 V	PASS
Check 3:	SPc + ET	≤	AV ? [upper limit]	
	110.5 + 0.35 V	≤	110.9 V	
	110.85	≤	110.9 V	PASS

8. SUMMARY AND CONCLUSIONS

The following are the recommended settings for the Division I and II second-level undervoltage relays:

The results summarized below are applicable for normal and accident operating conditions, for the existing Analytical Limit of 3820 V. It should be noted that the field setpoint value is required to be revised per this calculation.

Calculated Values Summary

Description	Div. I / II V at relay	Div. I / II (4.16kV equiv.)
SPc (DO)	110.5	3866
SPc (PU)	111.1	3885
AV(DO) lower	≥ 110.0	≥ 3851
AV(DO) upper	≤ 110.9	≤ 3881
Max. DO	111.3	3895
Max. PU	111.9	3915

NOTE: Pickup (PU) is 99.5% of Dropout (DO) (see Section 5.2.2)

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 Dresden Unit 2 Technical Specifications (Reference 6.8), which is 7 seconds.

Please utilize the Instruction Bulletin I.B. 7.4.1.7-7, Issue D (Reference 6.9) when setting the relay since the setpoints and setpoint terminology in this calculation are based on this instruction bulletin

Calibration Summary

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

Calibration Setpoint / Allowable Value (for Dropout (DO)):

EPN	Parameter	Process Units
127-3(4)-B33-1 127-3(4)-B34-1	Field Calibration Setpoint	≥ 110.5 V
	Allowable Value - Lower	≥ 110.0 V
	Allowable Value - Upper	≤ 110.9 V

Calibration Frequency, Setting Tolerances and Expanded Tolerances:

	Surveillance Interval	Setting Tolerance	Expanded Tolerance
Channel Calibration	18 months	± 0.2 V	± 0.35 V

The values calculated above are dependent on the relays being calibrated with a Fluke 45, set on medium rate, to read the voltage at the relay, in the 300 Vac range. Use of other M&TE is only permitted if it is analyzed to be of equal or better accuracy than the Fluke 45.

ATTACHMENT A

DIT DR-EPED-0685-00

SARGENT & LUNDY
ENGINEERS

DESIGN INFORMATION TRANSMITTAL

☒ SAFETY-RELATED	☐ NON-SAFETY-RELATED	DIT No. - DR-EPED-0685-00

CLIENT CECO

STATION DRESDEN UNIT(S) 3

PROJECT NO(S). 8982-17

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To W.G. BLOETHE - 25

SUBJECT ITE-27N UNDERVOLTAGE RELAY AND POTENTIAL TRANSFORMER TECHNICAL DATA

MODIFICATION OR DESIGN CHANGE NUMBER(S) —

S. K. SAHA	EPED	S. K. Saha	2-3-92
Preparer (Please print name)	Division	Preparer's signature	Issue date

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.)

APPROVED FOR USE

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.)

① 12E-3301 SH. 3 REV. Z
12E-3334 REV. K
12E-3345 SH. 2 REV. AB
12E-3346 SH. 2 REV. AF
12E-3655G REV. K

② SWITCHGEAR PROPOSAL DATA SHEET (PAGE 6) FOR SPEC. K-2175

③ DRESDEN UNIT 3 TECH. SPEC. SECTION 3.2 TABLE 3.2.2

POTENTIAL TRANSFORMER (PT) AND ITE-27N UNDERVOLTAGE RELAY INFORMATION.

MINOR PLANT CHANGE DESIGN PACKAGE, W.R. No. D-97546/D-97547, REV. 0, DATED JUNE 26, 1991 FOR DRESDEN UNIT 3.

FOR ENVIOURNMENTAL & OTHER INFORMATION.

SOURCE OF INFORMATION

Calc. no. — Rev. and/or date — Report no. — Rev. and/or date —

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F613A (1/2)
01-87- F3

Calculation No. 8982-17-19-2
Revision 004
Attachment: A
Page A2 of A27

MINOR PLANT CHANGE DESIGN PACKAGE

FOR

COMMONWEALTH EDISON COMPANY

DRESDEN STATION

UNIT 3

REPLACEMENT OF SECOND LEVEL

UNDERVOLTAGE RELAYS MODIFICATION

June 26, 1991

DESIGN INPUT REQUIREMENTS - TABLE OF CONTENTS

1.0 DESIGN INPUT REQUIREMENTS

1.1 BASIC FUNCTIONS TO BE PERFORMED

The basic function to be performed by this modification is to replace the existing second level undervoltage relays Type ITE-27D connected to the Class 1E 4.16-kV Buses 33-1 and 34-1 with Type ITE-27N.

1.2 PERFORMANCE REQUIREMENTS

The performance requirement is for the second level degraded voltage protection scheme relays for the Class 1E 4.16-kV Buses 33-1 and 34-1 to be able to reset (once it drops out) when the system voltage recovers to an acceptable level within the time delay setting. This can be achieved by replacing the existing ITE-27D with ITE-27N relays.

1.3 CODES, STANDARDS, REGULATORY REQUIREMENTS AND QA REQUIREMENTS

The codes and standards listed below will be used as guidelines for this modification. Some portions of the minor plant change may not be designed or procured according to these, but the design will conform to them whenever practical.

	Code	Standard
A)	ANSI C37.90	Relay and Relay System Associated with Electric Power Apparatus.
B)	ANSI C37.90A	Guide for Surge Withstand Capability.
C)	ANSI C37.98-1978	Standard Seismic Testing of Relays.
D)	ANSI N45.2-1971 or NQA-1 (1986) (*1977; 1983)	Quality Assurance Program Requirements for Nuclear Facilities.

E)	ANSI N45.2.2-1978 (*1972)	Packaging, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants.
F)	*IEEE-308-1980 (*1971)	Criteria for Class 1E Power Systems for Nuclear Power Generating Stations.
G)	*IEEE-323-1983 (*1974)	Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.
H)	*IEEE-344-1975	Recommended Practices for Seismic Qualification of Class 1E Equipment.
I)	10 CFR 21	Reporting of Defects and Noncompliance.
J)	10 CFR 50, App. A	General Design Criteria.
K)	10 CFR 50, App. B	Quality Assurance.
L)	10 CFR 50.49	Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants.
M)	Specification K4080 Rev. 2	General Work Specification for Maintenance/Modification Work.
N)	Specification 13524-068-N102, Rev. 3	Equipment Qualification Specification (by Bechtel).
O)	DC-SE-002-DR, Rev. 2	Dresden Seismic Design Criteria.
P)	Specification 13524-068-N101, Rev. 1	Bechtel Radiation Study
Q)	Nuclear Station Work Procedures (NSWP), Vol. III, Rev. 1	

R) CECo Electrical Installation Standard (EIS), Rev. 2

Note: An asterisk (*) designates a code or standard to which Commonwealth Edison Company (CECo) has committed Dresden Station, Unit 3. The revision committed to is not necessarily the same one as is to be used in the design of this modification.

1.4 DESIGN CONDITIONS

The Type ITE-27N relays shall operate under all plant operating conditions and in the environmental conditions given in Section 1.6. The ITE-27N relays will be purchased with an internal harmonic filter to eliminate harmonic distortion in the ac input circuit. The ITE-27N relay has a lower pickup voltage/dropout voltage ratio, which allows the relay to reset (once it drops out) when the system voltage recovers to an acceptable level. Thus, avoiding unnecessary tripping of the off-site power source and transferring of the Class 1E 4.16-kV buses to the on-site diesel generators. See also Section 1.12 for electrical design conditions.

1.5 DESIGN LOADS

The new ITE-27N relays are the same size as the existing ITE-27D relays. There is no significant change in structural loading of the panels where the relays will be installed. Structural loads (i.e., seismic and dead weight) have been evaluated for this modification and found acceptable (see also Sections 1.7 and 1.11). The new relay has an input circuit at 0.5 VA/120 Vac and a control circuit at 0.05 A/125 Vdc which are less than 1.2 VA/120 Vac and 0.08/125 Vdc for the existing relay. The new relays will have no significant thermal heat contribution to the area where they will be located.

1.6 ENVIRONMENTAL CONDITIONS

The existing Dresden, Unit 3 second level undervoltage relays are mounted in Panels 2253-83 and 2253-84. Each panel contains two undervoltage relays. These panels are associated with and located just behind

4160-kV Switchgear Buses 33-1 and 34-1, respectively. These switchgears and panels are located on elevation 545-6" of the Unit 3 Reactor Building. This area is Environmental Zone 26. The environmental parameters (based on E. Q. Binder 44D and Bechtel Specification 13524-068-N101, Rev. 1) were determined for the present locations of these undervoltage relays as presented below:

Parameter	Normal	LOCA
Temperature	104°F	104°F
Pressure	14.7 psia	14.7 psia
Humidity	<90%	100% (non-condensing)
Radiation	<1.0E04	*
Duration	40 years	1 year

* Further detailed reviews (based on distances from radiation sources) have determined that Core Spray Pipe 1404-12" is the relevant radiation source for all the panel locations. Comparison of the distances of each panel from this pipe provided the one-year post Loss Of Coolant Accident (LOCA) doses as shown in the following:

Panel No.	Distance From Pipe 1404-12"	Dose (rads)
2253-83	18 feet	3.5E04 (mild)
2253-84	43 feet	1.0E04 (mild)

Panels 2253-83 and 2253-84 are subject to the effects of an RWCU line break at this location. This area is considered to be a harsh environment in the event of an RWCU line break. However, per EQ binder 44D, the second level undervoltage relay is not required to mitigate the consequences of an RWCU line break (Bechtel Chron 13303 and MLEA Calc. No. 88011-03, dated 11/15/88). CECo is currently evaluating environmental status of the second level undervoltage relays.

1.7 SEISMIC QUALIFICATION

The seismic information contained in ABB Certification Report No. RC-5039-A (submitted for Modification M12-3-89-53) was compared against the seismic requirements for the location of the relays in each subject panel. The Seismic Design Criteria DC-SE-002-DR (Rev. 2) provides the response spectra damping values and seismic design requirements for the Dresden Station. The results of this review is that the ITE-27N relays, purchased to the ABB Report mentioned above, do indeed envelop the seismic requirements for this location and the relays would, therefore, maintain their functional ability during and after a seismic event (Reference Calculation CQD-051325, Rev. 1).

1.8 ENVIRONMENTAL QUALIFICATIONS

The new relays will be installed in the same location within Panels 2253-83 and 2253-84. For a LOCA condition, Panels 2253-83 and 2253-84 are considered to be in a mild environment. For a HELB condition, specifically a RWCU line break, these panels are considered to be in a harsh environment. But, second undervoltage relays are not required to mitigate the consequences of a RWCU line break. Therefore, the second level undervoltage relays do not require environmental qualifications.

1.9 INTERFACE REQUIREMENTS

This modification is limited to the second level undervoltage protection of the Class 1E 4.16-kV Buses 33-1 and 34-1. No other plant system is impacted. This modification will increase the reliability of the second level undervoltage protection by using ITE-27N relays, which have a lower pickup voltage/dropout voltage ratio.

1.10 MATERIAL REQUIREMENTS

In addition to the ABB ITE-27N undervoltage relays, the following materials are required for this modification:

a) Terminal lugs for #14 AWG SIS wires.

b) Switchboard wires, #14 AWG, and 600-V Type SIS.

1.11 STRUCTURAL REQUIREMENTS

The impact of replacing the second level undervoltage relays on Panels 2253-83 and 2253-84 have been seismically evaluated (see Section 1.7 above). The new relays provide no significant change to the structural loading of the subject panels. Therefore, the design capabilities of the structures are not affected.

1.12 ELECTRICAL REQUIREMENTS

This modification does not change the existing design and electrical function of the second level undervoltage relays. The new undervoltage relays shall meet the following specifications:

Detailed Description:

Type:	ABB ITE-27N (High Accuracy Undervoltage Protective Relay)
Control Voltage:	125 Vdc (Nominal)
Input Voltage:	125 Vac (Nominal), Single-Phase
Input Frequency:	60 Hz
Case:	Test Case
Mounting	Semi-Flush
Operating Time:	Definite Time Delay Unit (Dropout Range 1 to 10 Seconds)
Harmonic Filter:	Yes
Standards:	Per IEEE-344 (1975) ANSI C37.90 and C37.98
Catalog No.:	411T4375-HF

Replacement relays will have the same settings as the existing relays. System Planning will issue the relay setting order and Electrical/Instrument and Control Group will review the relay setting order.

The Dresden Station Technical Specification, ELMS electrical design drawings, vendor supplied information, and field walkdowns are utilized to establish the necessary electrical parameters for the second level undervoltage relays.

1.13 LAYOUT AND ARRANGEMENT REQUIREMENTS

The outline dimensions and panel drilling for the new ITE-27N undervoltage relays are identical to the existing ITE-27D relays. Therefore, there will be no additional layout arrangement requirements.

1.14 OPERATIONAL REQUIREMENTS

The plant operational requirements are not changed by this modification.

The second level undervoltage relays are required to protect Class 1E 4.16-kV Buses 33-1 and 34-1 against a degraded voltage condition. The relays are required to initiate a timer (five-minute time delay setting) if a degraded voltage condition persists (see Tech. Spec. Table 3.2.2). After the delay, the relays actuate associated circuits to trip off-site power source breakers, initiate load shedding and start the diesel generators. The relays are also required to be able to reset when the line voltage recovers to an acceptable level within the time delay setting. Thus, overriding unnecessary tripping of off-site power source breaker, load-shedding and starting of the diesel generator.

1.15 INSTRUMENTATION AND CONTROL REQUIREMENTS

There are no additional instrumentation and control requirements since this modification does not change the function or logic circuitry of the second level undervoltage protection scheme.

1.16 TECHNICAL SPECIFICATION CHANGES

This modification does not change any set points or time delay settings for the existing undervoltage protection scheme. The new relay has a drop out tolerance of +/- 0.5% which is bounded by the existing relay tolerance of +/- 2%. This tolerance is stated in Table 3.2.2 of the Technical Specification. The lower reset voltage is an internal characteristic of the new undervoltage relay. Therefore, no changes to the Technical Specifications are required as result of this modification. The Dresden station, Unit 3, Technical Specifications, Sections 3.2 and 3.9, and Table 3.2.2 were reviewed in making this determination.

1.17 FSAR/UFSAR CHANGES

This modification does not require changes to the Dresden Station, Unit 3 Final Safety Analysis Report (FSAR)/Updated Final Safety Analysis Report (UFSAR). The FSAR/UFSAR, Section 8.2.3.1. was reviewed in making this determination.

1.18 REDUNDANCY, DIVERSITY, AND SEPARATION REQUIREMENTS

The redundancy, diversity, and separation requirements for the Class 1E 4.16-kV Buses 33-1 (Division I) and 34-1 (Division II) are not affected by this modification.

1.19 FAILURE MODES AND EFFECTS REQUIREMENTS

This modification will reduce the probability of inadvertent tripping of the Class 1E 4.16-kV buses off-site power source when the system voltage is at an acceptable level, and thus minimize unnecessary load shedding and starting of the diesel generators. No other failure effects are changed by this modification.

1.20 TEST, NDE, AND WELDING REQUIREMENTS

CECo and S&L will define the applicable tests and the acceptance criteria for the tests. The new undervoltage relays are required to be tested per CECo Test Procedure DOS 6600-09. This test declares the relays operable after the implementation of this modification. There are no NDE or welding requirements.

1.21 ACCESSIBILITY , MAINTENANCE, REPAIR AND ISI

This modification does not affect or change the accessibility for maintenance, repair, and in-service inspection of the undervoltage relays.

1.22 RISK TO HEALTH AND SAFETY OF THE PUBLIC

This modification will not increase the risk to the health and safety of the public.

1.23 SUITABILITY OF PARTS, EQUIPMENT, PROCESSES, AND MATERIALS

All components used for this modification shall be compatible with the existing design and shall comply with the requirements in Sections 1.2, 1.6, 1.7, 1.8, 1.9, 1.10, and 1.12.

1.24 PERSONNEL SAFETY

No special personnel safety requirements exist for installing this modification. Standard precautions for working on electrical equipment are considered adequate for this project. No hazardous materials (e.g., asbestos) are to be used.

1.25 CATHODIC PROTECTION REQUIREMENTS

Cathodic protection is not required for this modification since no new metal pipes or structures are being added.

1.26 INDUSTRY EXPERIENCE (SER/SOER KEYWORK INDEX)

After the degraded system voltage events at the Millstone Unit 2 Nuclear Plant in 1976, the Nuclear Regulatory Commission concluded that system design alone does not ensure the adequacy of the off-site power supply, and therefore, undervoltage relaying schemes should be installed on the system to protect against the possibility of degraded system voltage. Experience with the added protection system over the past 10 years has revealed some problems in scheme logic and application that caused loss of the off-site power supply. The following is a brief review of one of these occurrences:

On August 1, 1983, the Monticello Nuclear Generating Plant experienced an actuation of the degraded voltage protection system. The plant was operating at rated power. The safety buses were running at 95.2% of nominal bus voltage. This is 1.8% higher than the degraded voltage protection system setpoint. During this time, a large safety-related pump motor was started. The voltage dip from starting the motor caused the voltage to drop below the degraded voltage protection system's setpoint. This activated the undervoltage relay and initiated the time intended to allow the protection system override such motor starting events. After the motor started, the voltage at the bus recovered to about 95% of bus nominal voltage, the same voltage level prevailing before the motor starting event. This, however, did not allow the undervoltage relay to reset at a higher level than the voltage of the buses even prior to the motor starting (95.8%). This actuated the degraded voltage protection system. This event suggested that the undervoltage relay reset characteristics have not been carefully considered in analyzing the system or selecting the hardware. In this case, the relay reset point is 2.6% higher than the trip setpoint. This would require that the bus voltage be maintained at a level 2.6% higher than the relay setpoint to prevent inadvertent loss of off-site power.

This modification is being initiated to prevent a similar occurrence at the Dresden Station, Unit 3.

1.27 STANDARD INSTALLATION SPECIFICATIONS

Installation work for this modification will be performed in accordance with the CECo's EIS, General Work Specification K4080, and Asea Brown Boveri Instruction Manual for ITE-27N relays.

1.28 STANDARD STATION INSTALLATION PROCEDURES AND QC PROCEDURES

Standard Station Installation and QC Procedures will be used for this modification.

1.29 ENGINEERING CHECKLISTS

Attachment 12.1 contains the following engineering checklists required by Procedure ENC-QE-06.

1.29.1 System Interaction

The Nuclear Engineering Department (NED) Procedure ENC-QE-06.2, Exhibit A, "System Interaction Checklist," was used to evaluate system interactions that might be created by the installation of use of this minor plant change and, therefore, must be considered in its design. Input for this evaluation was taken from the Dresden Final Safety Analysis Report (FSAR), Updated Final Safety Analysis Report (UFSAR), applicable station drawings, vendor information, and walkdown information. There are no system interactions that must be accounted for.

1.29.2 Acceptance Testing

The NED Procedure QE-06.4, Exhibit A, "Modification Acceptance Testing Checklist," was used to evaluate the testing requirements. The testing requirements are described in the Summary of Testing Acceptance Criteria. Input for this evaluation is from the documents used as the guidance for writing the test procedures and other references listed in the Summary of Testing Acceptance Criteria.

1.29.3 ALARA

The NED Procedure ENC-QE-06.5, Exhibits A, B, and C, "ALARA Review Checklist," was used to evaluate the ALARA requirements for this minor plant change. Input for this evaluation is from station personnel, Radiation Zone Maps, Regulatory Guide 8.8, and the modification description.

The radiological impact of this minor plant change is minimal. Therefore, a formal ALARA plan is not required and that standard radiological control procedures may be followed.

1.29.4 Environmental Qualification

The NED Procedure ENC-QE-06.6, Exhibit A, "Equipment Environmental Qualification Flowchart Checklist" was used to evaluate the environmental qualification requirements for this minor plant change. Input for this evaluation is from Bechtel's Specification 13524-068-N102 and Dresden Station UFSAR. Relays are located in a mild environment for a LOCA accident. For a HELB accident, relays are located in a harsh environment, but are not required for operation.

1.29.5 Fire Protection

The NED Procedure ENC-QE-06.7, Exhibit A, "Fire Protection Review Checklist," was used to evaluate the fire protection and safe shutdown requirements for this minor plant change. The Fire Protection System in the surrounding area where the undervoltage relays are located are not required to be modified as a result of this minor plant change. No other fire protection or safe shutdown concerns were identified.

2.0 WALKDOWNS

2.1 Designer's Walkdown

The Designer's Walkdown was performed on April 26, 1991, to confirm and provide input for the detailed design of this minor plant change. The Designer's Walkdown Checklist is included as an attachment.

2.2 Installer's Walkdown

The Installer's Walkdown has been performed on June 4, 1991, to verify constructability of this minor plant change. The Installer's Walkdown Checklist will be included in the Minor Plant Change Design.

3.0 CONCEPTUAL DESIGN DOCUMENTS

Conceptual design sketches of the second level undervoltage protection scheme for Class 1E 4.16-kV Buses 33-1 and 34-1 are included as an attachment. The sketches include schematic, wiring, and single line diagrams.

4.0 NOTES FROM CONCEPTUAL DESIGN PROJECT REVIEW KICKOFF MEETING

The notes from the Project Kickoff meeting and photographs taken during the Designer's Walkdown are included as an attachment.

5.0 SAFETY-RELATED COMPONENT OR MASTER EQUIPMENT LIST

The new second level undervoltage relays for the Class 1E 4.16-kV Buses 33-1 and 34-1 are classified as safety-related. The Master Equipment List should be updated to include the device numbers for the new relays. the Master Equipment List Update Form (Exhibit C, ENC-QE-12.1) is included as an attachment.

6.0 COMPONENT CLASSIFICATION

The new second level undervoltage relays are classified as safety-related. The Classification of Component Form (Exhibit B, ENC-QE-12.1) is included as an attachment.

7.0 INSTALLATION PROCEDURES

Installation work for this minor plant change shall be performed in accordance with the CECo EIS and standard procedures for safety-related work.

8.0 PROCUREMENT DOCUMENTS

8.1 Bills of Material

No Bill of Material is required for this minor plant change.

8.2 Equipment Specifications

No equipment specifications are required for this minor plant change.

8.3 Material Specifications

No material specifications are required for this Minor Plant Change.

8.4 Equipment Requirements Schedules (ERS)

Materials other than the protective relays required for this minor plant change are specified in the ERS.

8.5 Purchase Orders

Purchase orders for the undervoltage relays have been issued by CECo to the appropriate manufacturer.

9.0A AC/DC LOADS

Input load tickets have been completed to reflect the new model number (ITE-27N) and are included as an attachment (see attachments).

9.0B ELECTRICAL PROTECTIVE DEVICE SETTINGS

System Planning will issue the relay setting order and CECo. Electrical/Instrument and Control group will review the relay setting order. New relays will have the same settings.

10.0 ENGINEERING DESIGN EVALUATION (QP 3-1)

The design documents for this minor plant change have been reviewed in accordance with Quality Procedures 3.1.

11.0 REFERENCE TO CONFIRMATORY ANALYSES

11.1 Calculations

Seismic Qualification Calculation No. CQD-051325.

11.2 Technical Reports

There are no Technical Reports prepared for this minor plant change.

11.3 Stress Reports/Overpressure Protection Report

This minor plant change does not require a Stress Report or Overpressure Protection Report.

11.4 Computer I/O Listings

No Computer I/O Listings were generated for this minor plant change.

12.0 ATTACHMENTS

Approved by: ______________________ Date: ____________________

REO:kdf
WDQC1834.EP

SARGENT & LUNDY ENGINEERS

ELECTRICAL LOAD MONITORING SYSTEM (ELMS)

DC LOAD DATA FORM

SAFETY RELATED YES ☒ NO ☐

PAGE 1 OF 4

UTILITY: CECo STATION: Dresden UNIT: 3 PROJ. NO.: 8900-03

ITEM	DESCRIPTION	DATA	NOTES
A	LOAD NAME	127-3-B33-1	
B	LOAD STATUS (E, N OR M)	M	
C	INRUSH CURRENT - AMPS		
D	INRUSH DURATION - SECONDS		
E	CONTINUOUS LOAD CURRENTS - AMPS	0.05 Amps	
F	TIME LOAD STARTS - MM.ss	0.00	
G	LOAD DURATION - MM.ss	240.00	
H	SOURCE BUS OR PANEL	TB MN BUS 3A-1	
I	SYSTEM CODE		
M	MODIFICATION NUMBER		
N	CABLE NUMBER		

SOURCE OF DATA EXCEPT AS NOTED:

Model # ABB ITE-27N

CAT. No. 411T4375-HF

From ABB Instructions IB 7.4.1.7-7 (Issue D)

Control Input Current = .05 Amps (Max.)

DATA FORM PREPARATION				DATA ENTRY INTO (ELMS)			
DATE	PREPARER	REVIEWER	REV.	DATE	PREPARER	REVIEWER	REV.
5/24/91	T. E. Hill	R. E. O'Hara	0				

F10688 08-86-K

S&L EFILE: LASEISC.1

SARGENT & LUNDY ENGINEERS

ELECTRICAL LOAD MONITORING SYSTEM (ELMS)

DC LOAD DATA FORM

SAFETY RELATED
YES ☒ NO ☐

UTILITY: CECo STATION: Dresden UNIT: 3 PROJ. NO.: 8900-03

ITEM	DESCRIPTION	DATA	NOTES
A	LOAD NAME	127-4-B33-1	
B	LOAD STATUS (E, N OR M)	M	
C	INRUSH CURRENT - AMPS		
D	INRUSH DURATION - SECONDS		
E	CONTINUOUS LOAD CURRENTS - AMPS	0.05 A	
F	TIME LOAD STARTS - MM.ss	0.00	
G	LOAD DURATION - MM.ss	240.00	
H	SOURCE BUS OR PANEL	TB MN BUS 3A-1	
I	SYSTEM CODE		
M	MODIFICATION NUMBER		
N	CABLE NUMBER		

SOURCE OF DATA EXCEPT AS NOTED:

Model # ABB ITE-27N

CAT. No. 411T4375-HF

From ABB Instruction Manual IB 7.4.1.7-7 (Issue D):

Control Input Current = 0.05 Amps (Max.)

DATA FORM PREPARATION				DATA ENTRY INTO (ELMS)			
DATE	PREPARER	REVIEWER	REV.	DATE	PREPARER	REVIEWER	REV.
5/24/93	M.E. Hill	R.E. O'Hara	0				

S&L E[...]FILE: LASEISC.1

F1068B 08-86-K

SARGENT & LUNDY ENGINEERS

ELECTRICAL LOAD MONITORING SYSTEM (ELMS)

DC LOAD DATA FORM

SAFETY RELATED YES ☒ NO ☐

PAGE 3 OF 4

UTILITY: CECo STATION: Dresden UNIT: 3 PROJ. NO.: 8900-03

ITEM	DESCRIPTION	DATA	NOTES
A	LOAD NAME	127-3-834-1	
B	LOAD STATUS (E, N OR M)	M	
C	INRUSH CURRENT - AMPS		
D	INRUSH DURATION - SECONDS		
E	CONTINUOUS LOAD CURRENTS - AMPS	.05 A	
F	TIME LOAD STARTS - MM.ss	0.00	
G	LOAD DURATION - MM.ss	240.00	
H	SOURCE BUS OR PANEL	TB RES BUS 3B-1	
I	SYSTEM CODE		
M	MODIFICATION NUMBER		
N	CABLE NUMBER		

SOURCE OF DATA EXCEPT AS NOTED:

Model # ABB ITE-27N

CAT. No. 411T4375-HF

From ABB Instruction Manual IB 7.4.1.7-7 (Issue D):

Control Input Current = 0.05 Amps (Max.)

DATA FORM PREPARATION				DATA ENTRY INTO (ELMS)			
DATE	PREPARER	REVIEWER	REV.	DATE	PREPARER	REVIEWER	REV.
5/24/91	H. S. Hill	R.E. O'Hara	0				

S&L FILE: LASEISC.I

F1068B 08-86-K

SARGENT & LUNDY ENGINEERS

ELECTRICAL LOAD MONITORING SYSTEM (ELMS)

SAFETY RELATED
YES [X] NO [ ]

DC LOAD DATA FORM

UTILITY: CECo STATION: Dresden UNIT: 3 PROJ. NO.: 8900-03

ITEM	DESCRIPTION	DATA	NOTES
A	LOAD NAME	127-4-B34-1	
B	LOAD STATUS (E,N OR M)	M	
C	INRUSH CURRENT - AMPS		
D	INRUSH DURATION - SECONDS		
E	CONTINUOUS LOAD CURRENTS - AMPS	0.05 Amps	
F	TIME LOAD STARTS - MM.ss	0.00	
G	LOAD DURATION - MM.ss	240.00	
H	SOURCE BUS OR PANEL	TB RES BUS 3B-1	
I	SYSTEM CODE		
M	MODIFICATION NUMBER		
N	CABLE NUMBER		

SOURCE OF DATA EXCEPT AS NOTED:

Model # ABB ITE-27N

CAT. No. 411T4375-HF

From ABB Instruction Manual IB 7.4.1.7-7 (Issue D):

Control Input Current = 0.05 Amps (Max.)

DATA FORM PREPARATION				DATA ENTRY INTO (ELMS)			
DATE	PREPARER	REVIEWER	REV.	DATE	PREPARER	REVIEWER	REV.
5/24/91	M. E. Hill	R.E. O'Hara	0				

S&L EL FILE: LASEISC.I

F10688 08-86-K

Name of Bidder: General Electric Company

SWITCHGEAR DATA, Cont.

	(Insert all data in these columns) 1200 A	2000 A	3000 A
H. Percentage of water absorbed in bus supports per ASTM Test D570 (plastic) or XXXXXXXXXXXXXXX ....(X)	.05 grams		
I. Minimum clearance between buses:			
a. Phase-to-phase ....(inches)		4.5	
b. Phase-to-ground ....(inches)		3.0	
J. Bus spacing center-to-center.....(inches)		5.0	
K. Tap spacing center-to-center.....(inches)		6.0	
L. Type and description of bus joints.......	Bolted,	Silver	plated
M. Size and material of main bus............	Aluminum		
N. Size and material of ground bus..........	2 X 3/8	Copper	

	Manufacturer	Type
O. Watthour meter..........................		
P. Circuit breaker control switch...........		SBM
Q. Overcurrent relay.......................	All	IAC
R. Overcurrent ground relay................	General	IAC
S. Undervoltage relay......................	Electric	IAV
T. Elapsed time meter......................		KT
U. Potential transformer.....................		[redacted]
Accuracy..................................		[redacted]
V. Current transformer.....................		JCS-O
Accuracy..................................	ASA.6 B-0.1, 2.4,	B-0.2, B-0.5, 13-2
W. Cubicle Space Heaters:		
Watts per cubicle..........................		
Voltage rating............................		

9. BUS DUCT ASSEMBLIES (Furnish information for both indoor and outdoor designs, where different):

A. High potential withstand test at factory on assembled structure:

60-cycle (1 minute)................(kv)		19

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TABLE 3.2.2

INSTRUMENTATION THAT INITIATES OR CONTROLS THE CORE AND CONTAINMENT COOLING SYSTEMS

Min. No. of Operable Inst. Channels per Trip System (1)	Trip Function	Trip Level Setting	Remarks
(2)	Reactor Low Low Water Level	84" (plus 4, minus 0 inches) above top of active fuel (5)	1. In conjunction with low reactor pressure initiates core spray and LPCI. 2. In conjunction with high dry-well pressure, 120 sec. time delay, and low pressure core cooling interlock initiates auto blowdown. 3. Initiates HPCI and SBGTS. 4. Initiates starting of diesel generators.
2	High Drywell Pressure (2), (3)	Less than or equal to 2 PSIG	1. Initiates core spray LPCI, HPCI, and SBGTS. 2. In conjunction with low low water level 120 sec. time delay and low pressure core cooling interlock initiates auto blowdown. 3. Initiates starting of diesel generators.
1	Reactor Low Pressure	Greater than or equal to 300 PSIG & less than or equal to 350 PSIG	1. Permissive for opening core spray and LPCI admission valves. 2. In conjunction with low low reactor water level initiates core spray and LPCI.
1(4)	Containment Spray Interlock 2/3 Core Height	Greater than or equal to 2/3 core height	Prevents inadvertent operation of containment spray during accident conditions.
2(4)	Containment High Pressure	Greater than or equal to 0.5 PSIG & less than or equal to 1.5 PSIG	Prevents inadvertent operation of containment spray during accident conditions.
1	Timer Auto Blowdown	Less than or equal to 120 seconds	In conjunction with low low reactor water level, high dry-well pressure and low pressure core cooling interlock initiates auto blowdown.
2	Low Pressure Core Cooling Pump Discharge Pressure	Greater than or equal to 50 PSIG & less than or equal 100 PSIG	* Defers APR actuation pending confirmation of low pressure core cooling system operation.
2/Bus	4 KV Loss of Voltage Emergency Buses	Trip on 2930 volts plus or minus 5% decreasing voltage	1. Initiates starting of diesel generators. 2. Permissive for starting ECCS pumps. 3. Removes nonessential loads from buses. 4. Trips emergency bus normal feed breakers.
2	Sustained High Reactor Pressure	Less than or equal to 1070 PSIG for 15 seconds	Initiates isolation condenser.
2/Bus	Degraded Voltage on 4 KV Emergency Buses	Greater than or equal to 3708 volts (equals 3784 volts less 2% tolerance) after less than or equal to 5 minutes (plus 5% tolerance) with a 7 second (plus or minus 20%) inherent time delay	Initiates alarm and picks up time delay relay. Diesel generator picks up load if degraded voltage not corrected after time delay.

Notes: (See next page)

ATTACHMENT B

Fluke 45 Dual Display Multimeter User's Manual, Appendix A

FLUKE®

45

Dual Display Multimeter

Users Manual

PN 855981
January 1989, Rev. 4, 7/97

Calculation No. 8982-17-19-2
Revision 004
Attachment: B
Page B2 of B12

Appendix A
Specifications

Introduction

Appendix A contains the specifications of the Fluke 45 Dual Display Multimeter.

These specifications assume:

- A 1-year calibration cycle
- An operating temperature of 18 °C to 28 °C (64.4 °F to 82.4 °F)
- Relative humidity not exceeding 90 % (non-condensing) (70 % for 1,000 kΩ range

Accuracy is expressed as +(percentage of reading + digits).

Display Counts and Reading Rates

Rate	Readings per Second	Full Range Display Counts
Slow	2.5	99,999*
Medium	5	30,000
Fast	20	3,000
* Ohms full range will typically be 98,000 counts		

RS-232 and IEEE-488 Reading Transfer Rates

Rate	Reading Per Second		
	Internal Trigger Operation (TRIGGER 1)	Internal Trigger Operation (TRIGGER 4)	Print Mode Operation (Print set at 1)
Slow	2.5	1.5	2.5
Medium	4.5	2.4	5.0
Fast	4.5	3.8	13.5

Response Times

Refer to Section 4 for detailed information.

DC Voltage

Range	Resolution			Accuracy	
	Slow	Medium	Fast	(6 Months)	(1 Year)
300 mV	—	10 μV	100 μV	002 % + 2	0.025 % + 2
3 V	—	100 μV	1 mV	0.02 % + 2	0.025 % + 2
30 V	—	1 mV	10 mV	0.02 % + 2	0.025 % + 2
300 V	—	10 mV	100 mV	0.02 % + 2	0.025 % + 2
1000 V	—	100 mV	1 V	0.02 % + 2	0.025 % + 2
100 mV	1 μV	—	—	0.02 % + 6	0.025 % + 6
1000 mV	10 μV	—	—	0.02 % + 6	0.025 % + 6
10 V	100 μV	—	—	0.02 % + 6	0.025 % + 6
100 V	1 mV	—	—	0.02 % + 6	0.025 % + 6
1000 V	10 mV	—	—	0.02 % + 6	0.025 % + 6

Input Impedance

10 MΩ in parallel with <100 pF

Note

In the dual display mode, when the volts ac and volts dc functions are selected, the 10 MΩ dc input divider is in parallel with the 1 MΩ ac divider.

Normal Mode Rejection Ratio

>80 dB at 50 Hz or 60 Hz, slow and medium rates

>54 dB for frequencies between 50-440 Hz, slow and medium rates

>60 dB at 50 Hz, fast rate (Note: Fast rate has no filtering)

Maximum Allowable AC Voltage While Measuring DC Voltage or (AC + DC) Voltages

Range		Max Allowable Peak AC Voltage	Peak Normal Mode Signal	
			NMRR* >80 dB†	NMRR >60 dB†
300 mV	100 mV	15 V	15 V	15 V
3 V	1000 mV	15 V	15 V	15 V
30 V	10 V	1000 V	50 V	300 V
300 V	100 V	1000 V	50 V	300 V
1000 V	1000 V	1000 V	200 V	1000 V

* NMRR is the Normal Mode Rejection Ratio
† Normal Mode Rejection Ratio at 50 Hz or 60 Hz ±0.1 %

Common Mode Rejection Ratio

>90 dB at do, 50 or 60 Hz, (1 kΩ unbalanced, medium and slow rates)

Maximum Input

1000V dc or peak ac on any range

True RMS AC Voltage, AC-Coupled

Range	Resolution		
	Slow	**Medium**	**Fast**
300 mV	—	10 µV	100 µV
3 V	—	100µV	1 mV
30 V	—	1 mV	10 mV
300 V	—	10 mV	100 mV
750 V	—	100 mV	1 V
100 mV	1 µV	—	—
1000 mV	10 µV	—	—
10 V	100 µV	—	—
100 V	1 mV	—	—
750 V	10 mV	—	—

Accuracy

Frequency	Linear Accuracy			dB Accuracy		Power*	Max Input at Upper Freq
	Slow	**Medium**	**Fast**	**Slow/Med**	**Fast**		
20-50 Hz	1 % + 100	1 % + 10	7 % + 2	0.15	0.72	2 % + 10	750 V
50 Hz-10 kHz	0.2 % + 100	0.2 % + 10	0.5 % + 2	0.08	0.17	0.4 % + 10	750 V
10-20 kHz	0.5 % + 100	0.5 % + 10	0.5 % + 2	0.11	0.17	1 % + 10	750 V
20-50 kHz	2 % + 200	2 % + 20	2 % + 3	0.29	0.34	4 % + 20	400 V
50-100 kHz	5 % + 500	5 % + 50	5 % + 6	0.70	0.78	10 % + 50	200 V

* Error in power mode will not exceed twice the linear accuracy specification

Accuracy specifications apply within the following limits, based on reading rate:

Slow Reading Rate: Between 15,000 and 99,999 counts (full range)
Medium Reading Rate: Between 1,500 and 30,000 counts (full range)
Fast Reading Rate: Between 150 and 3,000 counts (full range)

Decibel Resolution

Resolution	
Slow & Medium	**Fast**
0.01 dB	0.1 dB

Decibel Reference Resistance

8000 Ω	500 Ω	124 Ω	8 Ω†
1200 Ω	300 Ω	110 Ω	4 Ω†
1000 Ω	250 Ω	93 Ω	2 Ω†
900 Ω	150 Ω	75 Ω	
800 Ω	135 Ω	50 Ω	
600 Ω*	125 Ω	16 Ω†	

* Default resistance
† Reading displayed in watts (POWER)

Input Impedance

1 MΩ in parallel with <100 pF

Maximum Crest Factor

3.0

Common Mode Rejection Ratio

>60 dB at 50 Hz or 60 Hz (1 kΩ unbalanced medium rate)

Maximum Input

750 V rms, 1000 V peak

2 X 107 Volt-Hertz product on any range, normal mode input

1 x 106 Volt-Hertz product on any range, common mode input

(AC + DC) Voltage Accuracy

Total Measurement Error will not exceed the sum of the separate ac and dc accuracy specifications, plus 1 display count. Refer to the table under "Maximum Allowable AC Voltage while Measuring DC Voltage or (AC + DC) Voltages" located on page A3.

Note

When measuring ac + dc, (or any dual display combination of ac and dc) in the fast reading rate, the Fluke 45 may show significant reading errors. This results from a lack of filtering on the dc portion of the measurement for the fast reading rate. To avoid this problem, use only the "slow" and "medium" reading rates for ac + dc or ac and dc combinations.

Maximum Frequency of AC Voltage Input While Measuring AC Current

When the meter makes ac current and ac voltage measurements using the dual display, the maximum frequency of the voltage input is limited to the maximum frequency of the current function. For example, if you are making an ac current measurement on the 10 A range, the maximum frequency of the voltage input must be less than 2 kHz.

DC Current

Range	Resolution			Accuracy	Burden Voltage
	Slow	Medium	Fast		
30 mA	—	1 µA	10 µA	0.05 % + 3	0.45 V
100 mA	—	10 µA	100 µA	0.05 % + 2	1.4 V
10 A	—	1 mA	10 mA	0.2 % + 5	0.25 V
10 mA	100 nA	—	—	0.05 % +	0.14 V
100 mA	1 µA	—	—	50.05 % + 5	1.4 V
10 A	100 µA	—	—	0.2 % + 7	0.25 V
* Typical at full range					

Maximum Input

To be used in protected, low energy circuits only, not to exceed 250 V or 4800 Volt-Amps. (IEC 664 Installation Category II.)

mA 300 mA dc or ac rms. Protected with a 500 mA, 250V, IEC 127-sheet 1, fast blow fuse

A 10 A dc or ac rms continuous, or 20 A dc or ac rms for 30 seconds maximum. Protected with a 15 A, 250 V, 10,000 A interrupt rating, fast blow fuse.

Note

Resistance between the COM binding post and the meter's internal measuring circuits is approximately .003 Ω.

AC Current

Range	Resolution			Burden Voltage*
	Slow	Medium	Fast	
10 mA	100 nA	—	—	0.14 V
30 mA	—	1 µA	10 µA	0.45 V
100 mA	1 µA	10 µA	100 µA	1.4 V
10 A	100 µA	1 mA	10 mA	0.25 V
* Typical at full range				

Accuracy

Range	Frequency	Accuracy		
		Slow	Medium	Fast
mA (To 100 mA)	20-50 Hz	2 % + 100	2 % + 10	7 % + 2
mA (To 100 mA)	50 Hz-10 kHz	0.5 % + 100	0.5 % + 10	0.8 % + 2
mA (To 100 mA)	10 -20 kHz	2 % + 200	2 % + 20	2 % + 3
A (1-10A)	20-50 Hz	2 % + 100	2 % + 10	7 % + 2
A (1-10A)	50 Hz-2 kHz	1 % + 100	1 % + 10	1.3 % + 2
A (0.5 to 1A)	20-50 Hz	2 % + 300	2 % + 30	7 % + 4
A (0.5 to 1A)	50Hz-2 kHz	1 % + 300	1 % + 30	1.3 % + 4

mA accuracy specifications apply within the following limits, based on reading rate:

Slow Reading Rate:	Between 15,000 and 99,999 counts (full range)
Medium Reading Rate:	Between 1,500 and 30,000 counts (full range)
Fast Reading Rate:	Between 150 and 3,000 counts (full range)

Maximum Crest Factor

3.0

Maximum Input

To be used in protected, low energy circuits only, not to exceed 250 V or 4800 Volt-Amps. (IEC 664 Installation Category II.)

mA 300 mA dc or ac rms. Protected with a 500 mA, 250 V, IEC 127-sheet 1, fast blow fuse

A 10 A dc or ac rms continuous, or 20 A dc or ac rms for 30 seconds maximum. Protected with a 15 A, 250 V, 10,000 A interrupt rating, fast blow fuse.

Note

Resistance between the COM binding post and the meter's internal measuring circuits is approximately .003Ω.

Ohms

Range	Resolution			Accuracy	Typical Full Scale Voltage	Max Current Through the Unknown
	Slow	Medium	Fast			
300 Ω	—	10 mΩ	100 MΩ	0.05 % + 2 + 0.02Ω	0.25	1 mA
3 kΩ	—	100 MΩ	1 Ω	0.05 % + 2	0.24	120μA
30 kΩ	—	1 Ω	10 Ω	0.05 % + 2	0.29	14 μA
300 kΩ	—	10 Ω	100 Ω	0.05 % + 2	0.29	1.5 μA
3 MΩ	—	100 Ω	1 kΩ	0.06 % + 2	0.3	150 μA
30 MΩ	—	1 kΩ	10 kΩ	0.25 % + 3	2.25	320 μA
300 MΩ*	—	100 kΩ	1 MΩ	2 %	2.9	320 μA
100 Ω	1 mΩ	—	—	0.05 % + 8 + 0.02 Ω	0.09	1 mA
1000 Ω	10 mΩ	—	—	0.05 % + 8 + 0.02Ω	0.10	120 μA
10 kΩ	100 mΩ	—	—	0.05 %+8	0.11	14 μA
100 kΩ	1 Ω	—	—	0.05 % + 8	0.11	1.5 μA
1000 kΩ	10 Ω	—	—	0.06 % +_8	0.12	150 μA
10 MΩ	100 Ω	—	—	0.25 % + 6	1.5	150 μA
100 MΩ*	100 kΩ	—	—	2 % + 2	2.75	320 μA

*Because of the method used to measure resistance, the 100 MΩ (slow) and 300 MΩ (medium and fast) ranges cannot measure below 3.2 MΩ and 20 MΩ, respectively. "UL" (underload) is shown on the display for resistances below these nominal points, and the computer interface outputs "+1 E-9".

Open Circuit Voltage

3.2 V maximum on the 100 Ω, 300 Ω, 30 MΩ, 100 MΩ, and 300 MΩ ranges, 1.5 V maximum on all other ranges.

Input Protection

500 V dc or rms ac on all ranges

Diode Test/Continuity

	Maximum Reading	Resolution
Slow	999.99 mV	10 μV
Medium	2.5 V	100 μV
Fast	2.5 V	1 mV

Test Current

Approximately 0.7 mA when measuring a forward biased junction.

Audible Tone

Continuous tone for continuity. Brief tone for normal forward biased diode or semiconductor junction.

Calculation No. 8982-17-19-2
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Attachment: B
Page B9 of B12

Open Circuit Voltage

3.2 V maximum

Continuity Capture Time

50 us maximum, 10 us typical

Input Protection

500 volts dc or rms ac

Note

When the meter is set to measure frequency and there is no input signal (i.e., input terminals are open), the meter may read approximately 25 kHz (rather than the expected zero). This is due to internal capacitive pickup of the inverter power supply into the high-impedance, input circuitry. With source impedance of <2 kΩ, this pickup will not affect the accuracy or stability of the frequency a reading.

Frequency

Frequency Range

5 Hz to >1 MHz

Applicable Functions

Volts ac and Current AC

Range	Resolution		Accuracy
	Slow & Medium	Fast	
1000 Hz	.01 Hz	.1 Hz	05% + 2
10 kHz	.1 Hz	1 Hz	.05% + 1
100 kHz	1 Hz	10 Hz	.05% + 1
1000 kHz	10 Hz	100 Hz	.05% + 1
1 MHz*	100 Hz	1 kHz	Not Specified
* Specified to 1 MHz, but will measure above 1 MHz.			

Sensitivity of AC Voltage

Frequency	Level (sine wave)
5 Hz-100 kHz	30 mV rms
100 kHz - 300 kHz	100 mV rms
300 kHz - 1 MHz	1 V V rms
Above 1 MHz	Not specified

Sensitivity Level of AC Current

Frequency	Input	Level
5 Hz-20 kHz	100 mA	>3 mA rms
45 Hz-2 kHz	10 A	>3 A rms

Note

When the meter is set to measure frequency and there is no input signal (i.e., the input terminals are open), the meter may read approximately 25 kHz (rather than zero). This is due to internal capacitive pickup of the inverter power supply into the high-impedance, input circuitry. With source impedance of <2 kΩ, this pickup will not affect the accuracy or stability of the frequency reading.

Environmental

Warmup time	1 hour to rated specifications for warmup < 1 hour, add 0.005 % to all accuracy specifications.
Temperature Coefficient	<0.1 times the applicable accuracy specification per degree C for 0 °C to 18 °C and 28 °C to 50 °C (32 °F to 64.4 °F and 82.4 °F to 122 °F)
Operating Temperature	0 °C to 50 °C (32 °F to 122°F)
Storage Temperature	-40 °C to + 70 °C (-40 °F to 158°F) Elevated temperature storage of battery will accelerate battery self-discharge. Maximum storage time before battery must be recharged: 20 °C – 25 °C 1000 days 50 °C 180 days 70 °C 40 days
Relative Humidity (non-condensing)	To 90 % at 0 °C to 28 °C (32-82.4 °F), To 80 % at 28 °C to 35 °C (82.4-95 °F), To 70 % at 35 ° C to 50 °C (95 °F -122 ° F) except to 70 % at 0 °C to 50 °C (32 °F -122 °F) for the1000 kΩ, 3 MΩ, 10 MΩ, 30 MΩ, 100 MΩ,and 300 MΩ ranges.
Altitude	Operating 0 to 10,000 feet Non-operating 0 to 40,000 feet
Electromagnetic Compatibility	In an RF field of 1 V/m on all ranges and functions: Total Accuracy = Specified Accuracy +0.4% of range. Performance above 1 V/m is not specified
Vibration	3 G @ 55 Hz
Shock	Half sine 40 G. Per Mil-T- 28800D, Class 3, Style E. Bench Handling. Per Mil-T-28800D, Class 3.

General

Common Mode Voltage	1000 V dc or peak ac maximum from any input to earth
Size	9.3 cm high, 21.6 cm wide, 28.6 cm deep (3.67 in high,8.5 in wide, 11.27 in deep)
Weight	Net, 2.4 kg (5.2 lbs) without battery; 3.2 kg (7.0 lbs) with battery; Shipping, 4.0 kg (8.7 lbs) without battery; 4.8 (10.5 lbs) with battery
Power	90 V to 264 V ac (no switching required), 50 Hz and 60 Hz < 15 VA maximum
Standards	Complies with: IEC 348, UL1244, CSA Bulletin 566B EMC: Part 15 subpart J of FCC Rules, and VDE 0871.
RS-232-C	Baud rates: 300, 600,1200,2400,4800 and 9600 Odd, even or no parity One stop bit

Options

Battery (Option -01 K)	Type	8 V, Lead-Acid
	Operating Time	8 hours (typical). [battery symbol] lights when less than 1/2 hour of battery operation remains. Meter still meets specifications.
	Recharge Time	16 hours (typical) with meter turned off and plugged into line power. Battery will not charge when meter is turned on.
IEEE-488 (Option -05K)	Capability codes	SH1, AH1, T5, L4, SRI, RL1, PPO, DC1, DT1, E1, TED, LEO and C0
	External Trigger Input	
	VIH	1.35 V minimum
	VIL	1.25 V maximum
	Input Threshold Hysteresis	0.6 V minimum

ATTACHMENT C

S&L Interoffice Memorandum from J. F. White

"Seismic Qualification of ITE/ABB Undervoltage Relay Model 27N, Series 411T"

S A R G E N T & L U N D Y

INTEROFFICE MEMORANDUM

From	J. F. White - 22 x-3172	Date	August 14, 1991
		Project No.	8900-03
Dept./Div.	Mech./Component Qualification	Spec. No.	
		File No.	CQD-052214 Rev. 01
		Page No.	1 of 1

Client Commonwealth Edison Co. Stn. Dresden Unit 2 & 3

Subject Seismic Qualification of ITE/ABB Undervoltage Relay Model 27N, Series 411T

To: J. Sinnappan - 22 (1/0)

CC: K. L. Adlon - 22 (1/0)
R. W. Fermier - 22 (1/0)
~~E. Zacharias - 22 (1/1)~~
CQD File - 22 (1/1)

Reference: Asea Brown Boveri (ABB) Equipment Performance Specification RC-5039-A, dated 1-10-90, including Qualification Report Summary RC-5139-A, dated 1-10-90 for "ndervoltage Relay Type 27N.

CQD has reviewed the Referenced Test Report and found it to be acceptable. This revision is being made to add a reference from the vendor that clarifies identification of the tested model. The seismic test levels meet the requirements for the intended application of the relay, and the test requirements of IEEE 344-1975. Therefore, the relay is seismically qualified for use in panels 2252(3)-83(4), at elevation 545'-6" in the Reactor Building at the Dresden Station.

By copy of this memorandum, the Checklist for Dynamic Qualification of Mechanical and Electrical Equipment, supporting documents, are being sent to the CQD file.

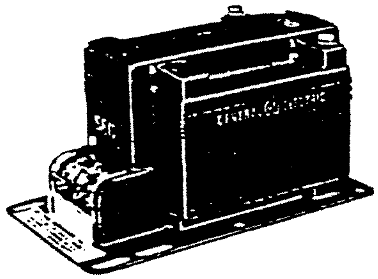
John F White

ATTACHMENT D

GE Document 7910 Dated 6-20-77

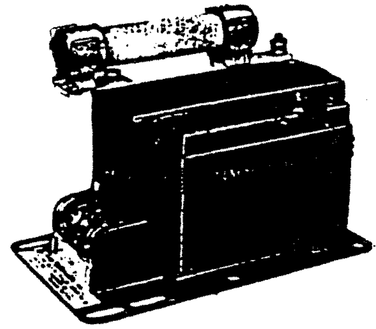
Type JVM-3

2400 to 4800 Volts **50-60 Hz** **BIL—60 Kv**



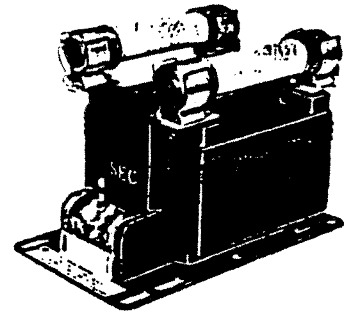
(Photo 1234873)

Fig. 1. Type JVM-3 voltage transformer (unfused)



(Photo 1234874)

Fig. 2. Type JVM-3 voltage transformer (one-fuse design)



(Photo 1234875)

Fig. 3. Type JVM-3 voltage transformer (two-fuse design)

APPLICATION—The Type JVM-3 voltage transformer is designed for indoor service and is suitable for operating meters, instruments, relays and control devices.

CONSTRUCTION AND INSULATION—See Section 7907, item 1.4.

CORE—See Section 7907, item 2.3.

COILS—Enamel insulated wire is used in the primary and secondary coils. The primary is wound and cast in epoxy resin. The secondary is inside the primary next to the core.

DIMENSIONS

Description	Dimensions in Inches		
	Height	Length	Width
Unfused	5 15/16	10 7/8	6 3/8
With one primary fuse	7 3/4	10 7/8	6 3/8
With two primary fuses	7 3/4	10 7/8	6 13/16

DATA TABLE (For Pricing Information, see Section 7901)

Transformer Rating Θ		Cat. No.	Thermal Rating in Volt-amperes		ANSI Accuracy Classification, 60 Hz			Application		Primary Fuses			Appro Wt in L	
					Burden Per ANSI		Burden Impedance as at Rated Voltage, but Operated at 58% Rated Voltage*							
Primary Voltage	Ratio		55 C Rise above 30 C Ambient	30 C Rise above 55 C Ambient	Operated at Rated Voltage	Operated at 58% Rated Voltage		Circuit Voltage, Line-to-line	Permissible Transformer Primary Connection	Voltage Rating	Amp	Fuse Cat. No.	Ship.	N
UNFUSED														
2400	20:1	643X83	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	2400 / 4160	Δ or Y / Y only	...	...	....	35	[illegible]
4200	35:1	643X90	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4200	Δ or Y	...	...	....	35	[illegible]
4800	40:1	643X95	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4800	Δ or Y	...	...	....	35	[illegible]
WITH ONE PRIMARY FUSE (Neutral terminal insulation to ground—2.5 Kv)¶														
2400	20:1	763X21G42	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	2400	Y only	2400	1	9F60AAB001	37	[illegible]
2400	20:1	643X85	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4160	Y only	4800	1	9F60BBD001	37	[illegible]
4200	35:1	643X91	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4200	Y only	4800	0.5	9F60BBD905	37	[illegible]
4800	40:1	643X96	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4800	Y only	4800	0.5	9F60BBD905	37	[illegible]
WITH TWO PRIMARY FUSES														
2400	20:1	763X21G40	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	2400	Δ or Y‡	2400	1	9F60AAB001	38	[illegible]
4200	35:1	643X92	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4200	Δ or Y‡	4800	0.5	9F60BBD905	38	[illegible]
4800	40:1	643X97	750	500	0.3 W, X, M, Y; 1.2 Z	0.3 W, X; 1.2 M, Y	0.3 W', X', M', Y'; 1.2 Z'	4800	Δ or Y‡	4800	0.5	9F60BBD905	38	[illegible]

* The prime symbol (') is used to signify that these burdens do not correspond to standard ANSI definitions.

¶ On transformers with one primary fuse the neutral terminal insulation to ground is 2500 volts.

Θ For continuous operation, the transformer-rated primary voltage should not be exceeded by more than 10%. Under emergency conditions, overvoltage must be limited to 1.25 times the transform primary-voltage rating.

‡ For Y connections, it is preferred practice to connect one lead from eac voltage transformer directly to the grounded neutral, using a fuse on in the line side of the primary. By this connection a transformer c: never be "alive" from the line side by reason of a blown fuse on t: grounded side.

Type JVM-3

June 20, 1977

2400 to 4800 Volts **50-60 Hz** **BIL—60 Kv**

RY TERMINALS—The primary ter-...inals on the *unfused* models consist of tapped holes in the center of a flat boss with lock washer and screw. On the *two-fuse* models, both terminals are bolts attached directly to the fuse supports and provided with lock washers and nuts. On the *one-fuse* design the line terminal is on the fuse support and the neutral terminal is a stud protruding from the back a short distance above the base plate. This stud is insulated from the base plate to permit primary insulation-resistance testing at voltages up to 2500 volts.

FUSES—Current-limiting fuses, Type EJ-1, are used.

SECONDARY TERMINALS—The secondary terminals are solderless clamp type. The terminal cover is made of transparent plastic. Provision is made for sealing the cover.

POLARITY—See Section 7907, item 6.2.

NAMEPLATE—See Section 7907, item 5.3.

BASE AND MOUNTING—The base is made of heavy steel plate and is provided with holes and slots adapting it for mounting by either bolts or pipe clamps.

DIMENSIONS

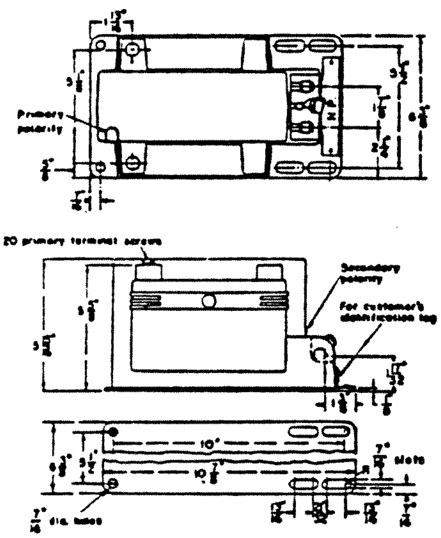


Fig. 4. Dimensions of JVM-3 (unfused)

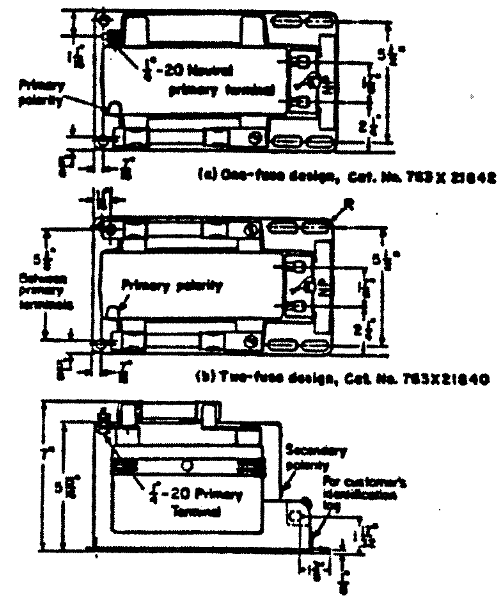
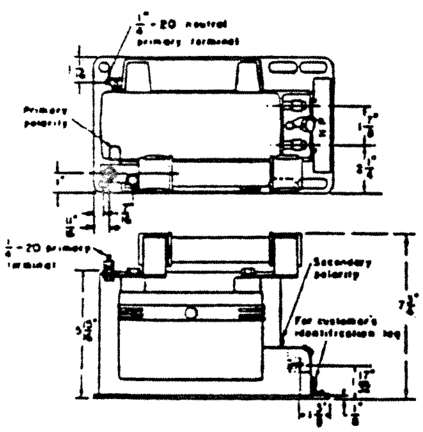


Fig. 5. Dimensions of JVM-3 Cat. No's. 763X21G42 and 763X21G40. (See Fig. 4 for base)



ig. 6. Dimensions of JVM-3 (one-fuse design), Cat. No's. 643X85, 643X91, and 643X96. (See Fig. 4 for base)

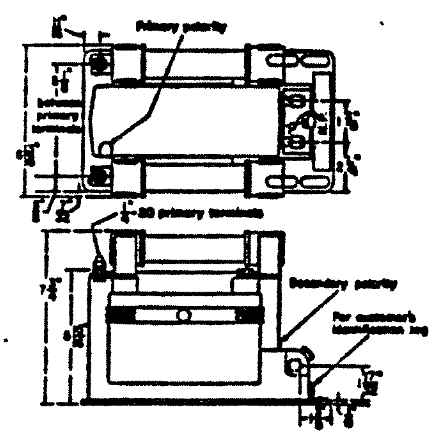


Fig. 7. Dimensions of JVM-3 (two-fuse design), Cat. No's. 643X92 and 643X97. (See Fig. 4 for base)

Calculation No. 8982-17-19-2
Revision 004
Attachment: D
Page D3 of D3

ATTACHMENT E

Telecon Between S. Hoats (ABB) and A. Runde (S&L)

	Date 1-23-92 Time 9:30 A
Person Called Steve Hoats	Company ABB (215) 395-7333
Person Calling A. J. Runde	Company S&L EAD (312) 269 6799
Project Dresden Unit 2	Project No. 8982-64

Subject Discussed

Repeatability of the ITE-27N Undervoltage Relay

Mr. Hoats provided the following information:

- The tolerances listed in IB 7.4.1.7-7 Issue D do not include an considerations for instrument drift. However, no drift error i. expected if the relay is calibrated at reasonable intervals.

- The absolute range of repeatability over temperature range is twice the published values. For example, the absolute range of repeatability over a temperature range of 0° to 55°C for a relay with a <u>harmonic filter</u> is 2 X 0.75% or 1.5% based on the published data.

- The published tolerances are generally twice the tested tolerances, so they are quite conservative.

- The information on the attached sheets from Cliff Downs of ABB concerning the linearity of the published tolerances over the identified ranges is applicable to both the 27D and the 27N relay.

- Al Wetter of CECo may have further information regarding the 27N relay tolerances by test methods.

NOTE: THIS CONSTITUTES OUR UNDERSTANDING OF THE DISCUSSIONS. IF WRITTEN COMMENTS ARE NOT RECEIVED WITHIN FIVE WORKING DAYS, THE ABOVE WILL BE ASSUMED CORRECT.

cc:
Steve Hoats - ABB

File

Andrew J Runde
A. J. Runde

AJR:lsc
C:\EAD\MS-TELE-AJR

ATTACHMENT F

ABB Instruction Bulletin I.B 7.4.1.7-7, Issue D

ABB
ASEA BROWN BOVERI

IB 7.4.1.7-7
Issue D

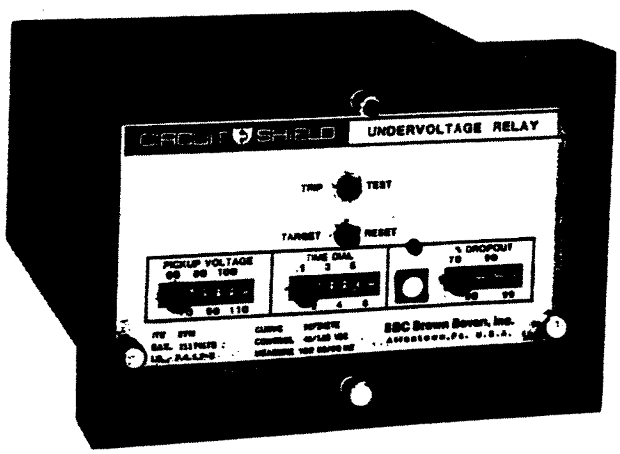
INSTRUCTIONS

Single Phase Voltage Relays

Type 27N HIGH ACCURACY UNDERVOLTAGE RELAY

Type 59N HIGH ACCURACY OVERVOLTAGE RELAY

Type 27N	Catalog Series 211T	Standard Case
Type 27N	Catalog Series 411T	Test Case
Type 59N	Catalog Series 211U	Standard Case
Type 59N	Catalog Series 411U	Test Case



ASEA BROWN BOVERI

Calculation No. 8982-17-19-2
Revision 004
Attachment: F
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TABLE OF CONTENTS

INTRODUCTION

These instructions contain the information required to properly install, operate, and test certain single-phase undervoltage relays type 27N, catalog series 211T and 411T; and overvoltage relays, type 59N, catalog series 211U and 411U.

The relay is housed in a case suitable for conventional semiflush panel mounting. All connections to the relay are made at the rear of the case and are clearly numbered. Relays of the 411T, and 411U catalog series are similar to relays of the 211T, and 211U series. Both series provide the same basic functions and are of totally drawout construction; however, the 411T and 411U series relays provide integral test facilities. Also, sequenced disconnects on the 410 series prevent nuisance operation during withdrawal or insertion of the relay if the normally-open contacts are used in the application.

Basic settings are made on the front panel of the relay, behind a removable clear plastic cover. Additional adjustment is provided by means of calibration potentiometers inside the relay on the circuit board. The target is reset by means of a pushbutton extending through the relay cover.

PRECAUTIONS

The following precautions should be taken when applying these relays:

1. Incorrect wiring may result in damage. Be sure wiring agrees with the connection diagram for the particular relay before energizing.

2. Apply only the rated control voltage marked on the relay front panel. The proper polarity must be observed when the dc control power connections are made.

3. For relays with dual-rated control voltage, withdraw the relay from the case and check that the movable link on the printed circuit board is in the correct position for the system control voltage.

4. High voltage insulation tests are not recommended. See the section on testing for additional information.

5. The entire circuit assembly of the relay is removable. The unit should insert smoothly. Do not use excessive force.

6. Follow test instructions to verify that the relay is in proper working order.

CAUTION: ***since troubleshooting entails working with energized equipment, care should be taken to avoid personal shock. Only competant technicians familiar with good safety practices should service these devices.***

PLACING THE RELAY INTO SERVICE

1. RECEIVING, HANDLING, STORAGE

Upon receipt of the relay (when not included as part of a switchboard) examine for shipping damage. If damage or loss is evident, file a claim at once and promptly notify Asea Brown Boveri. Use normal care in handling to avoid mechanical damage. Keep clean and dry.

2. INSTALLATION

Mounting:
The outline dimensions and panel drilling and cutout information is given in Fig. 1.

Connections:
Typical external connections are shown in Figure 2. Internal connections and contact logic are shown in Figure 3. Control power must be connected in the proper polarity.

For relays with dual-rated control power: before energizing, withdraw the relay from its case and inspect that the movable link on the lower printed circuit board is in the correct position for the system control voltage. (For units rated 110vdc, the link should be placed in the position marked 125vdc.)

These relays have an external resistor wired to terminals 1 and 9 which must be in place for normal operation. The resistor is supplied mounted on the relay.

These relays have metal front panels which are connected through printed circuit board runs and connector wiring to a terminal at the rear of the relay case. The terminal is marked "G". In all applications this terminal should be wired to ground.

3. SETTINGS

PICKUP
The pickup voltage taps identify the voltage level which the relay will cause the output contacts to transfer.

DROPOUT
The dropout voltage taps are identified as a percentage of the pickup voltage. Taps are provided for 70%, 80%, 90%, and 99% of pickup, or, 30%, 40%, 50%, and 60% of pickup.

Note: operating voltage values other than the specific values provided by the taps can be obtained by means of an internal adjustment potentiometer. See section on testing for setting procedure.

TIME DIAL
The time dial taps are identified as 1,2,3,4,5,6. Refer to the time-voltage characteristic curves in the Application section. Time dial selection is not provided on relays with an Instantaneous operating characteristic. The time delay may also be varied from that provided by the fixed tap by using the internal calibration adjustment.

4. OPERATION INDICATORS

The types 27N and 59N provide a target indicator that is electronically actuated at the time the output contacts transfer to the trip condition. The target must be manually reset. The target can be reset only if control power is available, AND if the input voltage to the relay returns to the "normal" condition.

An led indicator is provided for convenience in testing and calibrating the relay and to give operating personnel information on the status of the relay. See Figure 4 for the operation of this indicator.

Units with a "-L" suffix on the catalog number provide a green led to indicate the presence of control power and internal power supply voltage.

APPLICATION DATA

Single-phase undervoltage relays and overvoltage relays are used to provide a wide range of protective functions, including the protection of motors and generators, and to initiate bus transfer. The type 27N undervoltage relay and type 59N overvoltage relay are designed for those applications where exceptional accuracy, repeatability, and long-term stability are required.

Tolerances and repeatability are given in the Ratings section. Remember that the accuracy of the pickup and dropout settings with respect to the printed dial markings is generally not a factor, as these relays are usually calibrated in the field to obtain the particular operating values for the application. At the time of field calibration, the accuracy of the instruments used to set the relays is the important factor. Multiturn internal calibration potentiometers provide means for accurate adjustment of the relay operating points, and allow the difference between pickup and dropout to be set as low as 0.5%.

The relays are supplied with instantaneous operating time, or with definite-time delay characteristic. The definite-time units are offered in two time delay ranges: 1-10 seconds, or 0.1-1 second.

An accurate peak detector is used in the types 27N and 59N. Harmonic distortion in the AC waveform can have a noticible effect on the relay operating point and on measuring instruments used to set the relay. An internal harmonic filter is available as an option for those applications where waveform distortion is a factor. The harmonic filter attenuates all harmonics of the 50/60 Hz. input. The relay then basically operates on the fundamental component of the input voltage signal. See figure 5 for the typical filter response curve. To specify the harmonic filter add the suffix "-HF" to the catalog number. Note in the section on ratings that the addition of the harmonic filter does reduce somewhat the repeatability of the relay vs. temperature variation. In applications where waveform distortion is a factor, it may be desirable to operate on the peak voltage. In these cases, the harmonic filter would not be used.

CHARACTERISTICS OF COMMON UNITS

Type	Pickup Range	Dropout Range	Time Delay Pickup	Time Delay Dropout	Catalog Numbers Std Case	Catalog Numbers Test Case
27N	60 - 110 v	70% - 99%	Inst	Inst	211T01x5	411T01x5
			Inst	1 - 10 sec	211T41x5	411T41x5
			Inst	0.1 - 1 sec	211T61x5	411T61x5
	70 - 120 v	70% - 99%	Inst	Inst	211T03x5	411T03x5
			Inst	1 - 10 sec	211T43x5	411T43x5
			Inst	0.1 - 1 sec	211T63x5	411T63x5
	60 - 110 v	30% - 60%	Inst	Inst	211T02x5	411T02x5
			Inst	1 - 10 sec	211T42x5	411T42x5
			Inst	0.1 - 1 sec	211T62x5	411T62x5
59N	100 - 150 v	70% - 99%	Inst	Inst	211U01x5	411U01x5
			1 - 10 s	Inst	211U41x5	411U41x5
			0.1 - 1 s	Inst	211U61x5	411U61x5

IMPORTANT NOTES:

1. Each of the listed catalog numbers for the types 27N and 59N contains an "x" for the control voltage designation. To complete the catalog number, replace the "x" with the proper control voltage code digit:

   48/125 vdc 7
   250 vdc 5
   220 vdc 2
   48/110 vdc 0

2. To specify the addition of the harmonic filter module, add the suffix "-HF". For example: 411T4175-HF. Harmonic filter not available on type 27N with instantaneous delay timing characteristic.

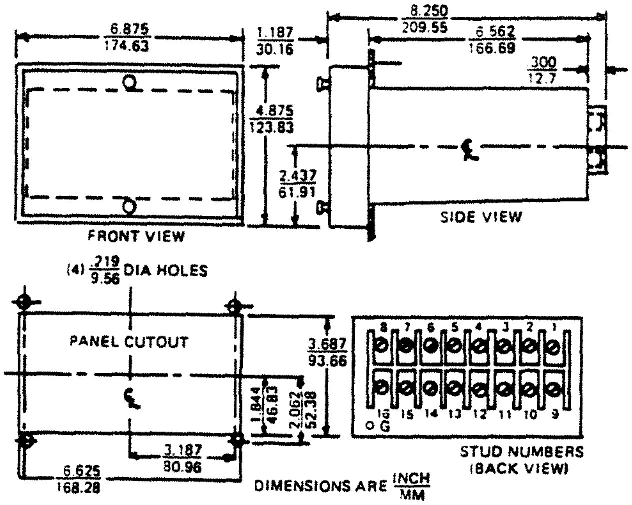


Figure 1: Relay Outline and Panel Drilling

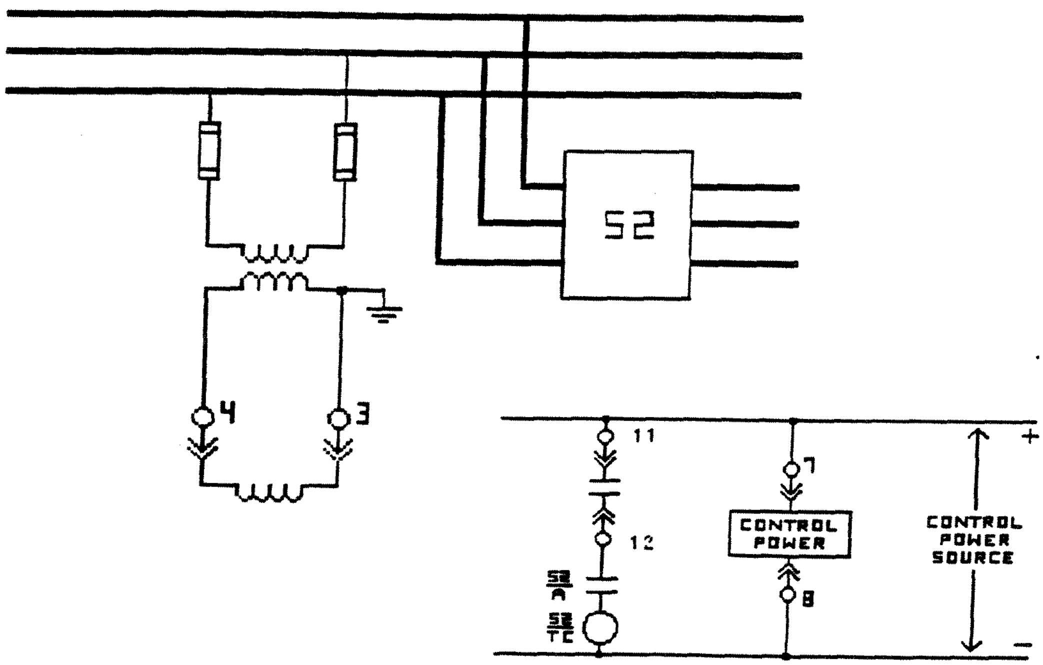


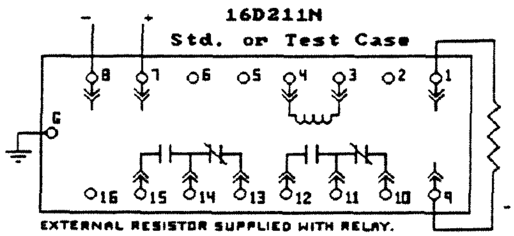
Figure 2: Typical External Connections

Calculation No. 8982-17-19-2
Revision 004
Attachment: F

Figure 3: **INTERNAL CONNECTION DIAGRAM AND OUTPUT CONTACT LOGIC**

The following table and diagram define the output contact states under all possible conditions of the measured input voltage and the control power supply. "**AS SHOWN**" means that the contacts are in the state shown on the internal connection diagram for the relay being considered. "**TRANSFERRED**" means the contacts are in the opposite state to that shown on the internal connection diagram.

Condition	Contact State	
	Type 27N	Type 59N
Normal Control Power AC Input Voltage Below Setting	Transferred	As Shown
Normal Control Power AC Input Voltage Above Setting	As Shown	Transferred
No Control Voltage	As Shown	As Shown



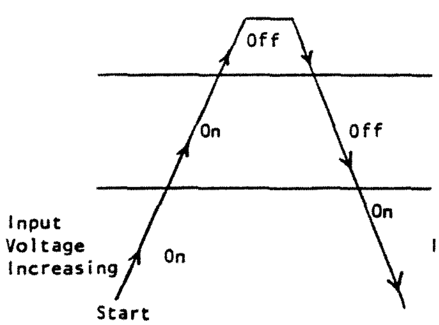


Figure 4a: ITE-27N Operation of Dropout Indicating Light

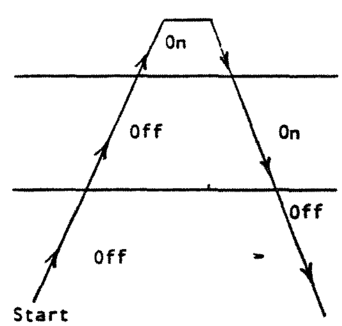
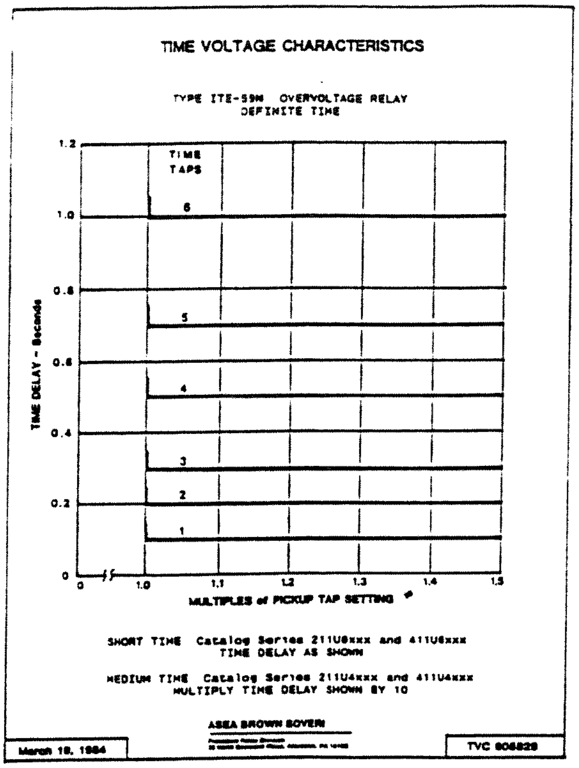
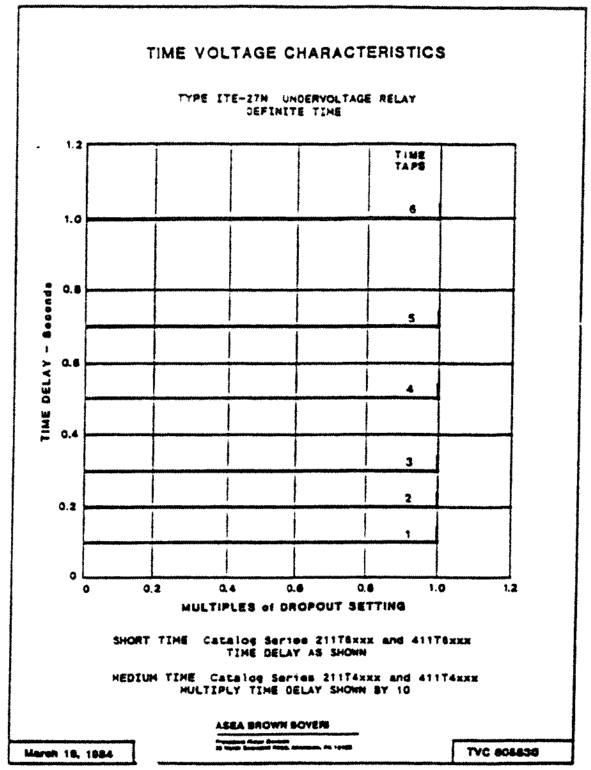


Figure 4b: ITE-59N Operation of Pickup Indicating Light

Figure 4: Operation of Pickup/Dropout Light-Emitting-Diode Indicator





* NOT TO EXCEED INPUT RATING

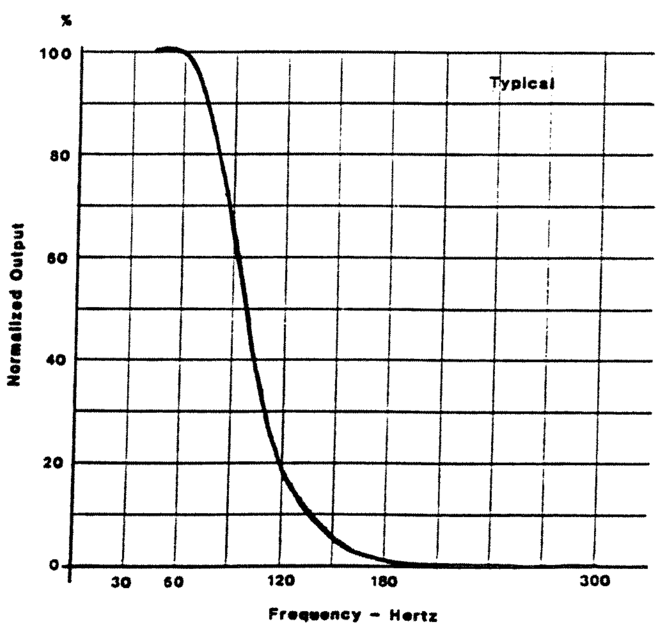


Figure 5: Normalized Frequency Response - Optional Harmonic Filter Module

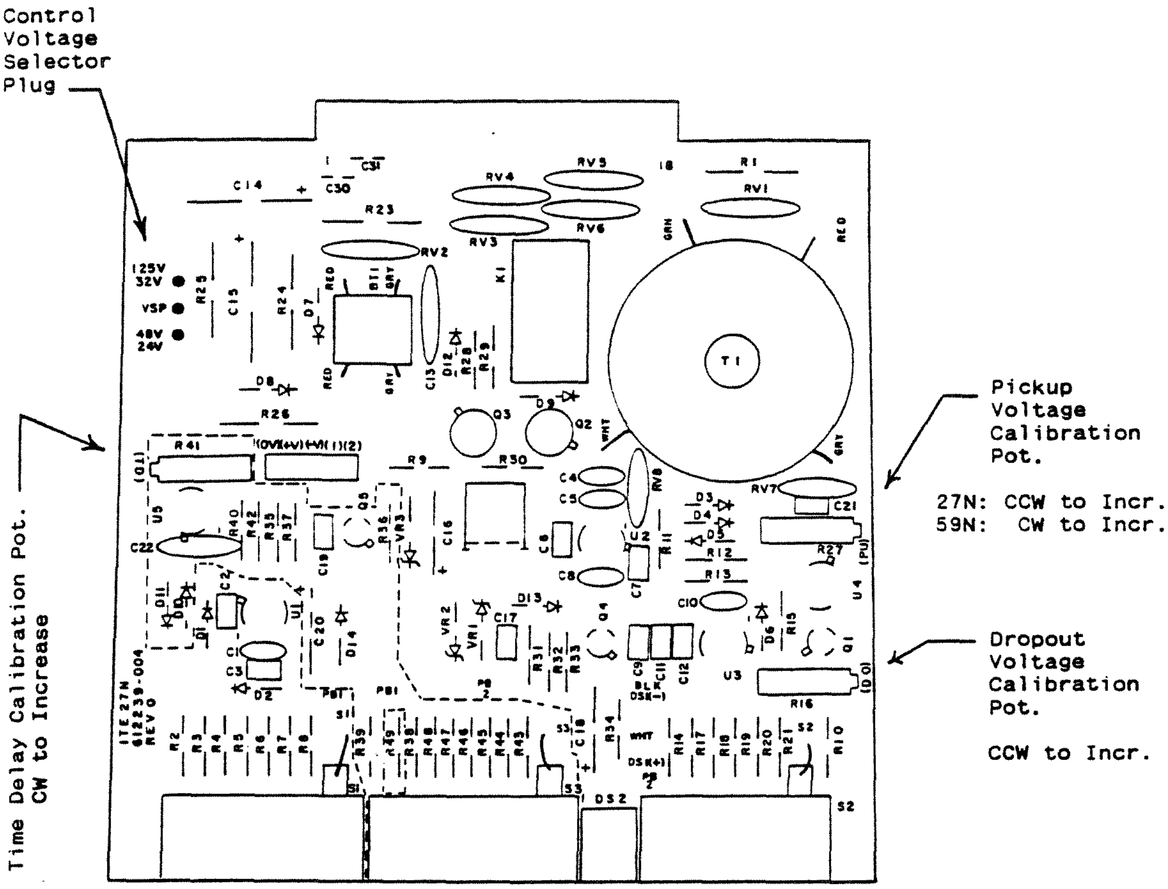


Figure 6: Typical Circuit Board Layouts, types 27N and 59N

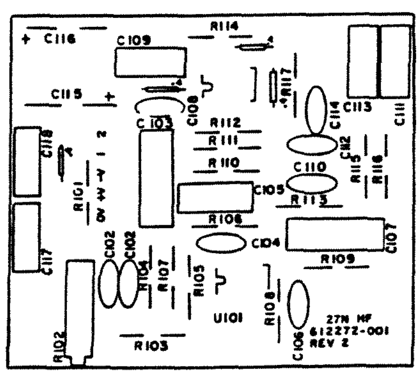


Figure 7: Typical Circuit Board Layout - Harmonic Filter Module

TESTING

1. MAINTENANCE AND RENEWAL PARTS

No routine maintenance is required on these relays. Follow test instructions to verify that the relay is in proper working order. We recommend that an inoperative relay be returned to the factory for repair; however, a circuit description booklet CD7.4.1.7-7 which includes schematic diagrams, can be provided on request. Renewal parts will be quoted by the factory on request.

211 Series Units

Drawout circuit boards of the same catalog number are interchangible. A unit is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom side of the drawout circuit board.

The board is removed by using the metal pull knobs on the front panel. *Removing the board with the unit in service may cause an undesired operation.*

An 18 point extender board (cat 200X0018) is available for use in troubleshooting and calibration of the relay.

411 Series Units

Metal handles provide leverage to withdraw the relay assembly from the case. Removing the unit in an application that uses a normally closed contact will cause an operation. The assembly is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom of the circuit board.

Test connections are readily made to the drawout relay unit by using standard banana plug leads at the rear vertical circuit board. This rear board is marked for easier identification of the connection points.

Important: these relays have an external resistor mounted on rear terminals 1 and 9. In order to test the 'rawout unit an equivilent resistor must be connected to terminals 1 & 9 on the rear vertical circuit board of the drawout unit. The resistance value must be the same as the resistor used on the relay. A 25 or 50 watt resistor will be sufficient for testing. If no resistor is available, the resistor assembly mounted on the relay case could be removed and used. ***If the resistor from the case is used, be sure to remount it on the case at the conclusion of testing.***

Test Plug:

A test plug assembly, catalog number 400X0002 is available for use with the 410 series units. This device plugs into the relay case on the switchboard and allows access to all external circuits wired to the case. See Instruction Book IB 7.7.1.7-8 for details on the use of this device.

2. HIGH POTENTIAL TESTS

High potential tests are not recommended. A hi-pot test was performed at the factory before shipping. If a control wiring insulation test is required, partially withdraw the relay unit from its case sufficient to break the rear connections before applying the test voltage.

3. BUILT-IN TEST FUNCTION

Be sure to take all necessary precautions if the tests are run with the main circuit energized.

The built-in test is provided as a convenient functional test of the relay and associated circuit. When you depress the button labelled TRIP, the measuring and timing circuits of the relay are actuated. When the relay times out, the output contacts transfer to trip the circuit breaker or other associated circuitry, and the target is displayed. The test button must be held down continuously until operation is obtained.

4. ACCEPTANCE TESTS

Follow the test procedures under paragraph 5. For definite-time units, select Time Dial #3. For the type 27N, check timing by dropping the voltage to 50% of the dropout voltage set (or to zero volts if preferred for simplification of the test). For the type 59N check timing by switching the voltage to 105% of pickup (do not exceed max. input voltage rating.) Tolerances should be within those shown on page 5. If the settings required for the particular application are known, use the procedures in paragraph 5 to make the final adjustments.

5. CALIBRATION TESTS

Test Connections and Test Sources:
Typical test circuit connections are shown in Figure 8. Connect the relay to a proper source of dc control voltage to match its nameplate rating (and internal plug setting for dual-rated units). Generally the types 27N and 59N are used in applications where high accuracy is required. The ac test source must be stable and free of harmonics. A test source with less than 0.3% harmonic distortion, such as a "line-corrector" is recommended. Do not use a voltage source that employs a ferroresonant transformer as the stabilizing and regulating device, as these usually have high harmonic content in their output. The accuracy of the voltage measuring instruments used must also be considered when calibrating these relays.

If the resolution of the ac test source adjustment means is not adequate, the arrangement using two variable transformers shown in Figure 9 to give "coarse" and "fine" adjustments is recommended.

When adjusting the ac test source do not exceed the maximum input voltage rating of the relay.

LED Indicator:
A light emitting diode is provided on the front panel for convenience in determining the pickup and dropout voltages. The action of the indicator depends on the voltage level and the direction of voltage change, and is best explained by referring to Figure 4.

The calibration potentiometers mentioned in the following procedures are of the multi-turn type for excellent resolution and ease of setting. For catalog series 211 units, the 18 point extender board provides easier access to the calibration pots. If desired, the calibration potentiometers can be resealed with a drop of nail polish at the completion of the calibration procedure.

Setting Pickup and Dropout Voltages:
Pickup may be varied between the fixed taps by adjusting the pickup calibration potentiometer R27. Pickup should be set first, with the dropout tap set at 99% (60% on "low dropout units"). Set the pickup tap to the nearest value to the desired setting. The calibration potentiometer has approximately a +/-5% range. Decrease the voltage until dropout occurs, then check pickup by increasing the voltage. Readjust and repeat until pickup occurs at precisely the desired voltage.

Potentiometer R16 is provided to adjust dropout. Set the dropout tap to the next lower tap to the desired value. Increase the input voltage to above pickup, and then lower the voltage until dropout occurs. Readjust R16 and repeat until the required setting has been made.

Setting Time Delay:
Similarly, the time delay may be adjusted higher or lower than the values shown on the time-voltage curves by means of the time delay calibration potentiometer R41. On the type 27N, time delay is initiated when the voltage drops from above the pickup value to below the dropout value. On the type 59N, timing is initiated when the voltage increases from below dropout to above the pickup value. Referring to Fig. 4, the relay is "timing out" when the led indicator is lighted.

External Resistor Values: The following resistor values may be used when testing 411 series units. Connect to rear connection points 1 & 9.

Relays rated	48/125 vdc:	5000 ohms;	(-HF models with harmonic filter 4000 ohms)
	48/110 vdc:	4000 ohms;	(-HF models with harmonic filter 3200 ohms)
	250 vdc:	10000 ohms;	(-HF models with harmonic filter 9000 ohms)
	220 vdc:	10000 ohms;	(-HF models with harmonic filter 9000 ohms)

ABB
ASEA BROWN BOVERI

ABB Power Transmission Inc.
Protective Relay Division
35 N. Snowdrift Rd.
Allentown, Pa. 18106
215-395-7333

Issue D (2/89)
Supersedes Issue C

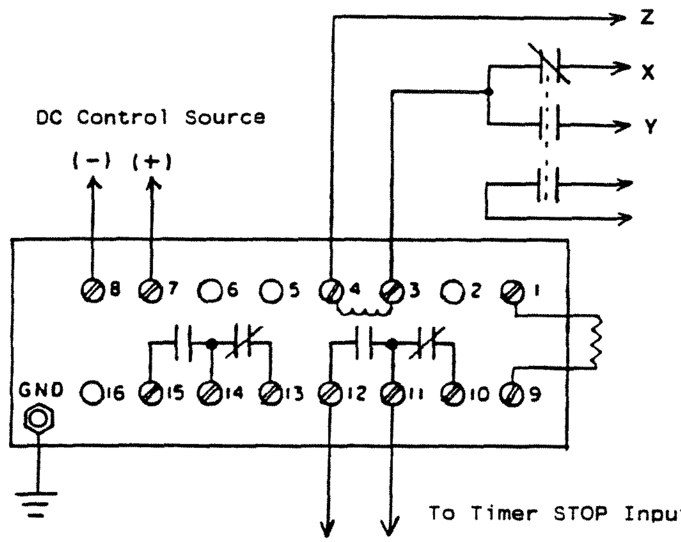


Figure 8: Typical Test Connections

T1, T2	Variable Autotransformers	(1.5 amp rating)
T3	Filament Transformer	(1 amp secondary)
V	Accurate AC Voltmeter	

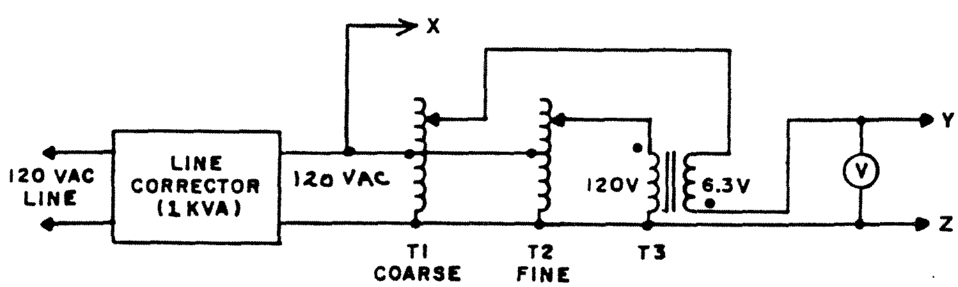


Figure 9: AC Test Source Arrangement

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in conjunction with installation, operation, or maintenance. Should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to Asea Brown Boveri.

ATTACHMENT G

Telecon Between C. Downs (ABB) and H. Ashrafi (S&L)

March 21, 1992

Memorandum of Telephone Conversation **SARGENT & LUNDY**

		Date 3/30/92	Time 11:15 a.m.
Person Called	Cliff Downs	Company	FAX (215) 395-1055 ABB (215) 395-7333
Person Calling	H. Ashrafi	Company	S&L (312) 269-2041
Project	Quad Cities	Project No.	8913-73 - DVPM01

Subject Discussed: Effect of Temperature on the ITE-27N Relays with Harmonic Filter Units

Summary of Discussion, Decisions, and Commitments:

Based on earlier conversations, it was understood by S&L that the deviation in the relay set point of ITE 27N Relays (from the calibration point) is linear over an operating temperature range of 0-55°C. It was also understood that the actual pickup or dropout voltage is lower than the set point value if the operating temperature is lower than the temperature at which the relay was calibrated. Similarly, the actual pickup or dropout voltage is higher with higher than calibration temperature.

It was later noted from the type test report (Page 6 of RC-6004) that this trend is not true for ITE 27N Relays with Harmonic Filter Units. The actual pickup or dropout voltage decreased with increased operating temperature and vice versa.

Mr. Cliff Downs informed me that this inverse relationship between pickup or dropout voltage and operating temperature is true because of the presence of the Harmonic Filter Unit in the ITE 27N Relays. He pointed out that the test results for the ITE 27N Relay without Harmonic Filters (on top of page 6 of RC 6004) does show direct relationship between pickup or dropout voltage and the operating temperature. He, therefore, mentioned that the information provided during earlier conversations was probably related to Relays without Harmonic Filters.

He suggested that, while it can be assumed that the deviation is linear over the operating temperature range of 0-55°C, the inverse relationship between pickup or dropout voltage and operative temperature should be considered in any calculation where ITE 27N Relays with Harmonic Filters are involved.

Note: THIS CONSTITUTES MY UNDERSTANDING OF OUR DISCUSSION. PLEASE CONTACT ME AT 312/269-2041 IF YOU HAVE ANY COMMENTS PERTAINING TO THE ACCURACY OF THE ABOVE SUMMARY.

cc: C. Downs-ABB
File: Relays

HA:kam
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H. Ashrafi

TRANSMISSION REPORT

THIS DOCUMENT (REDUCED SAMPLE ABOVE) WAS SENT

** COUNT **
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NO	REMOTE STATION I. D.	START TIME	DURATION	#PAGES	COMMENT
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		TOTAL	0:01'39"	3	

XEROX TELECOPIER 7021

March 21, 1992

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cc: C. Downs-ABB
File: Relays

HA:kam JBW
A:\Relays.HA

H. Ashrafi

Calculation No. 8982-17-19-2
Revision 004
Attachment: G
Page G3 of G6

ABB
ASEA BROWN BOVERI

From: STEVEN E. HOATS

ABB Power T&D Co.
Protective Relay Div.
7036 Snowdrift Rd.
Allentown, PA 18106
Telephone 215 395 7333
Telefax 215 395 1055

Date: 3/16/92 Total Pages: 2

To: Andy Runde cc:

Reference: 27N Relay performance

Andy,

Please find in the attachment the TYPE TEST certificate for our 27N relay. These are the actual test results from our laboratory tests. as you can see the results of these tests are typically Doubled when published in our I.L.'s

I hope this document will Help satisfy your problems.

Best Regards

[signature]

Temperature Tests:

Temperature	Pickup Voltage	Variation from Room Temperature	Dropout Voltage	Variation from Room Temperature
25°C	100.04v	---	99.95v	---
0	100.04	0.00 %	99.94	-0.01%
-20	100.04	0.00 %	99.94	-0.01%
40	100.11	+0.07 %	99.93	-0.02%
55	100.15	+0.11 %	99.96	+0.01%
70	100.21	+0.17 %	100.10	+0.15%

Temperature	Time Delay	Variation from Room Temperature
25°C	0.997 sec	-----
0	0.996	-0.1%
-20	0.993	-0.4%
+40	0.998	+0.1%
+55	1.007	+1.0%
+70	1.013	+1.6%

Results of Test: relay characteristics are stable with temperature and within published specifications.

Relay Tested: 211T6175 **Date of Test:** 10/15/82
Tester: W.C. Martin

Temperature Test with Harmonic Filter Option:

Temperature	Pickup Voltage	Variation from Room Temperature	Dropout Voltage	Variation from Room Temperature
22°C	100.12v	---	100.03v	---
-3	100.53	+0.41%	100.43	+0.40%
-20	100.90	+0.78%	100.81	+0.78%
+40	100.14	+0.02%	100.05	+0.02%
+55	99.88	-0.24%	99.79	-0.24%
+70	99.30	-0.82%	99.25	-0.78%

Results of Test: relay operation is stable with temperature and within published specifications.

Relay Tested: 211T0175-HF **Date of Test:** 3/6/84
Tester: C.L. Downs

March 21, 1992

Memorandum of Telephone Conversation — **SARGENT & LUNDY**

TD

		Date 3/30/92	Time 11:15 a.m.
Person Called	Cliff Downs	Company	FAX (215) 395-1055 ABB (215) 395-7333
Person Calling	H. Ashrafi	Company	S&L (312) 269-2041
Project	Quad Cities	Project No.	8913-73 - DVPM01

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cc: C. Downs-ABB
File: Relays

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OK
CD 4/2/91

H. Ashrafi

Calculation No.	8982-17-19-2
Revision	004
Attachment:	G
Page	G6 of G6

ATTACHMENT H

Calculation MLEA 91-014

MAIN LINE ENGINEERING ASSOCIATES

January 23, 1992
Serial No. 92-024

Mr. Boris Pikelny
Commonwealth Edison Company
Nuclear Engineering Department
1400 Opus Place, Suite 300
Downers Grove, IL 60515

Subject: Transmittal of Environmental Qualification of Dresden Second Level Undervoltage System and Equipment for RWCU Line Break Environmental Conditions, Dresden Nuclear Power Station Units 2 and 3, MLEA Calculation MLEA-91-014, Revision 0, dated 1/23/92, System Code 6705

Dear Mr. Pikelny:

Attached is the subject document for use. Please contact us if you have any questions.

Prepared by:

Annette M. McHugh
Senior Project Engineer

Approved by:

C. J. Crane
Project Manager/Manager of Engineering

cc: (per DDL C020 and Steve Hunsader)
H. Massin (CECo/NED)(Letter Only)
N. Smith (CECo/NED)(Letter Only)
S. Hunsader (CECo/NED)(Letter Only)
D. Wheeler (CECo/Dresden)(Letter Only)
E. Eenigenburg (CECo/Dresden)(Letter Only)
R. Tyler (CECo/NED)(P.O. Box 767 34FNW)(Letter Only)
CHRON System
B. Wong (CECo/NED)(Letter Only)
F. Petrusich (CECo/Dresden)(Letter Only)
MLEA Project File M0071
MLEA Serial File (Letter Only)

967 East Swedesford Road • Exton, Pennsylvania 19341 • (215) 889-9525 • FAX (215) 889-9419

MAIN LINE ENGINEERING ASSOCIATES	Calculation Cover Sheet	Calculation No. MLEA 91-014
		Page 1 of 20
		Safety Related ■ Yes ☐ No
Client: Commonwealth Edison Company		Discipline: Environmental Qualification
Project Title: 4KV Second Level Undervoltage Protection Equipment		Project No. M0071

Calculation Title: Environmental Qualification of Dresden Second Level Undervoltage System and Equipment for RWCU Line Break Environmental Conditions

Status ☐ Preliminary ■ Final ☐ Void

Computer Program: NA Version NA Verified ☐ Yes ☐ No

Revision Record

Revision	Description	Signatures	Date
0	Original Issue	Prepared By [signature]	1/23/92
		Reviewed By C. J. Crane	1/23/92
		Approved By C. J. Crane	1/23/92
		Prepared By	
		Reviewed By	
		Approved By	
		Prepared By	
		Reviewed By	
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MLEF-103/2
Rev 0

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1.0 Purpose of the Evaluation

The Environmental Qualification (EQ) evaluation contained herein demonstrates qualification for the 4Kvac Second Level Undervoltage Circuitry and Equipment for Dresden Station 4Kvac Buses 23-1, 24-1, 33-1, and 34-1 for the harsh temperature and humidity environmental conditions resulting from RWCU line break.

Dresden Station EQ Binder EQ-44D, General Electric Switchgear Components, Model MC-4.76, Rev. 06 (Ref. 3.16) demonstrates environmental qualification in accordance with References 3.1 and 3.2 of the General Electric 4Kvac switchgear associated with Dresden Station buses 23-1, 24-1, 33-1, and 34-1 for a post LOCA radiation exposure of 3.08E+05 rads. Reference 3.17 established that the switchgear associated with Dresden Station buses 23-1 and 33-1 Located in Environmental Zone 26 (Reference 3.18) are environmentally qualified for the harsh temperature and humidity (212°F/100% RH) conditions resulting from a postulated break in the RWCU piping (Reference 3.5).

The second level undervoltage protection equipment for buses 23-1, 33-1, 24-1 and 34-1 are located in separate panels (2252-83, 2253-83, 2252-84, and 2253-84) in Environmental Zone 26 and are also subject to the harsh temperature and humidity (212°F/100% RH) environment resulting from the RWCU line break (Ref. 3.7). Reference 3.3 established that the second level undervoltage equipment for buses 23-1 and 33-1 must not fail in a manner which would prevent closure of the AC powered RWCU isolation valve in the first 40 seconds after RWCU line break. Reference 3.3 provided a Justification for Continued Operation and determined that failure of the second level undervoltage equipment is unlikely during the first 40 seconds of the RWCU line break accident when the break is isolated but that there is a possibility that the long term performance of the equipment could be adversely affected by the elevated temperature and humidity conditions resulting from RWCU line break (Reference 3.5).

Reference 3.7 provided a test plan for HELB simulation steam testing of the second level undervoltage circuitry and equipment. The acceptance criteria for the test was that the undervoltage relay equipment must not fail by changing state during the first minute of the steam exposure. Reference 3.8 contains the results of steam exposure testing which demonstrate that the second level undervoltage equipment does not fail for the one hour duration of the HELB exposure.

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2.0 Statement of Qualification and Summary of the Evaluation

This calculation demonstrates the qualification of the Dresden second level undervoltage circuitry and components located in environmental zone 26 for the harsh temperature and humidity conditions (212°F/100% RH) caused by RWCU line break (Reference 3.5). The calculation identifies the specific components which are required to be qualified for the postulated HELB in the RWCU system (see section 6 of this calculation). The installed components are similar (Reference 3.7) to those tested for HELB conditions as described in Wyle Test Report 17199-1 (Reference 3.8). Qualification for radiation conditions is not required (See Section 9.0).

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3.0 List of References

* 3.1 IEEE Standard 323-1974," Qualifying Class 1E Equipment for Nuclear Power Generating Stations".

* 3.2 10CFR50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants, January 1, 1987".

3.3 Main Line Engineering Associates Report M0064-11, Justification for Continued Operation Technical Evaluation and Environmental Qualification Deviation, Assessment for RWCU Line Break Scenario for ABB/ITE Type 27D Solid State Undervoltage Relay, Agastat ETR Time Delay Relays, and Agastat Control Relays Contained in the Circuitry for 4 KVac Bus 23-1, Dresden Nuclear Power Station Unit 2, Revision 1, 5-30-91.

* 3.4 S&L Letter No. 890003-0026E, dated 7/5/91; with Attachment: Engineering Change Notices (ECN) 12-00311E, Pages 1 through 7 and ECN 12-00312E, Pages 1 through 8, for Construction. (DIT-71-003)

3.5 Bechtel Letter Chron 13303, dated July 8, 1988, Subject: Equipment Qualification, Reactor Water Cleanup System Line Break Analysis. (DIT-71-016)

3.6 CECo Requisition No. D66469, dated 6/19/91 for 23 ABB ITE-27N Undervoltage Relays. (DIT-71-007)

3.7 Appendix VI to Wyle Nuclear Environmental Qualification Test Report No. 17199-1 dated September 25, 1991, HELB Simulation Test Program on Undervoltage Circuit Components: "MLEA Test Plan M0071-007-TP, Rev. 0 For Use, dated 9/12/91, Test Plan for HELB Simulation Testing of Second Level Undervoltage Circuitry and Equipment Including ABB Type 27D Solid State Undervoltage Relays, ABB Type 27N Solid State Undervoltage Relays, Agastat EGPD002 Control Relays, Agastat ETR14D3N002 Time Delay Relay, Agastat ETR14D3B003 Time Delay Relay, Westinghouse FT-1 Switch and Marathon 1600 Terminal Blocks." (*This reference is contained in reference 3.8 below.*)

3.8 Wyle Nuclear Environmental Qualification Test Report No. 17199-1 dated September 25, 1991, HELB Simulation Test Program on Undervoltage Circuit Components.

3.9 ABB Drawing No. 611996-003, Revision 003, dated 9/11/90, Schematic, Single Phase Undervoltage Relay, Type 27N (w/Harmonic Filter Mods). (DIT-71-032)

3.10 ABB Drawing No. 611798-001, Revision 0, dated 3/27/86, Harmonic Filter Schematic. (DIT-71-032)

3.11 ASEA Brown Boveri Report RC-5005B with RC-5105-B, dated 11/12/88, Class 1E Electrical Equipment Qualification of 27D/H Undervoltage Relays with Appendix "A", Component Aging Evaluations and Appendix "B", Seismic

Summary Report for Mechanically Equivalent Device Model 47D. (DIT-71-032)

3.12 ASEA Brown Boveri Report RC-5039-A with RC-5139-A, dated 1/10/90, Class IE Electrical Equipment Qualification, 27N undervoltage Relay with Appendix "A", Component Aging Evaluations and Appendix "B", Seismic Summary Report. (DIT-71-032)

*3.13 Agastat Nuclear Environmental Qualification Test Report on Agastat EGP, EML, and ETR Control Relays by Control Products Division Amerace Corporation, Test Report ES-2000, Rev. A dated 7/11/80. (Contained in CECo EQ files, Pages 1, 2, 3, and 7 are attached.) (DIT 71-045)

3.14 Memorandum from C. Collins (CECo/Dresden) to C. Crane (MLEA) dated September 11, 1991, Subject: Replacement of 2nd Level Undervoltage Relays Dresden Unit 2. (DIT-71-034)

3.15 Telecopy from C. Collins (CECo/Dresden) to J. Murphy (MLEA) containing CECo Requisition No. D66469B, dated 10/1/91, Subject: Increase Description of Relay to Better Specify the Green Light Emitting Diode & Dust Proof Bezel & Correction in Part Number. (DIT-71-033)

*3.16 Dresden Station EQ Binder EQ-44D, General Electric Switchgear Components, Model MC-4.76, Rev. 06 dated 11/14/89.

*3.17 MLEA Calculation No. 88011-03, Rev. 1, dated 2/9/90, Environmental Qualification of GE Switchgear, MC-4.76, bus 23-1(33-1), Dresden Station RWCU Line Break.

*3.18 Bechtel Specification N102, Rev. 3, dated 10/21/88, Response to IE Bulletin 79-01B, Procedure for Use of Environmental Zone Maps for Dresden Nuclear Power Station Units 2 and 3, Commonwealth Edison Company. (DIT-64-007)

3.19 Westinghouse Descriptive Bulletin 41-075C, dated December, 1977, Flexitest Switch Type FT-1.

3.20 Telecopy from Bill Denny (SE Technologies, Inc.) to Joe Murphy (MLEA) dated October 28, 1991, Subject: Thermal Aging Data for Polycarbonate. (DIT-71-035)

*3.21 Main Line Engineering Associates Report M0064-8, Justification for Continued Operation Technical Evaluation and Environmental Qualification Deviation, Assessment for RWCU LOCA Scenario for ABB/ITE Type 27D Solid State Undervoltage Relay, Agastat ETR Time Delay Relays, and Agastat Control Relays Contained in the Circuitry for 4 KVac Bus 23-1, Dresden Nuclear Power Station Unit 2, Revision 2, 5-20-91.

* - Indicates that the referenced document is not attached and controlled within this calculation.

4.0 Qualification Criteria

Criteria used to demonstrate qualification is in accordance with the following (indicate documents which are applicable):

_X_ USNRC DOR-Guidelines, "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors", November 1979.

___ USNRC NUREG-0588, Revision 1, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment", July 1981
Category I ___ Category II ___

___ 10CFR50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants", February 22, 1983.

_X_ USNRC Regulatory Guide 1.89 Revision 1, "Environmental Qualification of Certain Equipment Important to Safety for Nuclear Power Plants", June 1984, Paragraph C.6.e.

_X_ IEEE 323-1974, "IEEE Standard for Qualifying Class 1E Electrical Equipment for Nuclear Power Generating Stations".

___ Other, Specify:

5.0 Method of Qualification and Test Sequence

(1) Methodology (Check only one block)

_ Test of Identical Item Under Identical Conditions or Under Similar Conditions with Supporting Analysis

X Test of Similar Items with Supporting Analysis

_ Analysis in Combination with Partial Type Test Data that Supports the Analytical Assumptions and Conclusions

_ Experience with Identical or Similar Equipment Under Similar Conditions with Supporting Analysis

Wyle Laboratories report 17199-1 (Reference 3.8) demonstrates that the circuitry and equipment similar to that used in the Dresden 4Kvac second level undervoltage equipment located in environmental zone 28 was exposed to a steam environment which envelops the harsh temperature and humidity (212°F/100% RH) described in Reference 3.5 and meets the acceptance criteria (i.e. the equipment does not change state as a result of the steam exposure in the first minute of the HELB environment).

(2) Test Sequence: (Reference 3.8 Section 10.0)

- Equipment was inspected for damage and conformity to test plan description by Wyle Labs. (Ref 3.8, 10.1)

- Time delays for Agastat Time delay relay ETR14D3B003 was set at 4.98 seconds and for ETR14D3N002 was set at 5 minutes, 7 seconds. (Ref. 3.8, 10.2)

- Base line functional testing (Ref. 3.8, 10.3):

  (a) With the DC control voltage at 125 Vdc, the 120 Vac voltage was reduced to 107 Vac to verify that the ABB undervoltage relays would change states approximately 7 seconds after the AC input voltage reached 108.1 Vac. In addition, it was also verified that the Agastat ETR14D3N002 relay changed state approximately 5 minutes after the ABB undervoltage relays changed state.

  (b) The on-off switch of the Agastat ETR14D3B003 relay was closed to verify that it would change state after approximately 5 seconds.

  (c) The AC input voltage was increased to 120 Vac to verify that all specimens would return to their initial condition at normal voltage.

  (d) Proper operation of all wired specimen contacts was also verified.

- HELB Test (Ref. 3.8, 10.4.2): Initial ramp to 212°F followed by a gradual reduction to approximately 142°F at one hour after start of the test. The specimens were monitored for any unintended change of state during the HELB test.

- Post HELB Functional Test (Ref. 8, 10.5): The functional tests described in Reference 3.8, paragraph 10.3 were repeated.

- Post Test Inspection (Ref. 3.8, 10.6): The specimens were visually inspected, and the condition of the specimens was recorded.

6.0 Equipment Description and Similarity to Tested Equipment

The following table lists the equipment installed in Dresden Station as identified in Reference 3.7 and the Equipment tested as identified in References 3.4, 3.7, 3.8, and 3.15.

Installed Equipment	Tested Equipment
ABB Type 27D Relay Cat. 211R4175	ABB Type 27D Relay Cat. 411R4175
ABB Type 27N Relay Cat. 411T4375-L-HF-DP	ABB Type 27N Relay Cat. 411T4375-HF-DP
Westinghouse FT-1 Switch Style 129A501G01	Westinghouse FT-1 Switch Style 129A501G01
Agastat Time Delay Relay ETR14D3N002	Agastat Time Delay Relay ETR14D3N002
Agastat Time Delay Relay ETR14D3B002	Agastat Time Delay Relay ETR14D3B003
Agastat Control Relays (2) EGPD002	Agastat Control Relays (2) EGPD002
Marathon 1600 Series Terminal Blocks	Marathon 1600 Series Terminal Blocks
Hoffman Junction Box Cat. A302420LP	Hoffman Junction Box Cat. A302420LP
Junction Box Back Panel Cat. A30P24	Junction Box Back Panel Cat. A30P24
Agastat Relay Socket Base ECR0095001	Agastat Relay Socket Base ECR0095001
Agastat Locking Strap ECR0155001	Agastat Locking Strap ECR0155001
Amer-tite 3" Flex Conduit	Anaconda Sealtite 3" Flex Conduit
Top Entry 3" conduit Fitting	Top Entry 3" O-Z/Gedney conduit Fitting
GE Vulkene 14 AWG SIS Wire	Rockbestos 14 AWG SIS Wire
Rockbestos 14 AWG Firewall Wire	Rockbestos 14 AWG SIS Wire

Reference 3.7 establishes that the equipment and circuitry listed above and tested in Reference 3.8 are similar to the equipment and circuitry installed in the Dresden Station Second Level Undervoltage circuits.

Reference 3.15 transmitted a revised CECo purchase requisition for the ABB type 27N solid state undervoltage relays for installation at Dresden Station (Reference 3.4). Reference 3.15, required the installation of the DP Bezel (as in the tested ABB Type 27N undervoltage relay) and also required a green light emitting diode to be added to indicate the presence of DC control power ("L" option) in addition to the red light emitting diode normally installed for indication that the relay has changed state.

The ABB type 27N test specimen did not have the green light emitting diode for indication of DC control power. The test specimen was based on the original CECo purchase requisition, Reference 3.6. However, it was not known that the "L" designator was required to be specified to ABB.

Reference 3.9 shows the green light emitting diode as "L" option, installed in series with a 15 kohm resistor across the positive and negative sides of the DC control power portion of the relay circuit. The green light emitting diode is installed in the same manner as the normally installed red light emitting diode, which is installed in series with a 15 kohm resistor as shown on Reference 3.9.

The normally installed red light emitting diode performed satisfactorily during the HELB exposure testing described in Reference 3.8. Since the green light emitting diode added to the ABB type 27N relays for Dresden Station by Reference 3.15 is installed in the same manner (and is the same device) as the normally installed red light emitting diode (viz., in series with a 15 kohm resistor) and the normally installed red light emitting diode performed satisfactorily under HELB conditions, the green light emitting diode added to the type ABB 27N solid state undervoltage relays by Reference 3.15 is qualified by similarity for HELB exposure.

Therefore, the testing of similar equipment to the Dresden 4KVac Second Level Undervoltage Protection circuitry and equipment establishes that the installed equipment and circuitry are environmentally qualified by Reference 3.8 for the harsh temperature and humidity conditions (212°F/100% RH) resulting from RWCU line break.

7.0 Safety Function and Required Operating Time

During normal plant operation, the function of the second level undervoltage circuitry and equipment is to provide protection against a degraded voltage condition on the safety related 4 KVac buses. A degraded voltage condition will cause induction motors to draw more current and may result in overheating of the motor windings. The second level undervoltage relays are set between 3708 Vac and 3784 Vac. If a degraded condition persists for 7 seconds, an annunciator alerts the operator and a 5 minute time delay is initiated. If the bus voltage is not restored to normal operating voltage within 5 minutes, the diesel generator is started, the incoming breakers are tripped, load shedding is initiated, and the diesel generator breakers close when all permissives are satisfied Ref. 3.3).

In the event of RWCU line break, 4 KVac buses 23-1(33-1) must provide AC power to 480 Vac motor control centers MCC 18-1A(28-1A) for at least 40 seconds after the line break in order to close the AC RWCU isolation valves MO-2(3)-1201-1 and isolate the RWCU line break (Ref. 3.3).

The need to maintain the second level undervoltage protection, coincident with a RWCU line break scenario, is not considered to be necessary and the scenario is not considered to be a credible event ((Ref. 3.7).

Therefore, the second level undervoltage protection circuit must not change state during the first 40 seconds of exposure to the harsh temperature and humidity environment (212°F/100% RH) caused by RWCU line break (Ref. 3.3).

8.0 Qualified Life

8.1 ABB Type 27D and Type 27N solid state undervoltage relays:

In References 3.11 and 3.12, ABB provides analyses of the components used in the Type 27D and 27N solid state undervoltage relays. The method used is a combination of Arrhenius evaluations of insulation materials used in the relays and MIL-HDBK-217 evaluations of the effects of electrical and thermal stresses on the electronic components used in the relays. References 3.11 and 3.12 conclude that the qualified life of the Type 27D and Type 27N solid state undervoltage relays is in excess of 40 years at an average ambient air temperature of 45°C, an internal air temperature of 60°C, and a control voltage of 131 Vdc.

8.2 Agastat ETR Time Delay Relays and EGP Control Relays:

Reference 3.13 identifies the qualified life of the Agastat ETR and EGP relays as 10 years from the date of manufacture or 25,000 operations, whichever comes first.

8.3 Marathon 1600 Series Terminal Blocks:

Dresden EQ Binder EQ48D, Revision 8, establishes a 40 year qualified life of the Marathon 1600 series terminal blocks used in Dresden Station both inside and outside containment. (This binder is located in the CECo Dresden EQ files.)

8.4 Westinghouse FT-1 Switch:

Reference 3.19 identifies the material of construction of the case and cover of the Westinghouse FT-1 switch as polycarbonate. Reference 3.20 lists the life of a typical polycarbonate material as 31,290 years at a temperature of 105°F.

Therefore, it is concluded that, with the exception of the Agastat ETR and EGP relays, the second level undervoltage equipment installed in Dresden Station for the Safety-Related 4 KVac buses is qualified for 40 years at 104°F (the maximum ambient temperature in Zone 26 as identified in Ref. 3.18). The qualified life of the Agastat ETR and EGP relays is 10 years from the date of manufacture or 25,000 operations whichever comes first. The SIS wire used by CECo throughout the plant is environmentally qualified for 40 year lifetime and the information is contained in the CECo Dresden EQ files.

9.0 Qualification for Radiation

The second level undervoltage circuitry and equipment for Dresden Station 4 KVac busses 24-1, 33-1, and 34-1 are located in a mild radiation environment in the event of LOCA. Dresden Station 4 KVac bus 23-1 is subject to a harsh radiation environment in the event of LOCA. Reference 3.21 established that the Agastat ETR time delay relays and EGP control relays, the Marathon 1600 series terminal blocks and the Westinghouse FT-1 switch are qualified for the radiation environment to which they would be subjected in the event of LOCA. Reference 3.21 also established that the ABB Type 27D solid state undervoltage relays are operable in the radiation environment caused by LOCA although the time delay is increased from 7 seconds to approximately 20 seconds.

Reference 3.14 states that the ABB Type 27D relays associated with 4 KVac bus 23-1 will be replaced with ABB Type 27N relays (Reference 3.4) and that the panel containing the second level undervoltage equipment for 4 KVac bus 23-1 will be moved to a location which is mild for radiation in the event of LOCA.

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10.0 Qualification for High Temperature Steam Environments

10.1 Plant Accident Profile:

Reference 3.5, Figures 2 and 3, provide the temperature in the mezzanine area of the Dresden Station Reactor Building (environmental zone 26) as a function of time after RWCU line break. The temperature rises to 212°F at approximately 40 seconds after the break (at which time the break is isolated). The temperature then falls off to approximately 140°F at one hour after the RWCU line break occurs. Figures 2 and 3 of Reference 3.5 are reproduced on pages 17 and 18 of this calculation.

Figures 2 and 3 of Reference 3.5 are based on a double ended, guillotine break in the 6 inch RWCU piping in the RWCU heat exchanger room (Reference 3.3).

10.2 Equipment Performance Characteristics:

Reference 3.7, Section 6, and Reference 3.3, Section 6.2, note that the second level undervoltage protection circuitry and equipment are not required to function to mitigate the RWCU line break, but must not fail (viz., change state) during the first minute after RWCU line break in any manner which would prevent closure of the AC RWCU isolation valve (MO-2(3)-1201-1).

10.3 Effects of Humidity:

Reference 3.5 does not specifically identify the relative humidity in the mezzanine area of the reactor building. Therefore, for conservatism, a relative humidity of 100% has been assumed in this calculation.

The ABB Type 27D and Type 27N solid state undervoltage relays and the Agastat ETR relays in the second level undervoltage protection circuitry are electronic devices. Reference 3.3 indicates that moisture intrusion and condensation on the electronics might adversely affect the performance of the equipment. Reference 3.3. concluded that it is unlikely that the electronics would be exposed to moisture during the first forty seconds after RWCU line break.

Reference 3.8 is the report of steam testing (100% RH) of the second level undervoltage protection equipment. The report demonstrates that the equipment is not adversely affected (i.e., does not change state) when exposed to a steam environment for one hour.

10.4 Accident Simulation Testing and Results:

Reference 3.8 describes HELB simulation (steam exposure) testing of the Dresden Second Level Undervoltage relay equipment and circuitry. The test profile shown on pages 41 through 45 of Reference 3.8 envelopes the accident temperature profile shown on Figures 2 and 3 of Reference 3.5. The test was conducted using steam which ensured that the relative humidity was at 100% throughout the test. Page 45 of Reference 3.8 shows that the internal temperature of the junction box which contained the second level undervoltage equipment substantially lags the temperature of the steam environment.

Reference 3.8, pages 48 through 53, demonstrates that the undervoltage equipment did not change state throughout the HELB simulation testing. In addition, post HELB test functional testing (Reference 3.8, page 9) demonstrated that the undervoltage equipment performed within design specification requirements (Reference 3.7, Section 6.0).

10.5 Margin:

Although Reference 3.8 demonstrates a temperature margin of 4°F to 15°F during the HELB simulation testing, the qualification margin for the Dresden 4KVac Second Level Undervoltage Protection Circuitry and Equipment is a Time margin.

The Dresden 4KVac Second Level Undervoltage Protection Circuitry and Equipment must not change state during the first 40 seconds after RWCU line break (Reference 3.3) in order to assure closure of the AC RWCU system isolation valve (MO-2(3)-1201-1). The HELB simulation testing described in Reference 3.8 established that the Dresden 4KVac Second Level Undervoltage Protection Circuitry and Equipment did not change state for one hour after RWCU line break. This time margin meets the recommended time margin of Regulatory Guide 1.89 (1 hour plus operating time).

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Bechtel Eastern Power Company

Figure 2

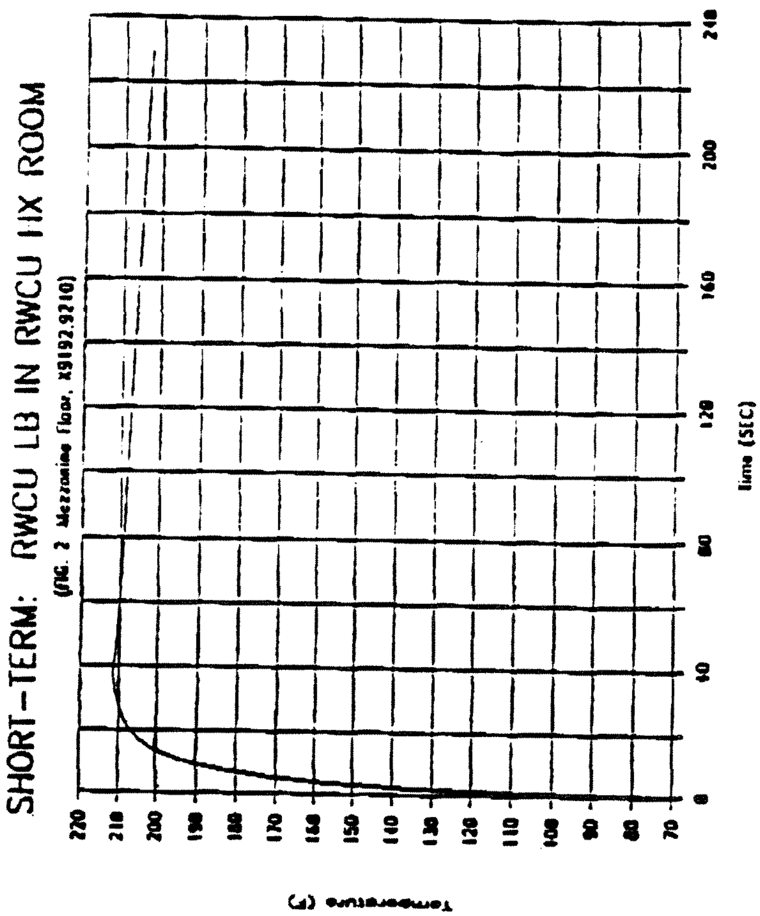

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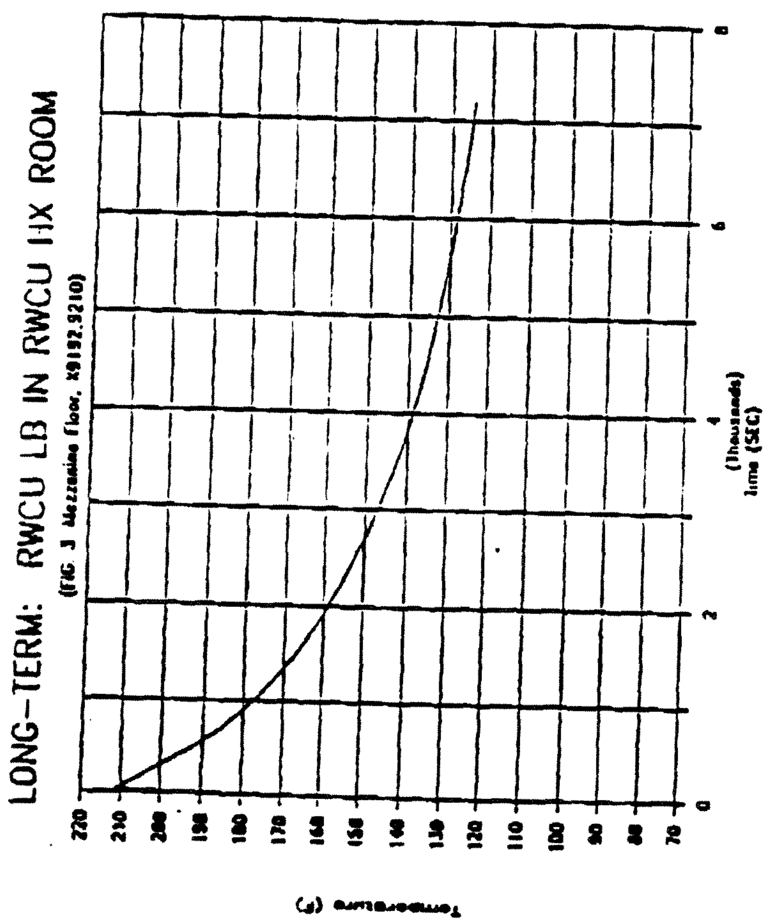
Figure 3



11.0 Synergistic Effects

Synergistic effects are associated with interactions of temperature (Aging) and radiation dose rates. The second level undervoltage circuitry and equipment installed in Dresden Station are located in mild radiation environments and therefore would not exhibit synergistic effects due to ambient temperature and radiation dose rate.

References 3.11 and 3.12 address synergistic effects for the ABB Type 27D and Type 27N solid state undervoltage relays and state that no synergistic effects have been identified for the equipment.

Extensive testing of Agastat ETR and EGP relays described in Reference 3.13 indicate that there are no synergistic effects associated with these relays.

Dresden EQ Binder EQ-48D establishes that there are no synergistic effects for Marathon 1500/1600 Series terminal blocks.

A review of available literature on polycarbonate materials established that there are no identified synergistic effects caused by gamma dose/dose rate and temperature. (Some clear formulations of polycarbonate have shown sensitivity to ultraviolet light and temperature but the Westinghouse FT-1 switch is not constructed of clear polycarbonate and therefore not subject to synergistic effects due to ultraviolet light.)

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12.0 **Maintenance and Surveillance**

12.1 **ABB Type 27D and Type 27N Solid State Undervoltage Relays:**

In References 3.11 and 3.12, ABB recommends that the testing identified in the ABB instruction manuals for the equipment, which are contained in Appendix B to Reference 3.7, be conducted at two year intervals.

12.2 **Agastat ETR Time Delay Relays and EGPD Control Relays:**

The performance of the Agastat ETR Time Delay Relays and Agastat EGPD Control Relays can be monitored during performance of the ABB Solid State Undervoltage Relays every two years. In Reference 3.13, Amerace Corp. states that the Agastat ETR and EGPD relays must be replaced ten (10) years after the date of manufacture or after 25,000 operations, whichever comes first.

12.3 **Marathon 1600 Series Terminal Blocks:**

Dresden Station EQ Binder, EQ-48D, Tab E, contains the maintenance and surveillance requirements for Marathon 1600 series terminal blocks. No other maintenance or surveillance is required for the Marathon 1600 Series terminal blocks installed in the junction boxes for the second level undervoltage equipment.

12.4 **Westinghouse FT-1 Switch:**

In Reference 3.19, Westinghouse does not provide any requirements for maintenance or surveillance of the FT-1 switch. However, Reference 3.3 established that the FT-1 switch is essentially a terminal block. Therefore, the maintenance and surveillance recommended in Tab E of Dresden EQ Binder EQ-48D for Marathon terminal blocks should be applied to the Westinghouse FT-1 switch.

ATTACHMENT I

DIT DR-EPED-0671-01

DIT

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DIT

SARGENT & LUNDY ENGINEERS

DESIGN INFORMATION TRANSMITTAL

☒ SAFETY-RELATED ☐ NON-SAFETY-RELATED

DIT No. - DR-EPED-0671-01

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To W. G. BLOETHE

CLIENT CECO

STATION DRESDEN UNIT(S) 2 & 3

PROJECT NO(S). 8982-13

SUBJECT REACTOR BUILDING VENTILATION, MINIMUM TEMPERATURE.

MODIFICATION OR DESIGN CHANGE NUMBER(S)

Preparer (Please print name)	Division	Preparer's signature	Issue date
S. K. SAHA	EPED	S. K. Saha	05-08-'92

STATUS OF INFORMATION (This information is approved for use. Design information not approved for use, that contains assumptions or is preliminary or requires further verification (review) shall be so identified.)

SARGENT & LUNDY EAD MAY 12 1992 RECEIVED

THE DESIGN INFORMATION IS APPROVED FOR USE.

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 IS SUPPLEMENT TO DIT # DR-EPED-0671-00

THIS DIT PROVIDE THE MINIMUM REACTOR BUILDING AND THE TURBINE BUILDING ENVIOURNMENTAL TEMPERATURE ACCORDING TO THE DRESDEN UFSAR. (SECTION 10.11.2-1) PAGE 2 OF THIS DIT IS THE PAGE FROM UFSAR. PREVIOUS DIT (# DR-EPED-0671-00) DID NOT PROVIDE THE MINIMUM TEMPERATURE.

SOURCE OF INFORMATION

Calc. no. — Rev. and/or date — Report no. — Rev. and/or date —

Other UFSAR (DRESDEN)

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Form QQ-3.17.1 Rev.2 (01-08-87)

F613A (1/2)
01-87- F3

DRESDEN
UFSAR.

10.11.2 DESCRIPTION

The plant heating, ventilating and air conditioning system consists of the elements required to effect and control the following space air processes: supply and exhaust; distribution and recirculation; velocity; differential and static pressure control; filtration of particulate contaminates; cooling and heating; complete air conditioning; and area isolation.

Elements necessary to perform and control the space air requirements are filters, dampers, cooling and heating coils, electric duct heaters, air washers, refrigerating equipment, fans, and the necessary control and support equipment.

The overall system is related, but divided into subsystems which are designed to control the air requirements in a particular area (see Figures 10.11.2:1 thru 10.11.2:5). They are as follows:

1. Reactor Building Ventilation; Min 65°F, Max 103°F

2. Turbine Building Ventilation; Min 65°F, Max 120°F

3. Radwaste Building:

   Occupied areas; Min 50°F, Max 103°F

   Cells and Collector Tank Room; Min 50°F, Max 120°F

   Concentrator & Concentrator Waste Tank Cells; Min 50°F, Max 150°F

4. Main Control Room; Min 70°F, Max 80°F

5. Drywell Ventilation:

   Normal; 135°F Average

   8 hrs after Shutdown; 105°F Average

~~DIT No: DR-EPED-0671-01~~
~~PROJECT No. 8982-13~~
~~PAGE 2 OF 2~~

ATTACHMENT J

S&L Interoffice Memorandum from B. Desai

DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

Assumption - 9. 15

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 used near 110 V.

Reference Calculations

8982-13-19-6, Revision 2
8982-17-19-2, Revision 1

Verification Description

The attached relay setting order for Dresden Station Unit 2, Buses 23-1, 24-1, and Unit 3, Buses 33-1 and 34-1 from CECo System Planning already addresses tolerance of ±0.2 V and setpoints are near 110 V. Therefore, this assumption does not require further verification.

Follow Up Action

Incorporate assumption verification in the calculation.

RELAY SETTING ORDER

C.E. CO. 86-4600

FROM [ ] STA. ELEC. [X] SYST. PLAN.

STATION 12-DRESDEN BUS 23-1 KV 4.16 RELAY TYPE ITE 27N-HF

A [X] B [ ] C [X] RES. [ ] = [ ] BL [ ] INSTALL [ ] REPL. [ ] CHG. [X] DEACTIVATE [ ]

* SECOND LEVEL UNDER-VOLTAGE

	RESET		TRIP		
ZONE OR EL.(CHARAC)	UV		UV	FOR INFORMATION ONLY	
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	NA		NA		
RANGE (RATING)	70-120V		70-120V		
PRIMARY SETTING	3820		3835		
SEC. SET'G (OP. VALUE)	109.15 +/- .2V		109.57 +/- .2V		
COMPUTED TAPS	110 VOLTS		110 VOLTS		
TEST A-V CUR. LAG DEG	RESET TAP @ 99%		RESET TAP @ 99%		
TIMING	7 SECS (USE 5 TAP)		7 SECS (USE 5 TAP)		

RESET V. MAY NOT EXCEED 110.12 VOLTS

OAD RECORD RESET V: A-B: 109.58V B-C: 109.60V

SUPERSEDES RSO ISSUED 1-27-92 ISSUE DATE 6-2-92 BY MC COMPLETED JB BY 6/9/92

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

8982-13-19-6 Rev. 2

RELAY SETTING ORDER

C.E. CO. 86-4600

FOR INFORMATION ONLY

FROM [ ] STA. ELEC. [X] SYST. PLAN. [ ] OR ________ DIV. ENG.

STATION 12-DRESDEN BUS 24-1 KV 4.16 RELAY TYPE ITE 27N-HF

A [X] B [ ] C [X] RES. [ ] = [ ] BL [ ] INSTALL [ ] REPL. [ ] CHG. [X] DEACTIVATE [ ]

* SECOND LEVEL UNDER-VOLTAGE

	RESET		TRIP		
ZONE OR EL.(CHARAC)	UV		UV		
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	NA		NA		
RANGE (RATING)	70-120V		70-120V		
PRIMARY SETTING	3784		3820		
SEC. SET'G (OP. VALUE)	108.1		109.15 +/- .2 VOLTS		
COMPUTED TAPS	110 VOLTS		110 VOLTS		
TEST A-V CUR. LAG DEG	RESET TAP @ 99%		RESET TAP @ 99%		
TIMING	7 SECS (USE 5 TAP)		7 SECS (USE 5 TAP)		

RESET V. MAY NOT EXCEED 109.7 VOLTS

OAD RECORD RESET V: AB relay = 109.22 BC relay = 109.19

ISSUE DATE 1-27-92 BY MC COMPLETED 1/20/92 BY WJM

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

Does not [illegible] ... 2 but ... 23-1

7, 15 - 2

RELAY SETTING ORDER FOR INFORMATION ONLY

C.E.CO. 88-4604 5-83

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 72 - DRESDEN BUS 33-1 KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* SECOND LEVEL UNDER-VOLTAGE

	AS-FOUND	TO BE	
ZONE OR EL.(CHARAC)	UV	UV	FOR INFORMATION ONLY
P.T. (P.D.) RATIO	35:1	35:1	
C.T. TURN RATIOS	NA	NA	
RANGE (RATING)	70-120V	70-120V	
PRIMARY SETTING	3870	~~3884~~	
SEC. SET'G (OP. VALUE)	110.6V +/- .2V	110.97 +/- .2V	
COMPUTED TAPS	110 VOLTS	110 VOLTS	
TEST A-V CUR. LAG DEG	RESET TAP @ 99%	RESET TAP @ 99%	
TIMING	7 SECS (USE 5 TAP)	7 SECS (USE 5 TAP)	

RESET V MAY NOT EXCEED 111.53 VOLTS

OAD RECORD RESET V: AB = 110.96V BC - 110.99V

SUPERSEDES RSO ISSUED 2-11-92 ISSUE DATE 6-2-92 BY TJC COMPLETED GB BY 6/8/92

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

* matches with calc 8982-17-19-6 Rev. 1

RELAY SETTING ORDER FOR INFORMATION ONLY

C.E.CO. 88-4604 5-83

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 12 DRESDEN KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* BUS 34-1 SECOND LEVEL UNDERVOLTAGE

ZONE OR EL.(CHARAC)	OLD UV	NEW UV	FOR INFORMATION ONLY
P.T. (P.D.) RATIO	35/1	35/1	
C.T. TURN RATIOS			
RANGE (RATING)	70-120V	70-120V	
PRIMARY SETTING	3784V	3870V	
SEC. SET'G (OP. VALUE)	108.1V	110.6V (± .2V)	SET R TAP = 99%
COMPUTED TAPS	110V	110V	110.6V ≤ VRESET ≤ 111.1V
TEST A-V CUR. LAG DEG	120V→0V	120V→0V	
TIMING	7 SEC (5 TAP)	7 SEC (5 TAP)	Actual Reset = 110.61

OAD TO RECORD RESET VOLTAGE. SETTINGS BASED ON NED

RECOMMENDATION LETTER OF 2/10/92 TUCKER TO HORWATH

CHRON# 180284 ISSUE DATE 2/11/92 BY CRS COMPLETED 2/13/92 BY TJ

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

Does not match ... Rev. 0 of calc ...

9/15-3

Calculation No. 8982-17-19-2

Revision 004

Attachment: J

DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

Assumptions 10 & 16

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

Reference Calculations

(1) 8982-13-19-6, Revision 2

(2) 8982-17-19-2, Revision 1

Verification Description

To verify above assumption calculation 9198-42-19-1 was prepared.

The calculation demonstrates that there are sufficient terminal voltages at the second-level UV relays during the first seven seconds of a LOCA (no LOOP) combined with a degraded voltage condition. The calculation also shows that these relays will not be exposed to terminal voltages exceeding their maximum limit during battery equalization.

Follow-Up Action

Incorporate assumption verification in the calculation

wp: G:\ELEC\DQC\QDC3545.EP

I. The battery chargers are rated at 200A (Reference 16) and are set to curren limit at 100% of the charger rating (Reference 15).

J. The characteristics of the NCX-21 battery cells for the 125-Vdc battery (Reference 5) are the same as those of the NCX-1500 battery cells of the 250-Vdc batteries (References 6 and 21).

IV. ASSUMPTIONS

Assumptions not Requiring Verification

A. Fuse resistances are not included in this calculation. The fuses which are upstream of the control circuits where the second-level UV relays are installed, are all 35 A (Reference 10). The resistances of the 35 A fuses are negligible when compared to the resistances of the cables. (ENGINEERING JUDGMENT)

B. Contact resistance for switches, breakers, and relays are assumed negligible. This is based on Dresden Station Design Information Transmitta DR-EPED-0503-00 (Reference 11) which shows that contact resistances vary from 0.0028 to 0.0002 OHMS. (ENGINEERING JUDGMENT)

C. The battery is fully charged at the time of LOCA initiation. The battery voltages are checked daily by personnel from the station operations department (Reference 12).

D. No LOOP condition exists.

E. The new main feed to Panel 903-34 on Bus 3A-2 (Reference 22) has been installed. (ENGINEERING JUDGMENT - This loading is conservative relative tc premodification loading on the same bus).

V. ACCEPTANCE CRITERIA

The input voltage at the terminals of the second level UV relays must not be belov the established minimum value of 95 Vdc or above the maximum value of 140 Vdc as determined by vendor information (References 7 and 19). However, the relay will also tolerate a one second dip in minimum (Reference 19) terminal voltage to 89 Vdc.

Table 1 shows that during the worst interval (Switchgear 24-1, from -6.917 to -6 seconds), the battery is still able to supply the minimum voltage to the UV relay, and would discharge from a fully charged state in about 15 minutes if this load were kept constant. Since the time delay for the UV relays is only seven seconds long, it is evident from the table that all UV relays will have the minimum necessary control voltage to operate during this time period.

The tables in Attachments A and B show the loading during a dual unit LOCA with no LOOP. However, the design basis for the station is a single unit LOCA only. Therefore, the results shown in Table 1 are conservative.

- The maximum battery equalization voltage is 135V when the battery is connected to the bus. Therefore, the maximum voltage of 140V at the terminals of the undervoltage relays will not be exceeded.

VIII. COMPARISON OF RESULTS WITH ACCEPTANCE CRITERIA

From the analysis of Section VII, the terminal voltages of all second level UV relays will be within their minimum and maximum established limits under the postulated conditions.

IX. CONCLUSIONS

The calculation demonstrates that there are sufficient terminal voltages at the second-level UV relays during the first seven seconds of a LOCA (no LOOP) combine with a degraded voltage condition. The calculation also shows that these relays will not be exposed to terminal voltages exceeding their maximum limit during battery equalization.

X. RECOMMENDATIONS

Not Applicable.

XI. REFERENCES

1. Sargent & Lundy Standard ESA-102, Revision 04-14-93
2. Sargent & Lundy Standard ESI-253, Revision 12-06-91
3. Sargent & Lundy Standard ESC-291, Revision 05-23-91
4. Design Information Transmittal DR-EDD-0086-00, dated 08-02-93 (attached)
5. Sargent & Lundy Calculation 7056-00-19-5, Revision 23, dated 08-27-93

Calc. No. 8982-17-19-2
Rev. 2
Page R25 of
Project No. 8982-64

ABB
ASEA BROWN BOVERI

Telephone: 215-395-7333
Telecopy: 215-395-1055

DATE: 10/14/93 PAGES INCLUDING COVER SHEET: 1

TO: JIM KULAGA S+L

FROM: CLIFF DOWNS - PRODUCT MGR

REFERENCE: 27N

MESSAGE: PER YOUR REQUEST, THIS IS TO CONFIRM THAT THE ALLOWABLE DC CONTROL VOLTAGE RANGE FOR TYPE 27N WITH HARMONIC FILTER IS 95-140V AND THAT A 1 SECOND EXCURSION TO 89VDC WILL NOT AFFECT ITS OPERATION. THIS ASSUMES THE RESISTOR INSTALLED BETWEEN TERMINALS 1 AND 9 HAS A VALUE OF 4000 OHMS.

Cliff Downs

Calculation No. 8982-17-19-2
Revision 004
Attachment: J

DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

Assumptions - 11, 17

"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."

Assumptions - 12, 18

"It is assumed that the multimeter is calculated 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°. This assumption is necessary to limit the conservatism in the error due to relay temperature effect to a reasonable level."

Reference Calculations

8982-13-19-6, Revision 2
8982-17-19-2, Revision 1

Verification Description

Dresden Relay Setting Procedure DOS 6600-09, Revision 8, specify to: a) use calibrated model Fluke 45 digital multimeter b) relays must be calibrated to an ambient temperature between 70° and 75°F.

Commonwealth Edison Company will revise Procedure DOS 6600-09 to include the use of Fluke 45 Digital Multimeter with user-selected reading rate of five (medium) readings per second.

Follow Up Action

Incorporate assumption verification in calculation.

To: J.J. Horwath

Subject: Second Level Degraded Voltage Relay Settings
Switchgear 23-1(Div. I) & Switchgear 33-1(Div. I)
Dresden Station, Unit 2 & 3

Ref.: 1. S&L Calculation Number 8982-13-19-6, Rev.2, entitled "Calc. for Second-Level Undervoltage Relay Setpoint", Dresden Unit 2, CHRON # 186718.

Ref.: 2. S&L Calculation Number 8982-17-19-2, Rev.1, entitled "Calc. for Second-Level Undervoltage Relay Setpoint", Dresden Unit 3, CHRON # 186716.

Ref.: 3. Operability Determination of Safety Related Equipment Affected by the Second Level Undervoltage Relay Setpoint Change on Division I of Units 2 and 3, Dresden Station, CHRON # 186841.

The above listed references are for your files. Reference 1 and 2 establish the design basis for the setpoints of the subject relays. In order to expedite issuing new Relay Setting Orders reference 1 and 2 were previously sent to you and discussed via phone on June 2, 1992. The need to adjust the existing settings is due to incorrectly applied vendor information which changed the ambient temperature effect tolerance in the original calculations. This setpoint adjustment will restore margin to the level established in our current setpoint methodology. It is our understanding that Relay Setting Orders for the subject relays have been issued as follows:

Dresden Unit 2 - Division I

Primary Trip Setting	:	3835 volts nominal
Secondary Trip Setting	:	109.57 volts +/- .2 volts
Reset Bandwidth	:	set to minimum achievable by device, approximately .5% (.55 volts) above trip setpoint i.e. 110.12 volts
Timing	:	7 seconds +/- 20%

Dresden Unit 3 - Division I

Primary Trip Setting	:	3884 volts nominal
Secondary Trip Setting	:	110.97 volts +/- .2 volts
Reset Bandwidth	:	set to minimum achievable by device, approximately .5% (.56 volts) above trip setpoint i.e. 111.53 volts
Timing	:	7 seconds +/- 20%

// 7,15-2

It should be noted that the existing setpoints on the Division II second level undervoltage relays are conservatively set above the values indicated in the revised S&L calculations (see Ref. 3). Therefore it is not required at this time to adjust the Division II settings.

The setpoint calculation has several stipulations for setting these relays which must be adhered to by the Operational Analysis Department. They are as follows:

1. A Fluke Model 45 multimeter, must be used to set the relay and have been calibrated within the manufacturer's specified tolerance range of 18 to 28 degrees Centigrade. The Fluke 45 must be set for a 60 Hz signal and at the medium sampling rate. If another voltmeter is to be used then it must have an accuracy equal to or better than the Model 45 in the appropriate volt range and be approved for use in this application by the Nuclear Engineering Department.

2. The relay must be set (calibrated) at a temperature between 21 to 24 degrees Centigrade (70 to 75 degrees Fahrenheit).

3. Utilize ABB instruction bulletin I.B.7.4.1.7-7 Issue D when setting the ABB/ITE, type 27N undervoltage relay with harmonic filter.

A copy of this letter has been sent to the station for appropriate setpoint control review. If you have any questions or concerns regarding this matter please call Stan Gaconis, X7644 or Mike Tucker, X7648.

M.L. Reed
Superintendent
NED-E/I&C Design

Attachment

cc: H.L. Terhune w/o attachment
G.P. Wagner w/o attachment
C.W. Schroeder w/o attachment
H.L. Massin w/o attachment
K.E. Faber w/o attachment
M.S. Tucker w/o attachment
S.L. Gaconis w/o attachment

2.17.18-2

In Reply, Refer to

CHRON # **190945**

Subject: Second Level Undervoltage Protection
Relay Setting Orders
Dresden and Quad Cities Stations

Mr. T.T. Clark:

Please provide copies of the Second Level Undervoltage (Degraded Voltage Protection) Relay Setting orders for the ABB 27N relays installed for 4160 Volt buses 13-1, 14-1, 23-1 and 24-1 for Station 4, Quad Cities, and for 4160 Volt buses 23-1, 24-1, 33-1 and 34-1 for Station 12, Dresden. NED requires copies of the actual relay setting orders to close out some of the assumptions made in the degraded voltage calculations and for the FSAR rebaseline project.

We would appreciate copies of the subject Relay Setting orders by August 31, 1992. If you have any questions, please call me on extension 7648 at Downers Grove.

Prepared: M.S. Tucker — Date: 8/20/92
M.S. Tucker

Approved: M. Pietraszewski — Date: 8-26-92
M.F. Pietraszewski
E/I&C Design Supervisor

8-31-92

cc: M.L. Reed — D. VanPelt
T.S. Kriz — H.S. Mirchandani

Mike - Per your request - Tom Clark
Sys Protection
X 2768

Page 1 of 1
RSOREQST.DOC

12 17 17-

Calculation No. 8982-17-19-2
Revision 004
Attachment: J
Page J12 of J42

InterOffice Memo

To: Bipin Desai

From: Mike Tucker

Date: September 2, 1992

Subject: Calculation Assumptions.
Relay Setting Orders
Degraded Voltage

Tom Clark of System Planning has sent copies of the Second Level Undervoltage Relay Settings as you requested. However, note that the new RSO for Quad Cities Unit 1 has not been issued at this time. Therefore, only the relay setting orders for Quad Cities Unit 2, Dresden Unit 2 and Unit 3 are attached.

The relay setting order does not address the type of meter to be used, much less specify that the medium sampling rate only be user selected. Therefore, we[1] are going to have to determine an alternate course of action.

If you have any questions, please call me on ext. 7648.

CC: M.L Reed

[1] The term "we" in this context should be best interpreted to mean "you."

RELAY SETTING ORDER
C.E.CO. 18-4804 5-63

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 4 Quad Cities KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☒ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* Bus 23-1 2ND Level Undervoltage

ZONE OR EL. (CHARAC)					
P.T. (P.D.) RATIO	35:1		FOR INFORMATION ONLY		
C.T. TURN RATIOS	N/A				
RANGE (RATING)	70-120V				
PRIMARY SETTING	3886				
SEC. SET'G (OP. VALUE)	111.03 V	+/- 0.2 V	- -		
COMPUTED TAPS	110 V Tap				
TEST A-V CUR. LAG DEG					
TIMING	7.0 Sec - Tap 5				

Dropout at 99.5% use 99% Tap

Per Calc. 8913-73-19-4 Rev. 0 ISSUE DATE 4-10-92 BY GMK COMPLETED 4-16-92 BY DEW/Bwy

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

RELAY SETTING ORDER
C.E.CO. 18-4804 5-63

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 4 Quad Cities KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☒ C ☒ RES. ☐ = ☐ BL ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* Bus 24-1 2ND Level Undervoltage

ZONE OR EL. (CHARAC)					
P.T. (P.D.) RATIO	35:1				
C.T. TURN RATIOS	N/A				
RANGE (RATING)	70-120V		FOR INFORMATION ONLY		
PRIMARY SETTING	3886				
SEC. SET'G (OP. VALUE)	111.03 V	+/- 0.2 V			
COMPUTED TAPS	110 V Tap				
TEST A-V CUR. LAG DEG					
TIMING	7.0 Sec - Tap 5				

Dropout at 99.5% use 99% Tap

Per Calc. 8913-73-19-4 Rev. 0 ISSUE DATE 4-10-92 BY GMK COMPLETED 4-16-92 BY DEW/Bwy

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

RELAY SETTING ORDER FOR INFORMATION ONLY FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ______ DIV. ENG.
C.E.CO. 86-4604 5-83

STATION 12 - DRESDEN BUS 33-1 KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL. ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* SECOND LEVEL UNDER-VOLTAGE

	RESET		TO BE	
ZONE OR EL.(CHARAC)	UV		UV	FOR INFORMATION ONLY
P.T. (P.D.) RATIO	35:1		35:1	
C.T. TURN RATIOS	NA		NA	
RANGE (RATING)	70-120V		70-120V	
PRIMARY* SETTING	3870		3884	
SEC. SET'G (OP. VALUE)	110.6V +/- .2V		110.97 +/- .2V	
COMPUTED TAPS	110 VOLTS		110 VOLTS	
TEST A-V CUR. LAG DEG	RESET TAP @ 99%		RESET TAP @ 99%	
TIMING	7 SECS (USE 5 TAP)		7 SECS (USE 5 TAP)	

RESET V MAY NOT EXCEED 111.53 VOLTS

OAD RECORD RESET V: AB - 110.96V BC - 110.99V

SUPERSEDES RSO ISSUED 2-11-92 ISSUE DATE 6-2-92 BY TJC COMPLETED GB BY 6/8/92

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

RELAY SETTING ORDER FOR INFORMATION ONLY FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ______ DIV. ENG.
C.E.CO. 86-4604 5-83

STATION 12 DRESDEN KV 4.16 RELAY TYPE ITE-27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL. ☐ INSTALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* BUS 34-1 SECOND LEVEL UNDERVOLTAGE

ZONE OR EL.(CHARAC)	OLD UV	NEW UV	FOR INFORMATION ONLY	
P.T. (P.D.) RATIO	35/1	35/1		
C.T. TURN RATIOS				
RANGE (RATING)	70-120V	70-120V		
PRIMARY SETTING	3784V	3870V		
SEC. SET'G (OP. VALUE)	108.1V	110.6V (± .2V)		SET & TAP = 99%
COMPUTED TAPS	110V	110V		110.6V ≤ VRESET ≤ 111.1V
TEST A-V CUR LAG DEG	120V → 0V	120V → 0V		
TIMING	7 SEC (5 TAP)	7 SEC (5 TAP)		Actual Reset = 110.61

OAD TO RECORD RESET VOLTAGE. SETTINGS BASED ON NED RECOMMENDATION LETTER OF 2/10/92 TUCKER TO HORWATH

CHRON# 180284 ISSUE DATE 2/11/92 BY CRS COMPLETED 2/13/92 BY [illegible]

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

RELAY SETTING ORDER

C.E.CO. ~~86-4680-7-73~~

FROM — ☐ STA. ELEC. ☒ SYST. PLAN.

STATION 12-Dresden Bus 23-1 KV 4.16 RELAY TYPE ITE 27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL. ☐ IN-STALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* Second Level Under-Voltage

	PRESENT		TO BE		
ZONE OR EL.(CHARAC)	UV		UV	For information only	
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	NA		NA		
RANGE (RATING)	70-120V		70-120V		
PRIMARY SETTING	3820		3835		
SEC. SET'G (OP. VALUE)	109.15 +/- .2V		109.57 +/- .2V		
COMPUTED TAPS	110 Volts		110 Volts		
TEST A-V CUR. LAG DEG	Reset Tap @ 99%		Reset Tap @ 99%		
TIMING	7 secs (Use 5 Tap)		7 secs (Use 5 Tap)		

Reset V. may not exceed 110.12 volts

OAD Record Reset V: A-B: 109.58V B-C: 109.60V

Supersedes RSO issued 1-27-92 ISSUE DATE 6-2-92 BY MC COMPLETED GB BY 6/9/92

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

RELAY SETTING ORDER

C.E.CO. FOR INFORMATION ONLY

FROM — ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ________ DIV. ENG.

STATION 12-Dresden Bus 24-1 KV 4.16 RELAY TYPE ITE 27N-HF

A ☒ B ☐ C ☒ RES. ☐ = ☐ BL. ☐ IN-STALL ☐ REPL. ☐ CHG. ☒ DEACTIVATE ☐

* Second Level Under-Voltage

	PRESENT		TO BE		
ZONE OR EL.(CHARAC)	UV		UV		
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	NA		NA		
RANGE (RATING)	70-120V		70-120V		
PRIMARY SETTING	3784		3820		
SEC. SET'G (OP. VALUE)	108.1		109.15 +/- .2 volts		
COMPUTED TAPS	110 Volts		110 Volts		
TEST A-V CUR. LAG DEG	Reset Tap @ 99%		Reset Tap @ 99%		
TIMING	7 secs (Use 5 Tap)		7 secs (Use 5 Tap)		

Reset V. may not exceed 109.7 volts

OAD Record Reset V: AB relay = 109.22 BC relay = 109.19

ISSUE DATE 1-27-92 BY MC COMPLETED 1/20/92 BY WJM

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

Commonwealth Edison
Dresden Nuclear Power Station
R.R. #1
Morris, Illinois 60450
Telephone 815/942-2920

FACSIMILE TRANSMITTAL SHEET

DATE: 9/3/92

TO: Mike Tucker

TELECOPIER NUMBER: 7299

FROM: J. Gates

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Mike,
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Sent:
Time:
By:

11, 12, 17, 18-

TESTING OF ECCS UNDERVOLTAGE
AND DEGRADED VOLTAGE RELAYS

Requirements:

Technical Specifications Section 4.2, Table 4.2.1

Special Controls/Reviews:

NONE.

L. Rivera
Originator

S. Rhee
Independent Reviewer/Verifier (If Applicable)

J. Fiedler
Department Procedure Writer

M. Korchynsky
Department Supervisor

APPROVED

AUG 05 '92

D.O.S.R.

ZDOS/137
ZW/198

Calculation No. 8982-17-19-2
Revision 004
Attachment: J
Page J18 of J42

TESTING OF ECCS UNDERVOLTAGE AND DEGRADED VOLTAGE RELAYS

A. PURPOSE:

This procedure verifies the undervoltage relay settings for Emergency Core Cooling System (ECCS) Buses 23-1, 24-1, 28 and 29 (33-1, 34-1, 38 and 39) and assures calibration of related Diesel Generator power instruments.

B. USER REFERENCES:

1. Technical Specifications:

   a. Section 4.2, Table 4.2.1, Minimum Test and Calibration Frequency for Core and Containment Cooling Systems Instrumentation, Rod Blocks and Isolations.

2. Procedures:

   a. Relay Calibration Procedure (Supplied by Operational Analysis Department).

3. Prints:

   a. 12E-2334, Relaying and Metering Diagram - 4160 V Switch Group 23-1 & 24-1.

   b. 12E-2335, Relay and Metering Diagram - 480 V Switch Groups 25, 26, 27, 28 & 29.

   c. 12E-2344, Schematic Control Diagram, 4160 V Buses 23-1 & 24-1 Main Feed BKRS.

   d. 12E-2345, Schematic Control Diagram, 4160 V Bus 23-1 4KV SWGR Bus 40 Feed BKR.

   e. 12E-2346, Schematic Control Diagram, 4160 V Bus 24-1 Standby Diesel 2 Feed & 34-1 Tie Breaker.

   f. 12E-3334, Relaying and Metering Diagram - 4160 V Switch Group 33-1 & 34-1.

   g. 12E-3335, Relay and Metering Diagram - 480 V Switch Groups 35, 36, 37, 38, 39, & 30 and 4160 V SWGR CUB 15.

   h. 12E-3344, Schematic Control Diagram, 4160 V Buses 33-1 & 34-1 Main Feed BKRS.

   i. 12E-3345, Schematic Control Diagram, 4160 V Bus 33-1 4KV SWGR Bus 40 Feed BKR.

   j. 12E-3346, Schematic Control Diagram, 4160 V Bus 34-1 Standby Diesel 3 Feed & 24-1 Tie Breaker.

C. SUPPLEMENTS:

1. Checklist A, ECCS Bus Relay Test.

D. EQUIPMENT REQUIRED:

1. Timer (Calibrated per DAP 11-12). Record Serial Number and Calibration Due Date on Checklist A.

2. ●Fluke Model 45 Multimeter. Record Serial Number and Calibration Due Date on Checklist A. ● (W-2, W-3, W-4)

3. Digital Thermometer. Record Serial Number and Calibration Due Date on Checklist A.

E. PREREQUISITES:

NOTE

Indicate completion of the prerequisites on Checklist A.

---

1. Reactor in Cold Shutdown or Refuel.

2. Bus being tested is out of service for the Operational Analysis Department (OAD).

3. Operational Analysis Department (OAD) has verified the relay settings for the relays listed in Checklist A.

4. Permission to start the undervoltage test on each bus (Bus 23-1, 24-1, 33-1 or 34-1) has been obtained from the Shift Engineer.

F. PRECAUTIONS:

1. Use proper sequences when disconnecting or reconnecting the relays to avoid spurious bus trips.

G. LIMITATIONS AND ACTIONS:

1. A Fluke Model 45 Multimeter must be used to calibrate the ECCS degraded voltage relays. IF another voltmeter is to be used, THEN the Nuclear Engineering Department must approve it's use.

H. ACCEPTANCE CRITERIA:

1. All operating voltages and trip times shall be within the tolerances listed in Checklist A.

2. IF any of the AS FOUND values fall outside of the Checklist A tolerances, THEN notify the Operations Shift Supervisor and submit an out-of-tolerance notification sheet to the Technical Staff Supervisor.

H. 3. Acceptance criteria is annotated by acceptance criteria (AC) before the step.

I. PROCEDURE:

NOTE

Indication of completion of the relay tests is accomplished by completing Checklist A.

---

1. Remove the undervoltage relays as follows:

   a. Isolate the trips by removing the LOWER paddle.

   b. Isolate the voltage sensing circuits by removing the UPPER paddle.

   c. Remove the relay.

2. Remove the degraded voltage relays as follows:

   a. Isolate the trips by opening Test Switch E in the Test Switch Group TS 23-1 UV (TS 33-1 UV) and TS 24-1 UV (TS 34-1 UV) directly below the relay.

   b. Isolate the voltage sensing circuits by opening Test Switches A, B, C, and D in the Test Switch Group TS 23-1 UV (TS 33-1 UV) or TS 24-1 UV (TS 34-1 UV) directly below the relay.

   c. Remove the relay.

3. Complete the following on each relay:

   a. Verify relay settings.

   b. Clean the relay.

   c. Note anything abnormal.

   d. Complete Checklist A, ECCS Bus Relay Test.

4. Install the degraded voltage relays as follows:

   a. Install the relay.

   b. Connect the voltage sensing circuits by closing Test Switches A, B, C, and D in the Test Switch Group TS 23-1 UV (TS 33-1 UV) or TS 24-1 UV (TS 34-1 UV) directly below the relay.

I. 4. c. Connect the trips by closing Test S Switch Group TS 23-1 UV (TS 33-1 UV) or TS 24-1 UV (TS 34-1 UV) directly below the relay.

5. Install the undervoltage relays as follows:

a. Install the relay.

b. Connect the voltage sensing circuits by installing the UPPER paddle.

c. Connect the trips by installing the LOWER paddle.

6. (AC) All operating voltages and trip times are within the tolerances listed on Checklist A.

(Initial or N/A)________.

a. IF any of the as found values fall outside of the Checklist A tolerances, THEN notify the Operations Shift Supervisor and submit an out-of-tolerance notification sheet to the Technical Staff Supervisor.

(Initial or N/A)________.

7. Notify the Operations Shift Supervisor of test completion and give him the completed checklist.

J. DISCUSSION:

These tests are based on a nominal Bus voltage of 4160 volts and a potential transformer ratio of 35 (4200 volts/120 volts). The nominal voltage at the relay is 118.86 volts.

W. WRITER'S REFERENCES:

1. Response to IE Information Notice 84-02, dated June 20, 1984.

2. Electrical Distribution System Functional Inspection, July 1991.

3. S & L Calculation 8982-13-19-6 Rev. 2, Second-Level Undervoltage Relay Setpoint.

4. S & L Calculation 8982-17-19-2 Rev. 1, Second-Level Undervoltage Relay Setpoint.

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CHECKLIST A
ECCS BUS RELAY TEST

Prerequisites Complete:
Initial/Date ___/___

Unit ______________

ECCS Bus Undervoltage Relay Test
(Tap setting is 93)

Relay	Lever Setting 1.0 Nominal		Contact Closure Voltage (UV) 79.6 to 87.9 volts		Time to Contact Closure 120 to 0V 1.89 to 2.31 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-1-23-1(33-1)						
127-2-23-1(33-1)						
227-1-28 (38)						
227-2-28 (38)						

ECCS Bus Degraded Voltage Relay Tests*

Ambient Temperature ________°F

Relay	Lever Setting 5.0 Nominal		Contact Closure Voltage (UV) 109.37 to 109.77 V		Time to Contact Closure 120 to 0V 5.6 to 8.4 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-3-23-1						
127-4-23-1						
Relay	**Lever Setting 5.0 Nominal**		**Contact Closure Voltage (UV) 110.77 to 111.17 V**		**Time to Contact Closure 120 to 0V 5.6 to 8.4 sec**	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-3-33-1						
127-4-33-1						

		Time to Contact Closure 5 min to 5 min, 15 sec	
TDR 23-1 (33-1)			

		Time to Contact Closure 1.8 to 2.2 sec	
27XTD 23-1(33-1)			

* These relays must be calibrated at an ambient temperature between 70 and 75°F, utilizing ABB Instruction Bulletin I.B. 7.4.1.7-7 Issue D.

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12,17,12-

Calculation No. 8982-17-19-2
Revision 004
Attachment: J

CHECKLIST A (Continued)
ECCS BUS RELAY TEST

Prerequisites Complete: Unit ____________
Initial/Date ___/___

ECCS Bus Undervoltage Relay Test
(Tap setting is 93)

Relay	Lever Setting 1.0 Nominal		Contact Closure Voltage (UV) 79.6 to 87.9 volts		Time to Contact Closure 120 to 0V 1.89 to 2.31 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-1-24-1(34-1)						
127-2-24-1(34-1)						
227-1-29 (39)						
227-1-29 (39)						

ECCS Bus Degraded Voltage Relay Tests*
Ambient Temperature ________°F

Relay	Lever Setting 5.0 Nominal		Contact Closure Voltage (UV) 108.95 to 109.35 V		Time to Contact Closure 120 to 0V 5.6 to 8.4 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-3-24-1						
127-4-24-1						

Relay	Lever Setting 5.0 Nominal		Contact Closure Voltage (UV) 110.4 to 110.8 V		Time to Contact Closure 120 to 0V 5.6 to 8.4 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-3-34-1						
127-4-34-1						

		Time to Contact Closure 5 min to 5 min. 15 sec	
TDR 24-1 (34-1)			

		Time to Contact Closure 1.8 to 2.2 sec	
27XTD 24-1(34-1)			

* These relays must be calibrated at an ambient temperature between 70 and 75°F, utilizing ABB Instruction Bulletin I.B. 7.4.1.7-7 Issue D.

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CHECKLIST A (Continued)

ECCS BUS RELAY TEST

Abnormal Findings and Comments:____

____

____

____

____

Timer Serial Number____________

Calibration Due Date____________

OAD Representative____________

Voltmeter Serial Number ____________

Calibration Due Date ____________

Digital Thermometer Serial Number ____________

Calibration Due Date ____________

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DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

Assumptions - 13, 19

The Containment Cooling Service Water System (CCSW) pump cubicle cooler fans and the Diesel Generator 2/3 starting air compressor need not be considered in determining the minimum allowable 4.16-kV system voltage.

The CCSW pump cubicle cooler fans need not be considered in determining the minimum allowable 4.16-kV system voltage.

Reference Calculations

8982-13-19-6, Revision 2, and 8982-17-19-2, Revision 1.

Verification Description

See the attached CECo CHRON 179857 for swing diesel starting air compressor assessment.

The existing CCSW cubicle cooler fan motors are acceptable. The Calculation No. 9215-99-19-1, Rev. 1 (calculation for evaluation of 3 H.P.; 460 Volt CCSW motor minimum voltage starting requirements) demonstrates that the existing 460 Volt CCSW cooler fan motors will start during degraded voltage conditions without tripping their protective devices or exceeding their thermal capability limits.

Follow Up Action

Incorporate assumption verification in the calculation.

Feb:
In Reply, Refer to
CHRON # 179857

FOR DRESDEN
ASSIGNMENT ... OF
...

Mr. C.W. Schroeder
Station Manager
Dresden

Subject: Safety Assessment
Degraded Voltage
Dresden Unit 2

Reference: Safety Assessment of Degraded Voltage
Dresden Unit 2
M.F. Pietraszewski to C.W. Schroeder dated 1/30/92
CHRON 179582

Dear Mr. Schroeder:

The Electrical/I&C group of the Nuclear Engineering Department has revised the assessment of degraded voltage previously issued under the referenced letter. These assessments addressed the swing diesel generator starting air compressor, CCSW cubicle cooling fans and the battery chargers. Additional assessments have been performed on the affect of 120V contactors being subjected to a lower voltage than the manufacturer's recommended value and the use of test data to determine the minimum starting voltage required for the diesel generator cooling water pumps. Copies of the safety assessments are attached. Nuclear Engineering has concluded that this equipment is capable of performing all intended safety functions and is currently operable.

Attachment B contains actions required to be completed by March 31, 1992 to ensure equipment operability during the summer months.

If you have any questions, please call Mike Tucker on extension 7648 at Downers Grove.

Prepared: M S Tucker Date: 2/2/92
M.S. Tucker
Senior Engineer

Approved: M L Reed Date: 2/2/92
M.L. Reed
E/I&C Design Superintendent

DRSDN EDSFI\SADVA.DOC
MT:mst
attachments
cc: C.A. Grier, H.L. Massin, M.F. Pietraszewski
R. Radtke, D. Taylor, M.H. Richter
B.M. Viehl, M.C. Strait, G.A. Gates
S.A. Lawson, NEDCC

13...

Attachment A

Affects of Degraded Voltage on Non-Safety Equipment

Certain non-safety related equipment is shown in the critical voltage analysis below the NEMA acceptance criteria. These are the 2/3 diesel generator starting air compressor, the 250V battery charger 2 and the 250V battery charger 2/3.

Swing Diesel Starting Air Compressor

The diesel generator starting air compressor 2/3A would have 408.6 Volts at the motor terminals at the new second level undervoltage relay setpoint, slightly less than the NEMA required 414 Volts. To assure the NEMA criteria is met for this motor, the relay would have to be set to assure 3827 Volts at Bus 23-1 as compared to the 3784 required to assure operation of the 2/3 diesel generator cooling water pump. The safety related portion of the air start system relies on accumulators of stored air, and would be fully charged prior to starting the diesel generator. The air compressor would have adequate voltage when it would normally be expected to charge the receiver tank. The air compressor may start after the diesel has started due to low receiver pressure; however, as the diesel has already started, recharging the accumulator is not required. Therefore, low voltage at the 2/3A starting air compressor is not a concern. Starting air compressor 2A and 2B have adequate voltage at the new relay setpoint.

250 Volt Battery Chargers

The 250 Volt battery chargers are indicated as non-safety related in the Master Equipment List. The batteries were sized based on a loss of offsite power with no credit from the chargers. Unlike induction motors, the battery chargers are rated for 480 Volts nominal. Therefore, to meet the NEMA criteria of 90% terminal voltage, 432V is required. Further, the manufacturer of the battery charger, Power Conversion Products, specifies output voltage regulation and output current capability based on an input of 480V +15, -10%. To assure 432 Volts at the charger terminals, an operationally unacceptable setpoint would be required for the Second Level Undervoltage Relay.

NED has assessed the effect on the charger output at 414 Volts (86.25% of 480 Volt rating) and has concluded there would be less than a 4% reduction in output voltage. This would be sufficient to prevent a discharge of the 250V battery. The charger maximum current output capability is also reduced; however, with off-site power available the load demand on the DC system would be less than the design basis loading. Therefore the small reduction in charger output is acceptable.

Attachment B

Affects of Degraded Voltage on Safety-Related Equipment

Certain safety related electrical equipment is shown in the degraded voltage analysis with available terminal voltage below the NEMA acceptance criteria. Some of the safety related motors may have lower terminal voltage than vendor recommendations to assure successful starting. An assessment of this condition follows.

CCSW Cubicle Cooling Fans

The Containment Cooling Service Water System (CCSW) provides long term decay heat removal. This system has a total of four pumps. CCSW pump A and B are ESS Division I and pumps C and D are Division II. Two of the CCSW pumps, B and C, are in vaults to provide protection against local flooding. Each of these two pumps have four cooling fans fed by the respective ESS division power source. See Table 1 below. CCSW Pumps A and D are not in vaults. Therefore, these pumps do not require cooling fans. Only one CCSW pump is required per the FSAR.

Table 1

CCSW Pump	ESS Division	In Vault?	CCSW Cubicle Cooling Fans
A	Division I	No	None
B	Division I	Yes	A Fan 1, A Fan 2, B Fan 1 and B Fan 2
C	Division II	Yes	C Fan 1, C Fan 2, D Fan 1 and D Fan 2
D	Division II	No	None

The voltage available to the Division II fans (C and D) is adequate for starting and running these motors at the second level undervoltage relay setpoint issued per calculation 8982-13-19-6 Revision 1. However, setting the relay to assure starting of the Division I fans (A and B) would result in an unacceptably high relay setpoint.

The simultaneous events of flood, LOCA and degraded voltage with off site power available is not considered to be credible. This event is estimated to be on the order of 9.9×10^{-12} per year (see 1/20/92 C.A. Grier memo). Therefore, the potential low voltage at the Division I cooling fans is not a concern.

Diesel Generator Cooling Water Pump Minimum Starting Voltage

The purpose of this assessment is to evaluate the voltage available for starting the Diesel Generator Cooling Water Pumps (DGCWP). The critical voltage calculations used to determine the second level undervoltage relay setpoint have determined that the swing DGCWP has an available terminal voltage of 370.6 Volts under starting conditions. This is 80.6% of rated. The Unit 2 Division I critical voltage was determined in calculation 8982-13-19-1 Rev. 0 dated 1/8/92 (CHRON # 179302). Division I bounds Division II as shown by calculation 8982-15-19-3 Rev. 0 dated 1/14/92 (Unit 2 Division II, CHRON # 179755); this calcultation determined that DGCWP 2 has 372.3 Volts available for starting.

The vendor of the Diesel Generator Cooling Water Pumps (DGCWP), Chempump Division of Crane Company, does not specify a minimum starting voltage requirement. In response to a request by CECo for a minimum starting voltage requirement, the vendor responded that the motor was guaranteed to start and run at 90% of the 460 Volt rating (or 414 Volts) and may not start if the line voltage dips by more than 15% (85% of rated or 391 Volts). However, the 85% number was based on engineering judgement, and no actual testing was performed under degraded voltage conditions (under 90% of rated voltage). The vendor was unable to provide a motor torque-speed curve applicable to this pump. This specific motor is no longer used by Crane, and they no longer have one available for testing.

Crane obtained a standard motor for each of Dresden's DGCWPs. The pump vendor modified each motor to allow for use in a submerged location. To accomplish this, the vendor machined the rotor to increase air gap and installed a liner in the motor. This liner protects the windings from moisture, thus creating a submersible combination pump/motor in a common enclosure. A water cooling jacket was also provided integral with the housing. Machining the rotor and providing a custom enclosure is standard practice for the vendor. The pumps were supplied to CECo in 1973.

A test of the Unit 3 Diesel Generator Cooling Water pump was performed to obtain the torque - speed characteristic curve by developing an analytical model of the motor. Torque - speed curves would normally be obtained using a dynamometer. Due to the design of the DGCWP, the motor shaft can not be connected to a dynamometer. Dynamometer testing may also result in motor failure. Therefore, this method of testing was impractical for the Dresden DGCWP.

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Alternate analytical methods are available to determine torque - speed characteristics of induction motors. Generally, these methods are not used by manufacturers as potentially destructive dynamometer testing of redundant motors is more economical than the engineering effort required to develop the analytical model. For the Dresden DGCWP, developing an analytical model of the motor based on test data was the only possible alternative. The test measured the three phase currents and voltage values from the initial inrush current until reaching a steady state value, indicating that the motor had started. Current and potential transformers were installed in the motor circuit to allow the use of a digital fault recorder to obtain the required data. The DGCWP was then started in accordance with normal station operating procedures. The testing accurately monitored the motor and pump as it is installed in the plant with the actual mechanical load applied to the pump impeller (cooling water flow to the Unit 3 diesel generator).

An analytical model of the motor was developed and benchmarked against the test data for validity. This type of model can be used to predict motor behavior under all conditions. This type of motor model accurately represents the motor speed - torque curve, the changing rotor impedance with time and allows assessment of machine capability in response to available voltage. The motor circuit model developed is independent of starting voltage actually present during the test. The minimum starting voltage required to start and accelerate the motor was then calculated from the motor analytical circuit model. The test data, methodology and the torque - speed curve developed are documented in calculation 8982-13-19-4, Revision 0, dated 1/6/92.

Two requirements must be met at the minimum acceptable starting voltage. Adequate torque must be provided at reduced voltage and the protective devices must not trip on overcurrent before the inrush drops to the steady state value. The torque - speed curve determined by the testing shows that the motor will successfully start at 70% of rated voltage. The overload relay will not trip during a degraded voltage start, and the maximum current drawn by the motor is below the trip curve of the breaker.

The motor develops adequate breakdown and pull-up torque at 70% of rated voltage to assure successful starting. The critical factor in this application, by the test data, is net accelerating torque available. A minimum value of 25% of load torque must be provided to accelerate the load in a reasonable time, or about 50 lb.-ft. in this application; an accelerating torque of 73.8 lb.-ft. is available at 70% voltage, providing a

conservative margin in the calculated result. This will accelerate the pump to operating speed in 1.65 seconds.

At locked rotor current, the overload relay will trip in 13 to 21 seconds, assuring that the thermal rating of the motor is not compromised. As the motor will start in less than two seconds, the overload will not trip the motor under starting conditions at 70% of rated voltage. The maximum current will be drawn when the motor starts under the highest expected voltage, which causes a locked rotor current of 626 Amperes at 110% of rated voltage. The 200 Amp TFJ breaker will take 27 seconds to trip at this current.

Therefore, at 70% voltage,the motor has adequate torque to start and no undesired protective trip will occur.

<u>125 Volt Battery Chargers</u>

The 125 Volt Battery Chargers are rated 480V, not 460V as most motors. Therefore, to meet the NEMA criteria of 90% voltage, 432V is required at the charger terminals. Further, the manufacturer of the chargers (Power Conversion Products) has a published specification of 130V ±1% output voltage from no load to 200 Amperes with an input of 480V +15, -10%. To assure 432 Volts to the charger would require an operationally unacceptable setpoint for the Second Level Undervoltage Relay.

NED has assessed the effect on the charger output at 414 Volts (86.25% of 480 Volt rating) and has concluded there would be less than a 4% reduction in output voltage. This would be sufficient to prevent a discharge of the 125Vbattery. The charger maximum current output capability is also reduced; however, with off-site power available the load demand on the DC system would be less than the design basis loading (e.g. fewer breaker and solenoid operations; inverters remain on AC power). Therefore the small reduction in charger output is acceptable. Additionally it should be noted that the batteries were sized based on a loss of off site power with no credit from the battery chargers.

120 Volt Contactors

Five safety related 120 Volt contactors on Dresden Unit 2 do not meet the vendor stipulated minimum voltage requirement of 75% of the 120 Volt rating at the new second level relay setpoint. These contactors control motor operated valves required for LPCI injection. These valves are:

Reactor Recirculation Pump 2A Discharge Valve, 2-202-5A
Reactor Recirculation Pump 2B Discharge Valve, 2-202-5B
LPCI Injection Valve 2A, 2-1501-22A
LPCI Injection Valve 2B, 2-1501-22B
LPCI Full Flow Test Valve 2C, 2-1501-38B

At the new relay setpoint of 3820 ± 7 Volts, a minimum critical voltage of 3784 Volts is assured on the 4kV bus. This critical voltage is based on the minimum acceptable running voltage on all required safety related equipment under the highest auxiliary power system loading condition. The setpoint includes a tolerance for the lower analytical limit of the potential transformer, undervoltage relay and calibration equipment. The relay setpoint was determined in calculation 8982-13-19-6, dated 1-29-92 (CHRON # 179508). The critical voltage used was based on Unit 2 Division I (calculation 8982-13-19-1 Rev. 0 dated 1/8/92, CHRON # 179302). This value of critical voltage bounds the Unit 2 Division II analysis.

The worst case valve, LPCI Injection Valve 1501-22B, has 72.7% of rated voltage available at the contactor under these conditions. Raising the relay setpoint to meet the conservative vendor voltage requirement these contactors would result in an unacceptable relay setpoint. A higher relay setpoint would trip the preferred power source when it is still capable of supplying critical loads. This would challenge the diesel generators unnecessarily. Therefore, the higher relay setpoint is unacceptable, both from an operating perspective and considering overall plant safety.

The five contactors for the valves listed above were replaced during the fall 1991 outage with safety-related, environmentally qualified General Electric (GE) Series 300 contactors. CECo has tested the minimum pickup of a 300 Series contactor. The test data shows that the GE Series 300 contactor minimum pickup is 58% of rated voltage when new. The GE value for pickup of 75% is to allow aging over the useful life of the device (40 years) and to provide a margin for conservatism.

The minimum expected voltage on the 4kV bus is 3840 Volts. This is an extreme condition which would only occur at the highest off site power system loading condition with two transmission system contingences and a LOCA on Unit 2. CECo is a summer peaking utility, and the highest off site power system loading condition occurs on the hottest day of the year. Lower loading conditions of both the transmission system and the station auxiliary power system will provide higher available voltage during spring, 1992. This will assure pickup of the contactors under worst case loading conditions.

Based on; 1) the qualified GE Series contactor design which assures 75% voltage pickup at the end of its 40 year life; 2) the demonstrated 58% of rated pickup voltage of a new Series 300 contactor through testing; 3) the installation of new Series 300 contactors in all five safety related circuits in question; and 4) the minimum expected voltages during the Spring '92 time period, all contactors will properly perform their safety function.

Modifications will be completed by March 31, 1992 to assure that there is adequate voltage for contactor pickup at the new second level relay setpoint.

In Reply, Refer to

CHRON # 180914

Mr. C.W. Schroeder
Station Manager
Dresden

Subject: Safety Assessment
Degraded Voltage
Dresden Unit 3

Dear Mr. Schroeder:

The Electrical/I&C group of the Nuclear Engineering Department has assessed the affects of degraded voltage on plant equipment not bounded by the setpoint of the Second Level Under Voltage relay. These assessments address the Division II CCSW cubicle cooling fans, the battery chargers, certain 120V contactors being subjected to a lower voltage than the manufacturer's recommended value and the use of test data to determine the minimum starting voltage required for the diesel generator cooling water pumps. Copies of the safety assessments are attached. Nuclear Engineering has concluded that this equipment is capable of performing all intended safety functions and is currently operable.

The attachment to this letter contains actions required to be completed by March 31, 1992 to ensure equipment operability during the summer months.

If you have any questions, please call Mike Tucker on extension 7648 at Downers Grove.

Prepared: [signature] Date: 2/12/92
M.S. Tucker
Senior Engineer

Approved: [signature] Date: 2/13/92
M.L. Reed
E/I&C Design Superintendent

DRSDN EDSFT\U3SADVA.DOC
MT:mst
attachments

cc: C.A. Grier, R.M. Radtke, B.M. Viehl, S.A. Lawson, E.L. Massin, D.L. Taylor, M.C. Strait, NEDCC, M.F. Pietraszewski, M.H. Richter, G.A. Gates

Affects of Degraded Voltage Electrical Equipment

Certain electrical equipment is shown in the degraded voltage analysis with available terminal voltage below the NEMA acceptance criteria. Some of the safety related motors may have lower terminal voltage than vendor recommendations to assure successful starting. An assessment of this condition follows.

CCSW Cubicle Cooling Fans

The Containment Cooling Service Water System (CCSW) provides long term decay heat removal. This system has a total of four pumps. CCSW pump A and B are ESS Division I and pumps C and D are Division II. Two of the CCSW pumps, B and C, are in vaults to provide protection against local flooding. Each of these two pumps have four cooling fans fed by the respective ESS division power source. See Table 1 below. CCSW Pumps A and D are not in vaults. Therefore, these pumps do not require cooling fans. Only one CCSW pump is required per the FSAR.

Table 1

CCSW Pump	ESS Division	In Vault?	CCSW Cubicle Cooling Fans
A	Division I	No	None
B	Division I	Yes	A Fan 1, A Fan 2, B Fan 1 and B Fan 2
C	Division II	Yes	C Fan 1, C Fan 2, D Fan 1 and D Fan 2
D	Division II	No	None

The voltage available to the Division I fans (A and B) is adequate for starting and running these motors at the second level undervoltage relay setpoint issued per calculation 8982-17-19-2 Revision 0. However, setting the relay to assure starting of the Division II fans (C and D) would result in an unacceptably high relay setpoint.

The simultaneous events of flood, LOCA and degraded voltage with off site power available is not considered to be credible. This event is estimated to be on the order of 9.9×10^{-12} per year (see 1/20/92 C.A. Grier memo). Therefore, the potential low voltage at the Division II cooling fans is not a concern.

Diesel Generator Cooling Water Pump Minimum Starting Voltage

The purpose of this assessment is to evaluate the voltage available for starting the Diesel Generator Cooling Water Pumps (DGCWP). The critical voltage calculations used to determine the second level undervoltage relay setpoint have determined that the swing DGCWP has an available terminal voltage of 342.7 Volts under starting conditions. This is 74½% of rated. The Unit 3 Division I critical voltage was determined in calculation 8982-17-19-1 Rev. 0 dated 1/21/92 (CHRON # 179719). Division I bounds Division II as shown by calculation 8982-19-19-1 Rev. 1 dated 2/3/92 (Unit 3 Division II, CHRON # 180265); this calculation determined that DGCWP 3 has 349.6 Volts available for starting (76% of rated).

The vendor of the Diesel Generator Cooling Water Pumps (DGCWP), Chempump Division of Crane Company, does not specify a minimum starting voltage requirement. In response to a request by CECo for a minimum starting voltage requirement, the vendor responded that the motor was guaranteed to start and run at 90% of the 460 Volt rating (or 414 Volts) and may not start if the line voltage dips by more than 15% (85% of rated or 391 Volts). However, the 85% number was based on engineering judgement, and no actual testing was performed under degraded voltage conditions (under 90% of rated voltage). The vendor was unable to provide a motor torque-speed curve applicable to this pump. This specific motor is no longer used by Crane, and they no longer have one available for testing.

Crane obtained a standard motor for each of Dresden's DGCWPs. The pump vendor modified each motor to allow for use in a submerged location. To accomplish this, the vendor machined the rotor to increase air gap and installed a liner in the motor. This liner protects the windings from moisture, thus creating a submersible combination pump/motor in a common enclosure. A water cooling jacket was also provided integral with the housing. Machining the rotor and providing a custom enclosure is standard practice for the vendor. The pumps were supplied to CECo in 1973.

A test of the Unit 3 Diesel Generator Cooling Water pump was performed to obtain the torque - speed characteristic curve by developing an analytical model of the motor. Torque - speed curves would normally be obtained using a dynamometer. Due to the design of the DGCWP, the motor shaft can not be connected to a dynamometer. Dynamometer testing may also result in motor failure. Therefore, this method of testing was impractical for the Dresden DGCWP.

Alternate analytical methods are available to determine torque - speed characteristics of induction motors. Generally, these methods are not used by manufacturers as potentially destructive dynamometer testing of redundant motors is more economical than the enginerring effort required to develop the analytical model. For the Dresden DGCWP, developing an analytical model of the motor based on test data was the only possible alternative. The test measured the three phase currents and voltage values from the initial inrush current until reaching a steady state value, indicating that the motor had started. Current and potential transformers were installed in the motor circuit to allow the use of a digital fault recorder to obtain the required data. The DGCWP was then started in accordance with normal station operating procedures. The testing accurately monitored the motor and pump as it is installed in the plant with the actual mechanical load applied to the pump impeller (cooling water flow to the Unit 3 diesel generator).

An analytical model of the motor was developed and benchmarked against the test data for validity. This type of model can be used to predict motor behavior under all conditions. This type of motor model accurately represents the motor speed - torque curve, the changing rotor impedance with time and allows assessment of machine capability in response to available voltage. The motor circuit model developed is independent of starting voltage actually present during the test. The minimum starting voltage required to start and accelerate the motor was then calculated from the motor analytical circuit model. The test data, methodology and the torque - speed curve developed are documented in calculation 8982-13-19-4, Revision 0, dated 1/6/92.

Two requirements must be met at the minimum acceptable starting voltage. Adequate torque must be provided at reduced voltage and the protective devices must not trip on overcurrent before the inrush drops to the steady state value. The torque - speed curve determined by the testing shows that the motor will successfully start at 70% of rated voltage. The overload relay will not trip during a degraded voltage start, and the maximum current drawn by the motor is below the trip curve of the breaker.

The motor develops adequate breakdown and pull-up torque at 70% of rated voltage to assure successful starting. The critical factor in this application, by the test data, is net accelerating torque available. A minimum value of 25% of load torque must be provided to accelerate the load in a reasonable time, or about 50 lb.-ft. in this application; an accelerating torque of 73.8 lb.-ft. is available at 70% voltage, providing a

conservative margin in the calculated result. This will accelerate the pump to operating speed in 1.65 seconds.

At locked rotor current, the overload relay will trip in 13 to 21 seconds, assuring that the thermal rating of the motor is not compromised. As the motor will start in less than two seconds, the overload will not trip the motor under starting conditions at 70% of rated voltage. The maximum current will be drawn when the motor starts under the highest expected voltage, which causes a locked rotor current of 626 Amperes at 110% of rated voltage. The 200 Amp TFJ breaker will take 27 seconds to trip at this current.

Therefore, at 70% voltage, the motor has adequate torque to start and no undesired protective trip will occur.

125 and 250 Volt Battery Chargers

The Battery Chargers are rated 480V, not 460V as most motors. Therefore, to meet the NEMA criteria of 90% voltage, 432V is required at the charger terminals. Further, the manufacturer of the chargers (Power Conversion Products) has a published specification of 130V ±1% output voltage from no load to 200 Amperes with an input of 480V +15, -10%. To assure 432 Volts to the charger would require an operationally unacceptable setpoint for the Second Level Undervoltage Relay.

The worst case battery charger is 125 V Battery Charger 3 which has 410.9 Volts at the terminals during summer LOCA steady state conditions. All other chargers have greater than 420V available.

NED has assessed the effect on the charger output at 410.9 Volts (85.6% of 480 Volt rating) and has concluded there would be less than a 6% reduction in output voltage. This would be sufficient to prevent a discharge of the batteries. The charger maximum current output capability is also reduced; however, with off-site power available the load demand on the DC system would be less than the design basis loading (e.g. fewer breaker and solenoid operations; inverters remain on AC power). Therefore the small reduction in charger output is acceptable. Additionally it should be noted that the batteries were sized based on a loss of off site power with no credit from the battery chargers.

120 Volt Contactors

Five safety related 120 Volt contactors on Dresden Unit 3 do not meet the vendor stipulated minimum voltage requirement of 75% of the 120 Volt rating at the new second level relay setpoint. These contactors control motor operated valves required for LPCI injection. These valves are:

Reactor Recirculation Pump 3A Discharge Valve, 3-202-5A
Reactor Recirculation Pump 3B Discharge Valve, 3-202-5B
LPCI Injection Valve 3A, 3-1501-22A
LPCI Injection Valve 3B, 3-1501-22B
LPCI Full Flow Test Valve 3A, 3-1501-38A

At the new relay setpoint of 3870 ± 7 Volts, a minimum critical voltage of 3832 Volts is assured on the 4kV bus. This critical voltage is based on the minimum acceptable running voltage on all required safety related equipment under the highest auxiliary power system loading condition. The setpoint includes a tolerance for the lower analytical limit of the potential transformer, undervoltage relay and calibration equipment. The relay setpoint was determined in calculation 8982-17-19-2, dated 2-6-92. The critical voltage used was based on Unit 3 Division I (calculation 8982-17-19-1 Rev. 0 dated 1/21/92, CHRON # 179719). This value of critical voltage bounds the Unit 3 Division II analysis (Calculation 8982-19-19-1 Rev. 1 dated 2/3/92, CHRON # 180265)..

The worst case valve, LPCI Injection Valve 1501-22A, has 68.47% of rated voltage available at the contactor under these conditions. Raising the relay setpoint to meet the conservative vendor voltage requirement these contactors would result in an unacceptable relay setpoint. A higher relay setpoint would trip the preferred power source when it is still capable of supplying critical loads. This would challenge the diesel generators unnecessarily. Therefore, the higher relay setpoint is unacceptable, both from an operating perspective and considering overall plant safety.

The five contactors for the valves listed above were replaced during the fall 1991 outage with safety-related, environmentally qualified General Electric (GE) Series 300 contactors. CECo has tested the minimum pickup of a 300 Series contactor. The test data shows that the GE Series 300 contactor minimum pickup is 58% of rated voltage when new. The GE value for pickup of 75% is to allow aging over the useful life of the device (40 years) and to provide a margin for conservatism.

The minimum expected voltage on the 4kV bus is 3924 Volts (M.L. Reed, Evaluation of Dresden Station Unit 2 & 3 Degraded Voltage Condition, dated 2/3/92, CHRON 179942). This is an extreme condition which would only occur at the highest off site power system loading condition with two transmission system contingences and a LOCA on Unit 3. CECo is a summer peaking utility, and the highest off site power system loading condition occurs on the hottest day of the year. Lower loading conditions of both the transmission system and the station auxiliary power system will provide higher available voltage during spring, 1992. This will assure pickup of the contactors under worst case loading conditions.

Based on; 1) the qualified GE Series contactor design which assures 75% voltage pickup at the end of its 40 year life; 2) the demonstrated 58% of rated pickup voltage of a new Series 300 contactor through testing; 3) the installation of new Series 300 contactors in all five safety related circuits in question; and 4) the minimum expected voltages during the Spring '92 time period, all contactors will properly perform their safety function.

Modifications will be completed by March 31, 1992 to assure that there is adequate voltage for contactor pickup at the new second level relay setpoint.

DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

Assumption - 14

"The existing location of Panel 2252-83, which will contain one of the undervoltage relays is too close to the core spray pipe to be within the relays acceptable radiation level. Therefore, it is assumed that the panel has been relocated as planned such that the radiation level experienced by the relay is acceptable."

Reference Calculation

8982-13-19-6, Revision 2

Verification Description

Panel 2252-83 has been relocated.
Reference ECN 12-00470E ← To check this
W.R. No.: D-97548

Follow Up Action

Incorporate assumption verification in calculation.

ATTACHMENT K

RSO's for 2nd Lvl UV Relays & E:Mail from J. Kovach

RELAY SETTING ORDER
C.E.CO. 86-4804 5-83

FROM ☐ STA. ELEC. ☒ SYST. ~~PLAN~~ PROT ☐ OR ________ DIV. ENG.

STATION STA. 12 DRESDEN Bus 34-1 4.16 KV RELAY TYPE ITE 27N-R

A ☒ B ☐ C ☒ RES. ☐ ± ☐ BL. ☐ INSTALL ☒ *REPL. ☐ CHG. ☐ DEACTIVATE ☐

• 4.16 KV BUS 34-1 SECOND LEVEL UNDERVOLTAGE

ZONE OR EL.(CHARAC)	UV (ITE 27N-R)				
P.T. (P.D.) RATIO	35:1		(SEE 10/30/96 T. Melo LTR)		
C.T. TURN RATIOS	N/A				
RANGE (RATING)	70-120 V				
PRIMARY SETTING	3871 ± 7 VOLTS				
SEC. SET'G (OP. VALUE)	110.6 ± 0.2 VOLTS				
COMPUTED TAPS	110 VOLTS PICKUP, 99% RESET				
TEST A-V CUR. LAG DEG	ADJUST DROPOUT/PICKUP RATIO ≥ 0.995				
TIMING	7.0 sec ± 20%, USE TIME TAP 5				

PER NED/E&IC CHRON # 193690 dated 10-30-92.
THIS RSO ISSUED TO CLARIFY TEMPORARY SETTING RSO 4-8-94 AND TO MAKE IT PERMANENT. ISSUE DATE 10-31-96 BY TJM COMPLETED 11/8/96 BY [illegible]

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

Calculation No. 8982-17-19-2
Revision 004
Attachment: K
Page K2 of K4

RELAY SETTING ORDER
C.E.CO. 88-4804 5-83

FROM ☐ STA. ELEC. ☒ SYST. PLAN. ☐ OR ____ DIV. ENG.

STATION 12-Dresden Bus 33-1 KV 4.16 RELAY TYPE ITE 27N-R

A ☒ B ☐ C ☒ RES. ☐ ± ☐ BL. ☐ INSTALL ☒ REPL. ☐ CHG. ☐ DEACTIVATE ☐

* 4.16KV Bus 33-1 Second Level Undervoltage

ZONE OR EL.(CHARAC)	UV (ITE 27N)		UV (ITE 27N-R)		
P.T. (P.D.) RATIO	35:1		35:1		
C.T. TURN RATIOS	N/A		N/A		
RANGE (RATING)	70-120V		70-120V		
PRIMARY SETTING	3884 ± 7 Volts		3884V ± 7	Volts	
SEC. SET'G (OP. VALUE)	110.97 ±	0.2 Volts	110.97V ±	0.2 Volts	
COMPUTED TAPS	110 Volts		110 Volts		
TEST A-V CUR. LAG DEG	Reset Tap @ 99%		Reset Tap @ 99%		
TIMING	I. Agastat @ 7 sec.		7.0 seconds ± 10%		

Replace ITE 27N Relay w/ ITE 27N-R
Remove Agastat Timer

ISSUE DATE 3-16-94 BY TK COMPLETED 4-27-94 BY GB

*DESIGNATIONS NOT COVERED ABOVE OR BELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

ıor: John.G.Kovach@ucm.com at nxmime
e: 7/14/00 10:20 AM
ʸ: Normal
Requested
craig tobias at SNLPOB1A
Thomas.J.Meno@ucm.com at nxmime
ɔject: Bus 33-1 Degraded Voltage Relay RSO

aig, per your reqest, this is to document that the requirement to adjust e dropout/pickup ratio greater than or equal to 0.995 also applies to the bject relay. RSO's for Bus 23-1, 24-1, and 34-1 already reflect this quirement. Bus 33-1 RSO has not been revised since 1994. The noted opout/pickup ratio will be reflected in the next revision of the RSO that .ll be required to implement the new setpoint changes.

egards,

ohn G. Kovach
resden X-3645
/I&C Design Engineering

ATTACHMENT L

DOC ID 0006191944

ComEd

Dresden Station
Design Information Transmittal

[X]Safety-Related [ ]Non-Safety-Related [ ]Augmented Quality	Design Information Transmittal Dresden Station Unit(s): 2 and 3	DOC ID _0006191944____ Revision – 05 Page _1__ of _3_

|R5

To: Mr. William A. Barasa

Organization: Sargent & Lundy LLC

Address/Location: 55 E. Monroe, Chicago, IL 60603-5780

Subject: Improved Technical Specification (ITS) Analytical Limits

Status of Information: ☒ Verified ☐ Unverified

For Unverified DITs, include the Method and Schedule of Verification in the "Description of Information."
List Action Tracking # assigned for verification of "Unverified" information: ________

Description of Information: The attached table identifies the Analytical Limits, Allowable Values and References for the Timer, Time Delay Relay, Limit Switch, Displacer Switch, and Protective Relay functions identified in the Technical Specifications for use in the preparation of calculations to support the ITS submittal. For many of these functions, the actual Analytical Limits are unknown or unavailable (* Actual AL available). As such, "The Analytical Limits (AL) for these functions and devices shall be conservatively set equal to the current Technical Specification LCO values". This statement shall also be included in the Methodology section of each calculation prepared. Rev. 2 change 4160V ESS Bus Undervoltage (Degraded Voltage) value to 3820 volts per Calc. # 9198-18-19-1 Rev.3, 9198-18-19-2 Rev.3, 9198-18-19-3 Rev. 3 & 9198-18-19-4 Rev.3. Rev. 3 of this DIT changes 4160V ESS Time Delay (No LOCA) Setpoint and Tolerance per page 3. Rev. 4 of this DIT changes device type and calibration frequency for Condensate Storage Tank Level. Rev. 5 of this DIT changes the calibration frequency of calc.#8982-13-19-6 (DCR# 990552) and 8982-17-19-2 (DCR# 990560) due to not having valid site specific and vendor data. |R5

Purpose of Issuance: This Design Information Transmittal supersedes Revision 03 dated 7/05/00 in its entirety. For use in determining Allowable Values for the ITS calculations submittal.

Limitations: None

References (Source of Information):
Current Technical Specification/DCR#990552 & 990560 |R5

Prepared by: Sujal J. Patel / [signature] **Date:** 9/5/00
Printed Name / Signature

Reviewed by: Dale R. Eaman / [signature] **Date:** 9-6-00
Printed Name / Signature

Approved by: Steve V. Tutich / [signature] **Date:** 9-6-00
Printed Name / Signature

Distribution: Doc ID File, R. Peak, DG Central File, D. Eaman, T. Thorsell, T.Loch, D. Ugorcak,

This form has been reviewed against the requirements of CC-AA-310, Rev. 0 and Site Engineering Policy Statement No. 6

Station	Function	ITS Table	ITS Line Item	Current Tech. Specification LCO Value	Device Type	Cal Freq
Dresden	MS Isolation Valve Closure	3.3.1.1-1	5	≤ 10% closed	Limit Switch	24M
Dresden	Turbine Stop Valve Closure	3.3.1.1-1	8	≤ 10% closed	Limit Switch	24M
Dresden	Rx Vsl Water Level Low Low Time Delay	3.3.4.1	SR 3.3.4.1.4a	≥ 8 seconds and ≤ 10 seconds	Time Delay Relay	24M
Dresden	CS CS Pump Start Time Delay Relay	3.3.5.1-1	1e	≤ 14 seconds (Note 1)	Time Delay Relay	24M
Dresden	LPCI Pump Start Time Delay Relay	3.3.5.1-1	2e	≤ 9 seconds (Note 1)	Time Delay Relay	24M
Dresden	LPCI Recirc Pump dP Time Delay Relay	3.3.5.1-1	2i	Deleted. See DRE00-0035 for new values.	Time Delay Relay	24M
Dresden	LPCI Rx Vsl Dome Pressure Time Delay Relay	3.3.5.1-1	2j	Deleted. See DRE00-0035 for new values.	Time Delay Relay	24M
Dresden	LPCI Recirc Riser dP Time Delay Relay	3.3.5.1-1	2k	Deleted. See DRE00-0035 for new values.	Time Delay Relay	24M
Dresden	HPCI Condensate Storage Tank Level Low	3.3.5.1-1	3d	10. 8' for A CST and 7.25' for B CST *	Mech. Level Switch	24M
Dresden	HPCI Suppression Pool Water Level High	3.3.5.1-1	3e	≤ 15 feet-8 1/4 inches **	Mech. Displacer Switch	24M
Dresden	ADSA Initiation Timer	3.3.5.1-1	4c	≤ 120 seconds	Timer	24M
Dresden	ADSA Low Low Water Level Actuation Timer	3.3.5.1-1	4f	≤ 10 minutes	Timer	24M
Dresden	ADSB Initiation Timer	3.3.5.1-1	5c	≤ 120 seconds	Timer	24M
Dresden	ADSB Low Low Water Level Actuation Timer	3.3.5.1-1	5f	≤ 10 minutes	Timer	24M
Dresden	HPCI Steam Line Flow Timer	3.3.6.1-1	3b	≥ 3 seconds and ≤ 9 seconds	Time Delay Relay	92D
Dresden	Low Set RV Reactuation Time Delay	3.3.6.3-1	1b	≥ 8.5 seconds and ≤ 11.5 sec.(Note 1)	Time Delay Relay	24M
Dresden	4160V ESS Bus Undervoltage (Loss of Voltage)	3.3.8.1-1	1	≥ 2784 volts and ≤ 3076 volts	Protective Relay	24M
Dresden	4160V ESS Bus Undervoltage Time Delay	3.3.8.1-1	2a	≥ 5.6 seconds and ≤ 8.4 sec.	Time Delay Relay	24M
Dresden	4160V ESS Bus Undervoltage (Degraded Voltage)	3.3.8.1-1	2a	≥ 3820 volts (Note 3)	Protective Relay	Note 4 (R5)
Dresden	4160V ESS Time Delay (No LOCA)	3.3.8.1-1	2b	≥ 270 seconds and ≤ 330 sec (See page 3)	Time Delay Relay	24M
Dresden	RPS Elec. Power Monitoring - Overvoltage Trip	3.3.8.2	SR 3.3.8.2.2a	≤ 129.6 volts	Protective Relay	24M
Dresden	RPS Elec. Power Monitoring - Undervoltage Trip	3.3.8.2	SR 3.3.8.2.2b	≥ 105.3 volts	Protective Relay	24M
Dresden	RPS Elec. Power Monitoring - Underfrequency Trip	3.3.8.2	SR 3.3.8.2.2c	≥ 55.4 Hz	Protective Relay	24M
Dresden	RPS Elec. Power Monitoring-Overvoltage Time Delay	3.3.8.2	SR 3.3.8.2.2a	≤ 4 seconds (Note 2)	Time Delay Relay	24M
Dresden	RPS Elec. Power Monitoring-Undervoltage Time Delay	3.3.8.2	SR 3.3.8.2.2b	≤ 4 seconds (Note 2)	Time Delay Relay	24M
Dresden	RPS Elec. Power Monitoring-Underfrequency Time	3.3.8.2	SR 3.3.8.2.2c	≤ 4 seconds (Note 2)	Time Delay Relay	24M

** Actual AL Number (Refer to NDIT SEC-DR-00-018)
* Actual AL Number (Refer to DRE98-0030)
Note 3: Calc. # 9198-18-19-1 Rev.3, 9198-18-19-2 Rev.3, 9198-18-19-3 Rev. 3 & 9198-18-19-4 Rev.3

Note 1: Current Specified Value
Note 2: Allowable Value per DOC ID # 0006046402
Note 4: Due to a lack of plant specific data and to be consistent with Quad and LaSalle, a calibration frequency of 18M is selected. See Calc.#8982-13-19-6 (DCR#990552) & 8982-17-19-2 (DCR#990560). R5

Subject: Second Level Degraded Voltage 5-Minute Time Delay
Basis for Setpoint and Tolerance

A reviewed of the UFSAR and historical documentation was performed to determine if a basis exists for the current Time Delay setting of 5-Minutes +/- 15 Seconds. The following description is provided in UFSAR section 8.3.1.7:

'The 7-second time delay prevents circuit initiation due to grid disturbances and motor starting transients, whereas the 5-minute time allows the operator to attempt restoration of normal bus voltage. The 5-minute timer is bypassed on high drywell pressure / low-low reactor water level."

The NRC Staff SER of May 19, 1982 states:

"The five-minute time delay is of sufficient duration to prevent spurious operation of the second level loss of voltage relays during short bus voltage disturbances that may result from starting large motors or short term grid disturbances. Additional, this time delay will allow operator action to attempt restoration of grid voltage by means available to him." 3

This subject was also discussed with several individuals involved with the early-degraded voltage issues. Based on these discussions and the documentation review conducted, it is concluded that there is no analytical basis for the establishment of the specific time delay of 5-minutes with a tolerance of +/- 15 seconds. It is therefore reasonable to accept an increase in the setpoint tolerance (i.e., +/- 30 seconds) as a result of calculated drift errors.

J.G. Kovach
7/3/2000
JOHN G. KOVACH

ATTACHMENT M

Telecon Between J. Kovach (ComEd) and C. Tobias (S&L)

Date: 4/20/00 3:13 PM
Sender: John.G.Kovach@ucm.com
To: craig tobias
Priority: Normal
Receipt requested
Subject: FW: Telecon Documenting RSOs

Craig, I concur with the indicated RSO's as being current and the latest on file for the indicated services. Please note that the completion date (op authorization) for both Bus 23-1 and 24-1 Degraded Voltage RSO's is 08/23/96.

Regards, John

> -----Original Message-----
> From: craig_tobias@mail.sargentlundy.com
> [SMTP:craig_tobias@mail.sargentlundy.com]
> Sent: Thursday, April 20, 2000 9:15 AM
> To: john.g.kovach@ucm.com
> Subject: Telecon Documenting RSOs
>
> John,
>
> As we spoke on the phone, I am creating an email message to document our phone call on 4/18/2000. The topic discussed was the confirmation that the relay setting orders (RSO) that I obtained at Dresden were the most recent relay setting orders.
>
> Please confirm the relay setting orders that I obtained from Dresden are the most recent relay setting orders. The RSOs are identified below:
>
> Loss of Voltage Relays RSOs
> Bus 23-1 Issued 2/11/86 Completed 3/1/86
> Bus 24-1 Issued 2/11/86 Completed 3/1/86
> Bus 33-1 Issued 2/11/86 Completed 3/1/86
> Bus 34-1 Issued 2/11/86 Completed 3/1/86
>
> Degraded Voltage Relay RSOs
>
> Bus 23-1 Issued 6/27/96
> Bus 24-1 Issued 7/11/96
> Bus 33-1 Issued 3/16/94 Completed 4/28/94
> Bus 34-1 Issued 10/31/96 Completed 11/8/96
>
> Please review this information and verify that it is correct. If you agree with the information, please reply to the message and make a statement to that effect. This document will then serve as telecon for the calculations

> being
> performed.
>
> Thank you for your time and support.
>
> Yours truly,
> Craig Tobias
> Sargent & Lundy, LLC
> 312-269-6577

ATTACHMENT N

DIT BB-EPED-0178

SARGENT & LUNDY ENGINEERS

DESIGN INFORMATION TRA

● **SAFETY-RELATED** | ___ **NON-SAFETY-RELATED** | **DIT No.** BB-EPED-0178

CLIENT Commonwealth Edison Company

Page 1 of 1

STATION Byron/Braidwood **UNIT(S)** 1 & 2

To J. B. Wisniewski-25

PROJECT NO(S) 8915-88

SUBJECT Undervoltage Relay Accuracy Calculation Input Data

MODIFICATION OR DESIGN CHANGE NUMBER(S) N/A

J. J. Bojan	EPED	[signature]	5-7-92
Preparer	Division	Preparer's Signature	Issue Date

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 and requires no further verification.

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.)

The following information is for use in the preparation of the Degraded Voltage Relay Accuracy calculation:

Switchgear Room Environmental Conditions
- Minimum Temp. = 65° F = 18.33°
- Maximum Temp. = 108° F = 42.22°
- Relative Humidity = 8 to 70%
- Radiation exposure = ≤ 10^4 rads
- Internal Switchgear Temp. Rise = ≤ 5° F

Potential Transformer Data
- Westinghouse 4200 - 120 V; Model 9146D46G02
- Accuracy = 0.3W, X, Y and 1.2 Z

References
1. UFSAR Section
   a) 9.4.5.4.2
   b) 3.11 (Table 3.11-2)
2. Westinghouse Instruction Book, Volume 3A (Dwg. EN018-6A)
3. Specification F/L-2737-01, Amd. 1, dated 3-3-78
4. Byron Station Walkdown Data, dated 5-11-92 (copy attached)

SOURCE OF INFORMATION

Calc. No. -- N/A -- (Rev. and/or date) Report No. -- N/A -- (Rev. and or date)

Other See above

DISTRIBUTION

R. Galanis/File 66 & 41 - 23
Haddad - 25

BYRON WALKDOWN

DATA COLLECTED USING INSTR# BY 444
FLUKE "8024B MULTI METER W/FLUKE 80T-150 TEMP. PROBE

OUTSIDE AIR TEMP (NEAR UNIT 1 TRACKWAY) 79.8° AT 1:25 PM

BUS#	INSIDE SWGR CUB.*	OUTSIDE SWGR CUB
141	89.3°	86.3°
142	85.5°	84.2°
241	88.4°	87.5°
242	89.9°	89.2°

* WITH DOOR CLOSED TO ALLOW TEMPERATURE TO STABILIZE, THEN DOOR WAS OPENED & TEMPERATURE READ IMMEDIATELY. TEMPERATURE TAKEN INSIDE CUBICLE WHICH CONTAINS ITE DEGRADED VOLTAGE RELAY.

NOTE: BOTH UNITS OPERATING AND VENTILATION SYSTEMS IN ALL SWGR BUS ROOMS OPERATING. THE TEMPERATURE OUTSIDE THE CUBICLE WAS MEASURED NEAR THE SUPPLY AIR DUCT TO ENSURE THE COOLEST TEMPERATURE (RESULTING IN THE GREATEST TEMPERATURE DIFFERENTIAL) WAS RECORDED.

PREPARED: [signature] 5-11-92
VERIFIED: [signature] 5-11-92

ATTACHMENT 4

Procedure MA-DR-771-402, "Unit 2 – 4 kV Tech Spec Undervoltage and Degraded Voltage Relay Routines," Revision 03

UNIT 2 – 4 KV TECH SPEC UNDERVOLTAGE AND DEGRADED VOLTAGE RELAY ROUTINES

1. PURPOSE

1.1. This procedure provides the necessary administrative controls to perform testing of Dresden Unit 2 4 KV -Tech Spec Undervoltage and Degraded Voltage protective relays. This procedure also provides the guidance for the isolation, calibration, functional test, and restoration of these protective relays.

2. MATERIAL AND SPECIAL EQUIPMENT

2.1. Material - None

2.2. Special Equipment

2.2.1. Voltage Test Source

2.2.2. 4 each General Electric Test Paddles

2.2.3. Certified test equipment as required to perform quality measurements.

2.2.4. Fluke 45

2.2.5. Calibrated Thermometer

3. PRECAUTIONS, LIMITATIONS, AND PREREQUISITES

3.1. Precautions

3.1.1. **OBSERVE** personal safety precautions and treat all equipment as potentially live.

3.1.2. Foreign Material Exclusion (FME) Notice - Throughout the procedure care shall be taken to prevent the entry of Foreign Material into the protective relays and relay cases.

3.2. Limitations

3.2.1. **NOTIFY** the appropriate Operating personnel if any inadvertent operations occur during the performance of this procedure. If any inadvertent operations occur, **STOP** and **PLACE** equipment in a safe condition until the station and NOAD management makes a complete evaluation.

3.2.2. **NOTIFY** Unit Operating Engineer or Shift Manager of any discrepancies noted during this test.

3.2.3. **GENERATE** a Condition Report (CR) if any problem(s) are found.

3.2.4. **DOCUMENT** Temporary Alterations, Jumpers, Lifted Leads (LL), and other applicable items in accordance with appropriate Station Procedures.

3.2.5. **INFORM** the Unit Operator of any alarms they will receive during functional testing.

3.2.6. **MARK** N/A the steps in this procedure not required to be performed.

3.3. Prerequisites

3.3.1. Use controlled copies of schematic drawings and relay/metering diagrams to determine the function(s) of relay(s) to be tested in the associated circuit.

3.3.2. Determine if any isolating switches external to the relay package under test need to be opened to preclude unwanted operation of, or interference with equipment external to the relay package under test.

3.3.3. **SIGN** into work package.

3.3.4. **VERIFY** that test switches, panels, and relays are labeled correctly and agree with the appropriate attachment prior to the performance of any relay inspection, calibration, sensing circuit test, or trip checks.

3.3.5. **PERFORM** protective relay calibration of the relays to be tested using MA-AA-772-700 Series "Calibration of Protective Relays" and the applicable relay data sheets.

3.3.6. Attachments 1 and 2 may be performed with the Bus energized or de-energized. Attachments 3 and 4 are to be performed with the Bus energized.

4. MAIN BODY

4.1. Control Isolation

4.1.1. **LIST** any additional test switches **not** identified on the attachment that will be manipulated during the procedure, on a station approved temporary alteration sheet.

4.1.2. **LIST** all test switches that need to be isolated during the performance of any relay inspection, calibration, or trip checks to prevent any unwanted operations.

4.1.3. **LIST** all test switches that will be manipulated during the performance of any relay inspection, calibration, or trip checks.

4.1.4. **LIST** all test switches that are **not** identified on the station approve temporary alteration sheet that would be manipulated during the performance of any relay inspection, calibration, or trip checks.

4.2. Functional Testing

Acceptance Criteria: Protective relay functional testing is acceptable if relays and control devices, including all diodes in the trip circuit, perform and function per control schematic.

4.2.1. **INFORM** Operations/Control Room of any alarms they will receive during the functional testing.

4.2.2. Functionally **CHECK** the control functions of the schematic.

5. RETURN TO NORMAL

5.1. The test switches are restored and equipment is released back to service.

5.2. End of Procedure

5.2.1. **NOTIFY** Operations shift personnel that the relay routine is complete.

5.3. Evaluation

5.3.1. **INITIAL and DATE** as each attachment is completed.

6. REFERENCES

6.1. Commitments - None

6.2. Documents

6.2.1. Controlled Current and Potential Schematic

6.2.2. Controlled Tripping Schematic

6.2.3. MA-AA-772-700 Series "Protective Relay Calibration"

6.2.4. Company Instruction No. 36-0, Periodic Protective Relay Tests.

6.2.5. Generation Station Safety Rule Book

6.2.6. AD-AA-106 Corrective Action Program (CAP) Process Procedure

6.2.7. Tech Spec 3.3.8.1.1

7. ATTACHMENTS

The following is a list of relay routine attachments contained within this procedure and the completed attachments will be part of the completed work package.

7.1. Attachment 1 – 4 KV Bus 23-1 Bus Undervoltage Relays.

7.2. Attachment 2 – 4 KV Bus 24-1 Bus Undervoltage Relays.

7.3. Attachment 3 – 4 KV Bus 23-1 Degraded Voltage Relays.

7.4. Attachment 4 – 4 KV Bus 24-1 Degraded Voltage Relays.

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 1 of 11

1. References

1.1. 12E-2345 Sh. 3– Schematic Diagram 4160V Bus 23-1, 4 kv Swgr 40 Feed Breaker.

1.2. 12E-2655B - Wiring Diagram 4160V Swgr Bus 23-1 Cubicles 9, 10, 11, 12, 13, & 14.

1.3. 12E-2655G – 4160V Swgr Bus 23-1 Cubicle 13 Internal Schematic and Device Location Diagram.

2. Control Isolation

CAUTION: **ISOLATE** 4 KV Bus 23-1 Undervoltage trips **BEFORE** removing Undervoltage relays for calibration:

NOTE: **If** 4 KV Bus 23-1 is de-energized, **then** Alarm 2041, Window 29 "4 KV BUSES 23-1 & 24-1 VOLT LO" on Panel 902-8 will clear in the Control Room.

2.1 **NOTIFY** Operating that Isolating the following 3 test switches in the Isolation step of this UV surveillance will inhibit LPCI System 1 and Core Spray System 1 from starting during the performance of this surveillance.

TS 127B23-1X "A"	INTLK LPCI SYS 1
TS 127B23–1X "I"	INTLK CORE SPRAY SYS 1
TS 159SD2/3 "G"	INTLK LPCI SYS 1

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 2 of 11

2.2. **OPEN** the following test switches at Bus 23-1, Cubicle 13:

Print Number	Test Switch	Test Switch Label	CV/ Date	WV / Date
12E-2345 Sh. 3	TS 127B23-1X “A”	INTLK LPCI SYS 1		
12E-2345 Sh. 3	TS 127B23-1X “B”	TRIP BUS 23-1 FROM BUS 33-1		
12E-2345 Sh. 3	TS 127B23-1X “C”	TRIP BKR 152-2331		
12E-2345 Sh. 3	TS 127B23-1X “D”	TRIP BKR 152-2330		
12E-2345 Sh. 3	TS 127B23-1X “E”	TRIP BKR CUB 8		
12E-2345 Sh. 3	TS 127B23-1X “F”	TRIP BKR 152-2326		
12E-2345 Sh. 3	TS 127B23-1X “G”	TRIP BKR 152-2325		
12E-2345 Sh. 3	TS 127B23-1X “H”	TRIP BKR 152-2323		
12E-2345 Sh. 3	TS 127B23-1X “I”	INTLK CORE SPRAY SYS 1		
12E-2345 Sh. 3	TS 127B23-1X “J”	TRIP BKR 152-2321		
12E-2345 Sh. 3	TS 159SD2/3 “A”	TRIP BUS 23-1 FEED BKR		
12E-2345 Sh. 3	TS 159SD2/3 “B”	ALARM BUS 23-1 & 24-1 VOLTS LO PNL 902-8 W29.		
12E-2345 Sh. 3	TS 159SD2/3 “F”	D/G 2/3 START RELAY ASR 2/3-2		
12E-2345 Sh. 3	TS 159SD2/3 “G”	INTLK LPCI SYS 1		

3. Relay Calibration

3.1. **REMOVE** relays from 4 KV Bus 23-1 Cubicle 13 listed below and Initial/Date.

Relay Number	Service Description	Relay Type	WV/Date
127-1-B23-1	Bus 23-1 Undervoltage Relay Phase A-B	IAV69A	
127-2-B23-1	Bus 23-1 Undervoltage Relay Phase B-C	IAV69A	

3.2. **VERIFY** that the data sheets for this cubicle agree with the Relay Setting Orders (RSO).

______ / ______ ______ / ______
C V Date W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 3 of 11

3.3. **CALIBRATE** 127-1-B23-1.

_____ / _____
W V Date

Allowable Value:	79.91 VAC < VAC < 87.52 VAC
Expanded Tolerance:	80.86 VAC < VAC < 86.50 VAC
Setting Tolerance:	81.00 VAC < VAC < 86.40 VAC
Recommended Setpoint:	83.7 VAC

3.3.1. **IF** setting is outside the Allowable Value, **THEN NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.3.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.3.3. **IF** the setting is outside the setting tolerance, **THEN INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 4 of 11

3.4. **CALIBRATE** 127-2-B23-1.

_____ / _____
W V Date

Allowable Value:	79.91 VAC < VAC < 87.52 VAC
Expanded Tolerance:	80.86 VAC < VAC < 86.50 VAC
Setting Tolerance:	81.00 VAC < VAC < 86.40 VAC
Recommended Setpoint:	83.7 VAC

3.4.1. **IF** setting is outside the Allowable Value, **THEN NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.4.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.4.3. **IF** the setting is outside the setting tolerance, **THEN INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

3.5. **INSTALL** relays into 4 KV Bus 23-1 Cubicle 13 listed below and Initial/Date.

Relay Number	Service Description	Relay Type	WV/Date
127-1-B23-1	Bus 23-1 Undervoltage Relay Phase A-B	IAV69A	
127-2-B23-1	Bus 23-1 Undervoltage Relay Phase B-C	IAV69A	

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 5 of 11

4. Functional Testing with Bus 23-1 Energized

NOTE: **If** 4 KV Bus 23-1 is de-energized, **then N/A** Section 4.0 of this procedure and perform Functional Testing using Section 5.0 of this procedure.

4.1. **PREPARE** four each GE Test Paddles by **INSTALLING** the connecting links in all terminals EXCEPT terminals 5 and 6.

_____ / _____
W V Date

4.2. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-1-B23-1 at Bus 23-1, Cubicle 13 and **REPLACE** them with two GE Test Paddle as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that Bus 23-1 Undervoltage HFA Auxiliary relays 127B23-1X1, 127B23-1X2, 127B23-1X3, and 127B23-1X4 do not actuate.

_____ / _____
W V Date

4.3. **REMOVE** both GE Test Paddle from IAV69A relay 127-1-B23-1 at Bus 23-1, Cubicle 13. **REPLACE** upper and lower relay connection paddles and **VERIFY** that relay disc moves to its energized position.

_____ / _____
W V Date

4.4. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-2-B23-1 at Bus 23-1, Cubicle 13 and **REPLACE** them with GE Test Paddles as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that Bus 23-1 Undervoltage HFA Auxiliary relays 127B23-1X1, 127B23-1X2, 127B23-1X3, and 127B23-1X4 do not actuate. Do not remove GE Test Paddles.

_____ / _____
W V Date

4.5. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-1-B23-1 at Bus 23-1, Cubicle 13 and **REPLACE** them with two GE Test Paddles as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that:

4.5.1. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X1 actuates.

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 6 of 11

4.5.2. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X2 actuates.

_____ / _____
W V Date

4.5.3. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X3 actuates.

_____ / _____
W V Date

4.5.4. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X4 actuates.

_____ / _____
W V Date

4.5.5. Breaker Close Undervoltage Agastat Timer relay 27XTD-23-1 actuates.

_____ / _____
W V Date

4.6. **REMOVE** both GE Test Paddles from IAV69A relay 127-1-B23-1 at Bus 23-1, Cubicle 13. **REPLACE** upper and lower relay connection paddles. After relay disc moves to its energized position, **VERIFY** that Bus 23-1 Undervoltage HFA Auxiliary relays 127B23-1X1, 127B23-1X2, 127B23-1X3, and 127B23-1X4 remain actuated.

_____ / _____
W V Date

4.7. **REMOVE** both GE Test Paddles from IAV69A relay 127-2-B23-1 at Bus 23-1, Cubicle 13. **REPLACE** upper and lower relay connection paddles. After relay disc moves to its energized position, **VERIFY** that:

4.7.1. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X1 resets.

_____ / _____
W V Date

4.7.2. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X2 resets.

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 7 of 11

4.7.3. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X3 resets.

_____ / _____
W V Date

4.7.4. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X4 resets.

_____ / _____
W V Date

4.7.5. Breaker Close Undervoltage Agastat Timer relay 27XTD-23-1 resets.

_____ / _____
W V Date

5. Bus 23-1 Undervoltage Relays Functional Testing with Bus De-energized

NOTE: **If** 4 KV Bus 23-1 is energized and functional tests were performed using Section 4.0 of this procedure, **then N/A** Section 5.0 of this procedure.

5.1. **VERIFY** that Bus 23-1 Undervoltage HFA Auxiliary relays 127B23-1X1, 127B23-1X2, 127B23-1X3, and 127B23-1X4 are actuated.

_____ / _____
W V Date

5.2. **OPEN** test switch TS 23-1UV “E” at Panel 2252-83.

_____ / _____ _____ / _____
C V Date W V Date

5.3. **PLACE** a jumper between test switches TS 23-1 UV “F” and “G” on Panel 2252-83. **VERIFY** that Agastat relay 459X1-23-1 actuates.

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 8 of 11

5.4. **ACTUATE** IAV69A relay 127-1-B23-1 at Bus 23-1, Cubicle 13 by moving relay disc to its energized position. **VERIFY** that Bus 23-1 Undervoltage HFA Auxiliary relays 127B23-1X1, 127B23-1X2, 127B23-1X3, and 127B23-1X4 remain actuated. _____ / _____
W V Date

5.5. **RELEASE** relay disc to its de-energized position. _____ / _____
W V Date

5.6. **ACTUATE** IAV69A relay 127-2-B23-1 at Bus 23-1, Cubicle 13 by moving relay disc to its energized position, **VERIFY** that:

5.6.1. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X1 resets.

_____ / _____
W V Date

5.6.2. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X2 resets.

_____ / _____
W V Date

5.6.3. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X3 resets.

_____ / _____
W V Date

5.6.4. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X4 resets.

_____ / _____
W V Date

5.6.5. Breaker Close Undervoltage Agastat Timer relay 27XTD-23-1 resets.

_____ / _____
W V Date

5.7. **RELEASE** relay disc to its de-energized position. **VERIFY** that:

5.7.1. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X1 actuates.

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 9 of 11

5.7.2. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X2 actuates.

_____ / _____
W V Date

5.7.3. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X3 actuates.

_____ / _____
W V Date

5.7.4. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X4 actuates.

_____ / _____
W V Date

5.7.5. Breaker Close Undervoltage Agastat Timer relay 27XTD-23-1 actuates.

_____ / _____
W V Date

5.8. **REMOVE** jumper between test switches TS 23-1 UV “F” and “G” on Panel 2252-84. **VERIFY** that Agastat relay 459X1-23-1 resets.

_____ / _____ _____ / _____
C V Date W V Date

5.9 **CLOSE** test switch TS 23-1UV “E” at Panel 2252-83.

_____ / _____ _____ / _____
C V Date W V Date

6. <u>Bus 23-1 Undervoltage Relays Trip Restoration</u>

6.1. **VERIFY** all taps and time levers in all relays are in their "In Service" position as specified by each relay's "As Left" data.

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 10 of 11

6.2. **REPLACE** relay covers.

_____ / _____
W V Date

6.3. **REVIEW**, **INITIAL and DATE** appropriate data sheets.

_____ / _____
W V Date

CAUTION: **If** 4 KV Bus 23-1 is energized, **then VERIFY** 4 KV Bus 23-1 Undervoltage HFA Auxiliary relays 127B23-1X1, 127B23-1X2, 127B23-1X3, and 127B23-1X4 are reset **BEFORE** restoring Bus 23-1 Undervoltage relays trip test switches.

NOTE: **If** 4 KV Bus 23-1 is de-energized, **then** Alarm 1539, Window E-03 "4 KV BUSES 23-1 & 24-1 VOLT LO" on Panel 902-8 will annunciate in the Control Room when Test Switch TS 159SD2/3 "B" is closed.

6.4. **CLOSE** the following test switches at Bus 23-1, Cubicle 13:

Print Number	Test Switch	Test Switch Label	CV/ Date	WV / Date
12E-2345 Sh. 3	TS 127B23-1X "A"	*INTLK LPCI SYS 1		
12E-2345 Sh. 3	TS 127B23-1X "B"	TRIP BUS 23-1 FROM BUS 33-1		
12E-2345 Sh. 3	TS 127B23-1X "C"	TRIP BKR 152-2331		
12E-2345 Sh. 3	TS 127B23-1X "D"	TRIP BKR 152-2330		
12E-2345 Sh. 3	TS 127B23-1X "E"	TRIP BKR CUB 8		
12E-2345 Sh. 3	TS 127B23-1X "F"	TRIP BKR 152-2326		
12E-2345 Sh. 3	TS 127B23-1X "G"	TRIP BKR 152-2325		
12E-2345 Sh. 3	TS 127B23-1X "H"	TRIP BKR 152-2323		
12E-2345 Sh. 3	TS 127B23-1X "I"	*INTLK CORE SPRAY SYS 1		
12E-2345 Sh. 3	TS 127B23-1X "J"	TRIP BKR 152-2321		
12E-2345 Sh. 3	TS 159SD2/3 "A"	TRIP BUS 23-1 FEED BKR		
12E-2345 Sh. 3	TS 159SD2/3 "B"	ALARM BUS 23-1 & 24-1 VOLTS LO PNL 902-8 W29.		
12E-2345 Sh. 3	TS 159SD2/3 "F"	D/G 2/3 START RELAY ASR 2/3-2		
12E-2345 Sh. 3	TS 159SD2/3 "G"	*INTLK LPCI SYS 1		

***Note:** The following three (3) test switches could have 125VDC across the test switches: TS 127B23 1X "A"; TS 127B23 1X "I" and TS 159SD 2/3 "G". Since these test switches are used for monitoring permissives, it is acceptable to close them.

ATTACHMENT 1
Relay Routine for 4 KV Bus 23-1 Undervoltage Relays
Page 11 of 11

7. Return to Normal

7.1. **VERIFY** all relays are reset (or actuated if Bus 23-1 de-energized).

_____ / _____
W V Date

7.2. **VERIFY** targets reset (or actuated if Bus is 23-1 de-energized).

_____ / _____
W V Date

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 24-1 Undervoltage Relays
Page 1 of 10

1. References

1.1. 12E-2346 Sh. 3– Schematic Control Diagram 4160V Bus 24-1 Standby Diesel 2 Feed & 34-1 Tie Breaker.

1.2. 12E-2656A - Wiring Diagram 4160V Swgr Bus 24-1 Cub's 1, 2, 3, 4, 5, 6, 7, & 8.

1.3. 12E-2656E –Internal Schematic and Device Location Diagram 4160V Swgr Bus 24-1 Cubicle 3.

2. Control Isolation

CAUTION: **ISOLATE** 4 KV Bus 24-1 Undervoltage trips **BEFORE** removing Undervoltage relays for calibration:

NOTE: **If** 4 KV Bus 24-1 is de-energized, **then** Alarm 2042, Window 29 "4 KV BUSES 23-1 & 24-1 VOLT LO" on Panel 902-8 will clear in the Control Room.

2.1 **NOTIFY** Operating that Isolating the following 3 test switches in the Isolation step of this UV surveillance will inhibit LPCI System 2 and Core Spray System 2 from starting during the performance of this surveillance.

TS 159SD2 "C"	INTLK LPCI SYS 2
TS 159SD2 "D"	INTLK CORE SPRAY SYS 2
TS 159SD2 "E"	INTLK LPCI SYS 2

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 24-1 Undervoltage Relays
Page 2 of 10

2.2. **OPEN** the following test switches at Bus 24-1, Cubicle 3:

Print Number	Test Switch	Test Switch Label	CV/ Date	WV / Date
12E-2346 Sh. 3	TS 127B24-1X3 “A”	TRIP BUS 24-1 FEED BKR		
12E-2346 Sh. 3	TS 127B24-1X3 “C”	TRIP RWCU RECIRC PMP 2B BKR		
12E-2346 Sh. 3	TS 127B24-1X3 “D”	TRIP CORE SPRAY PMP 2B BKR		
12E-2346 Sh. 3	TS 127B24-1X3 “E”	TRIP SDC PMP 2B BKR		
12E-2346 Sh. 3	TS 127B24-1X3 “F”	TRIP LPCI PMP 2D BKR		
12E-2346 Sh. 3	TS 127B24-1X3 “G”	TRIP LPCI PMP 2C BKR		
12E-2346 Sh. 3	TS 127B24-1X3 “H”	TRIP 152-2424 UNASSIGN BKR		
12E-2346 Sh. 3	TS 127B24-1X3 “I”	TRIP 152-2423 UNASSIGN BKR		
12E-2346 Sh. 3	TS 127B24-1X3 “J”	TRIP RX BLDG CLG WTR PMP 2/3 BKR		
12E-2346 Sh. 3	TS 159SD2 “A”	ALARM BUS 23-1 & 24-1 VOLTS LO PNL 902-8 W29.		
12E-2346 Sh. 3	TS 159SD2 “B”	D/G 2 START RELAY ASR-2		
12E-2346 Sh. 3	TS 159SD2 “C”	INTLK LPCI SYS 2		
12E-2346 Sh. 3	TS 159SD2 “D”	INTLK CORE SPRAY SYS 2		
12E-2346 Sh. 3	TS 159SD2 “E”	INTLK LPCI SYS 2		

3. Relay Calibration

3.1. **REMOVE** relays from 4 KV Bus 24-1 Cubicle 3 listed below and Initial/Date.

Relay Number	Service Description	Relay Type	WV/Date
127-1-B24-1	Bus 24-1 Undervoltage Relay Phase A-B	IAV69A	
127-2-B24-1	Bus 24-1 Undervoltage Relay Phase B-C	IAV69A	

3.2. **VERIFY** that the data sheets for this cubicle agree with the Relay Setting Orders (RSO).

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 24-1 Undervoltage Relays
Page 3 of 10

3.3. **CALIBRATE** 127-1-B24-1.

_____ / _____
W V   Date

Allowable Value:	79.91 VAC < VAC < 87.52 VAC
Expanded Tolerance:	80.86 VAC < VAC < 86.50 VAC
Setting Tolerance:	81.00 VAC < VAC < 86.40 VAC
Recommended Setpoint:	83.7 VAC

3.3.1. **IF** setting is outside the Allowable Value, **THEN NOTIFY** the Unit Supervisor.

_____ / _____
W V   Date

3.3.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V   Date

3.3.3. **IF** the setting is outside the setting tolerance, **THEN INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V   Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 24-1 Undervoltage Relays
Page 4 of 10

3.4. **CALIBRATE** 127-2-B24-1.

_____ / _____
W V Date

Allowable Value: 79.91 VAC < VAC < 87.52 VAC
Expanded Tolerance: 80.86 VAC < VAC < 86.50 VAC
Setting Tolerance: 81.00 VAC < VAC < 86.40 VAC
Recommended Setpoint: 83.7 VAC

3.4.1. **IF** setting is outside the Allowable Value, **THEN NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.4.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.4.3. **IF** the setting is outside the setting tolerance, **THEN INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

3.5. **INSTALL** relays into 4 KV Bus 24-1 Cubicle 3 listed below and Initial/Date.

Relay Number	Service Description	Relay Type	WV/Date
127-1-B24-1	Bus 24-1 Undervoltage Relay Phase A-B	IAV69A	
127-2-B24-1	Bus 24-1 Undervoltage Relay Phase B-C	IAV69A	

ATTACHMENT 2
Relay Routine for 4 KV Bus 24-1 Undervoltage Relays
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4. Functional Testing with Bus 24-1 Energized

NOTE: **If** 4 KV Bus 24-1 is de-energized, **then N/A** Section 4.0 of this procedure and perform Functional Testing using Section 5.0 of this procedure.

4.1. **PREPARE** four each GE Test Paddles by **INSTALLING** the connecting links in all terminals EXCEPT terminals 5 and 6.

_____ / _____
W V Date

4.2. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-1-B24-1 at Bus 24-1, Cubicle 3 and **REPLACE** them with two GE Test Paddle as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that Bus 24-1 Undervoltage HFA Auxiliary relays 127B24-1X1, 127B24-1X2, and 127B24-1X3 do not actuate.

_____ / _____
W V Date

4.3. **REMOVE** both GE Test Paddle from IAV69A relay 127-1-B24-1 at Bus 24-1, Cubicle 3. **REPLACE** upper and lower relay connection paddles and **VERIFY** that relay disc moves to its energized position.

_____ / _____
W V Date

4.4. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-2-B24-1 at Bus 24-1, Cubicle 3 and **REPLACE THEM** with GE Test Paddle as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that Bus 24-1 Undervoltage HFA Auxiliary relays 127B24-1X1, 127B24-1X2, and 127B24-1X3 do not actuate. Do not remove GE Test Paddles.

_____ / _____
W V Date

4.5. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-1-B24-1 at Bus 24-1, Cubicle 3 and **REPLACE** them with two GE Test Paddle as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that:

4.5.1. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X1 actuates.

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 24-1 Undervoltage Relays
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4.5.2. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X2 actuates.

_____ / _____
W V Date

4.5.3. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X3 actuates.

_____ / _____
W V Date

4.5.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-24-1 actuates.

_____ / _____
W V Date

4.6. **REMOVE** both GE Test Paddles from IAV69A relay 127-1-B24-1 at Bus 24-1, Cubicle 3. **REPLACE** upper and lower relay connection paddles. After relay disc moves to its energized position, **VERIFY** that Bus 24-1 Undervoltage HFA Auxiliary relays 127B24-1X1, 127B24-1X2, and 127B24-1X3 remain actuated.

_____ / _____
W V Date

4.7. **REMOVE** both GE Test Paddles from IAV69A relay 127-2-B24-1 at Bus 24-1, Cubicle 3. **REPLACE** upper and lower relay connection paddles. After relay disc moves to its energized position, **VERIFY** that:

4.7.1. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X1 resets.

_____ / _____
W V Date

4.7.2. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X2 resets.

_____ / _____
W V Date

4.7.3. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X3 resets.

_____ / _____
W V Date

4.7.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-24-1 resets.

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 24-1 Undervoltage Relays
Page 7 of 10

5. Bus 24-1 Undervoltage Relays Functional Testing with Bus De-energized

NOTE: **If** 4 KV Bus 24-1 is energized and functional tests were performed using Section 4.0 of this procedure, **then N/A** Section 5.0 of this procedure.

5.1. **VERIFY** that Bus 24-1 Undervoltage HFA Auxiliary relays 127B24-1X1, 127B24-1X2, and 127B24-1X3 are actuated.

_____ / _____
W V Date

5.2. **OPEN** test switch TS 24-1UV "E" at Panel 2252-84.

_____ / _____ _____ / _____
C V Date W V Date

5.3. **PLACE** a jumper between test switches TS 24-1 UV "F" and "G" on Panel 2252-84. **VERIFY** that Agastat relay 459X1-24-1 actuates.

_____ / _____ _____ / _____
C V Date W V Date

5.4. **ACTUATE** IAV69A relay 127-1-B24-1 at Bus 24-1, Cubicle 3 by moving relay disc to its energized position. **VERIFY** that Bus 24-1 Undervoltage HFA Auxiliary relays 127B24-1X1, 127B24-1X2, and 127B24-1X3 remain actuated.

_____ / _____
W V Date

5.4. **RELEASE** relay disc to its de-energized position.

_____ / _____
W V Date

5.6. **ACTUATE** IAV69A relay 127-2-B24-1 at Bus 24-1, Cubicle 3 by moving relay disc to its energized position. **VERIFY** that:

5.6.1. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X1 resets.

_____ / _____
W V Date

5.6.2. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X2 resets.

_____ / _____
W V Date

5.6.3. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X3 resets.

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 24-1 Undervoltage Relays
Page 8 of 10

5.6.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-24-1 resets.

_____ / _____
W V Date

5.7. **RELEASE** relay disc to its de-energized position. **VERIFY** that:

5.7.1. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X1 actuates.

_____ / _____
W V Date

5.7.2. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X2 actuates.

_____ / _____
W V Date

5.7.3. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X3 actuates.

_____ / _____
W V Date

5.7.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-24-1 actuates.

_____ / _____
W V Date

5.8. **REMOVE** jumper between test switches TS 24-1 UV “F” and “G” on Panel 2252-84. **VERIFY** that Agastat relay 459X1-24-1 resets.

_____ / _____ _____ / _____
C V Date W V Date

5.9. **CLOSE** test switch TS 24-1UV “E” at Panel 2252-84.

_____ / _____ _____ / _____
C V Date W V Date

6. Bus 24-1 Undervoltage and Degraded Voltage Trip Restoration

6.1. **VERIFY** all taps and time levers in all relays are in their "In Service" position as specified by each relay's "As Left" data.

_____ / _____
W V Date

6.2. **REPLACE** relay covers.

_____ / _____
W V Date

6.3. **REVIEW**, **INITIAL and DATE** appropriate data sheets.

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 24-1 Undervoltage Relays
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CAUTION: **If** 4 KV Bus 24-1 is energized, **then VERIFY** 4 KV Bus 24-1 Undervoltage HFA Auxiliary relays 127B24-1X1, 127B24-1X2, and 127B24-1X3 are reset **BEFORE** restoring Bus 24-1 Undervoltage relays trip test switches.

NOTE: **If** 4 KV Bus 24-1 is de-energized, **then** Alarm 2042, Window 29 "4 KV BUSES 23-1 & 24-1 VOLT LO" on Panel 902-8 will annunciate in the Control Room when Test Switch TS 159SD2 "A" is closed.

6.4. **CLOSE** the following test switches at Bus 24-1, Cubicle 3:

Print Number	Test Switch	Test Switch Label	CV/ Date	WV / Date
12E-2346 Sh. 3	TS 127B24-1X3 "A"	TRIP BUS 24-1 FEED BKR		
12E-2346 Sh. 3	TS 127B24-1X3 "C"	TRIP RWCU RECIRC PMP 2B BKR		
12E-2346 Sh. 3	TS 127B24-1X3 "D"	TRIP CORE SPRAY PMP 2B BKR		
12E-2346 Sh. 3	TS 127B24-1X3 "E"	TRIP SDC PMP 2B BKR		
12E-2346 Sh. 3	TS 127B24-1X3 "F"	TRIP LPCI PMP 2D BKR		
12E-2346 Sh. 3	TS 127B24-1X3 "G"	TRIP LPCI PMP 2C BKR		
12E-2346 Sh. 3	TS 127B24-1X3 "H"	TRIP 152-2424 UNASSIGN BKR		
12E-2346 Sh. 3	TS 127B24-1X3 "I"	TRIP 152-2423 UNASSIGN BKR		
12E-2346 Sh. 3	TS 127B24-1X3 "J"	TRIP RX BLDG CLG WTR PMP 2/3 BKR		
12E-2346 Sh. 3	TS 159SD2 "A"	ALARM BUS 23-1 & 24-1 VOLTS LO PNL 902-8 W29.		
12E-2346 Sh. 3	TS 159SD2 "B"	D/G 2 START RELAY ASR-2		
12E-2346 Sh. 3	TS 159SD2 "C"	*INTLK LPCI SYS 2		
12E-2346 Sh. 3	TS 159SD2 "D"	*INTLK CORE SPRAY SYS 2		
12E-2346 Sh. 3	TS 159SD2 "E"	*INTLK LPCI SYS 2		

***Note**: The following three (3) test switches could have 125VDC across the test switches: TS 159SD2 "C", TS 159SD2 "D" and TS 159SD2 "E". Since these test switches are used for monitoring permissives, it is aceptable to close them.

7. Return to Normal

7.1. **VERIFY** all relays are reset (or actuated if Bus 24-1 de-energized). _____ / _____
W V Date

7.2. **VERIFY** targets reset (or actuated if Bus 24-1 de-energized). _____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 24-1 Undervoltage Relays

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

_____ / _____
W V   Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays
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1. References

1.1. 12E-2334 Relay and Metering Diagram – 4160. Switch Group 23-1 & 24-1.

1.2. 12E-2345 Sh. 2– Schematic Diagram 4160V Bus 23-1, 4 kV Swgr 40 Feed Breaker.

1.3. 12E-2345 Sh. 3– Schematic Diagram 4160V Bus 23-1, 4 kV Swgr 40 Feed Breaker.

2.3. 12E-2655B - Wiring Diagram 4160V Swgr Bus 23-1 Cubicles 9, 10, 11, 12, 13, & 14.

2.4. 12E-2655G – 4160V Swgr Bus 23-1 Cubicle 13 Internal Schematic and Device Location Diagram.

2.5. 12E-2650B – Wiring Diagram 4 KV Bus 23-1 2nd Level Undervoltage Panel 2252-83.

2. Relay Isolation and Relay Removal

2.1. **VERIFY** that the data sheets for this relay agree with the Relay Setting Orders (RSO).

_____ / _____ C V Date   _____ / _____ W V Date

2.2. **INFORM** Operations that the 2/3 DG will be inop to D2 prior to performing the following step.

_____ / _____ W V Date

2.3. **OPEN** test switch TS 23-1UV "E".

_____ / _____ C V Date   _____ / _____ W V Date

2.4. **INSTALL** a jumper between TS 23-1 UV "F" and TS 23-1 UV "G".

_____ / _____ C V Date   _____ / _____ W V Date

Note: After the Jumper is installed on the relay, care shall be taken to ensure that the jumper does not become disconnected.

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays
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2.5. **REMOVE** TDR-23-1 at Panel 2252-83.

_____ / _____ _____ / _____
C V Date W V Date

2.6. **OPEN** test switches TS 23-1UV “A” and “B” at Panel 2252-83.

_____ / _____ _____ / _____
C V Date W V Date

2.7. **VERIFY** that relay 127-3-B23-1 trip target is illuminated.

_____ / _____
W V Date

2.8. **REMOVE** relay 127-3-B23-1 from Panel 2252-83

_____ / _____ _____ / _____
C V Date W V Date

2.9. **OPEN** test switches TS 23-1UV “C” and “D” at Panel 2252-83.

_____ / _____ _____ / _____
C V Date W V Date

2.10. **VERIFY** that relay 127-4-B23-1 trip target is illuminated.

_____ / _____
W V Date

2.11. **REMOVE** relay 127-4-B23-1 from Panel 2252-83

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays
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3. Relay Calibration

3.1. **VERIFY** room temperature is between the range of 21 to 24 Deg. C.

_____ / _____ _____ / _____
C V Date W V Date

3.2. **SET** the Fluke 45 on the medium sampling rate.

_____ / _____ _____ / _____
C V Date W V Date

3.3. **CALIBRATE** relay 127-3-B23-1.

_____ / _____
W V Date

Allowable Value:	110.3 VAC < VAC < 111.5 VAC
Expanded Tolerance:	110.4 VAC < VAC < 111.0 VAC
Setting Tolerance:	110.5 VAC < VAC < 110.9 VAC
Recommended Setpoint:	110.7 VAC
Allowable Value:	5.7 seconds < Time < 8.3 seconds
Expanded Tolerance:	6.2 seconds < Time < 7.8 seconds
Setting Tolerance:	6.3 seconds < Time < 7.7 seconds
Recommended Setpoint:	7.0 seconds

3.3.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.3.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.3.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays
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3.4. **CALIBRATE** relay 127-4-B23-1.

_____ / _____
W V   Date

Allowable Value:	110.3 VAC < VAC < 111.5 VAC
Expanded Tolerance:	110.4 VAC < VAC < 111.0 VAC
Setting Tolerance:	110.5 VAC < VAC < 110.9 VAC
Recommended Setpoint:	110.7 VAC
Allowable Value:	5.7 seconds < Time < 8.3 seconds
Expanded Tolerance:	6.2 seconds < Time < 7.8 seconds
Setting Tolerance:	6.3 seconds < Time < 7.7 seconds
Recommended Setpoint:	7.0 seconds

3.4.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V   Date

3.4.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V   Date

3.4.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V   Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays
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3.5. **CALIBRATE** TDR-23-1 relay.

_____ / _____
W V Date

Allowable Value:	279.0 seconds < Time < 321.0 seconds
Expanded Tolerance:	297.8 seconds < Time < 317.2 seconds
Setting Tolerance:	300.0 seconds < Time < 315.0 seconds
Recommended Setpoint:	307.5 seconds

3.5.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.5.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.5.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD calibration procedure.

_____ / _____
W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays
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4. Relay Installation

4.1. **INSTALL** relay 127-3-B23-1 into Panel 2252-83.

_____ / _____ _____ / _____
C V Date W V Date

4.2. **VERIFY** that relay 127-3-B23-1 power indicating light is lit.

_____ / _____
W V Date

4.3. **CLOSE** test switches TS 23-1UV “A” and “B” at Panel 2252-83.

_____ / _____ _____ / _____
C V Date W V Date

4.4. **RESET** relay 127-3-B23-1 trip target.

_____ / _____ _____ / _____
C V Date W V Date

4.5. **INSTALL** relay 127-4-B23-1 into Panel 2252-83.

_____ / _____ _____ / _____
C V Date W V Date

4.6. **VERIFY** that relay 127-4-B23-1 power indicating light is lit.

_____ / _____
W V Date

4.7. **CLOSE** test switches TS 23-1UV “C” and “D” at Panel 2252-83.

_____ / _____ _____ / _____
C V Date W V Date

4.8. **RESET** relay 127-4-B23-1 trip target.

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays
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4.9. **INSTALL** TDR-23-1 relay into Panel 2252-83.

_____ / _____ _____ / _____
C V Date W V Date

5.0 Functional Testing

5.1. **CONNECT** VOM #1 to TB 1-6 and TB 1-8 in 2252-83 to monitor relay TDR-23-1 contact T1 and M1 **VERIFYING** no continuity (ohms) across contact. Do not disconnect VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.2. **CONNECT** VOM #2 to TB 1-5 and TS 23-1 UV "I" to monitor TDR-23-1 coil **VERIFYING** no 125VDC across coil. Do not disconnect VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.3. **REMOVE** jumper previously installed between TS 23-1 UV "F" and TS 23-1 UV "G".

_____ / _____ _____ / _____
C V Date W V Date

5.4. **CONNECT** VOM #3 between TS 23-1 UV "F" and TS23-1 UV "G", **VERIFYING** no 125VDC. Do not disconnect VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.5. **TRIP** Relay 127-3-B23-1 by **OPENING** test switch TS 23-1 UV "A"

_____ / _____ _____ / _____
C V Date W V Date

5.6. **VERIFY** that relay 127-3-B23-1 trip target is illuminated.

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays
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5.7. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-23-1 coil.

_____ / _____ C V Date _____ / _____ W V Date

5.8. **VERIFY** 125 VDC on VOM #3 connected to TS 23-1 UV “F” and TS 23-1 UV “G”.

_____ / _____ C V Date _____ / _____ W V Date

5.9. **RESET** Relay 127-3-B23-1 by **CLOSING** test switch TS 23-1 UV “A”

_____ / _____ C V Date _____ / _____ W V Date

5.10. **RESET** target on relay 127-3-B23-1.

_____ / _____ C V Date _____ / _____ W V Date

5.11. **VERIFY** no 125C VDC on VOM #2 connected across relay TDR-23-1 coil.

_____ / _____ C V Date _____ / _____ W V Date

5.12. **VERIFY** no 125 VDC on VOM #3 connected to TS 23-1 UV “F” and TS 23-1 UV “G”.

_____ / _____ C V Date _____ / _____ W V Date

5.13. **TRIP** Relay 127-4-B23-1 by **OPENING** test switch TS 23-1 UV “D”.

_____ / _____ C V Date _____ / _____ W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays
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5.14. **VERIFY** that relay 127-4-B23-1 trip target is illuminated.

_____ / _____
W V Date

5.15. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-23-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.16. **VERIFY** no 125 VDC on VOM #3 connected to TS 23-1 UV “F” and TS 23-1 UV “G”.

_____ / _____ _____ / _____
C V Date W V Date

5.17. **PRIOR** to performing the next step, **NOTIFY** Operations that the “4KV Bus 23-1 Voltage Degraded’’ alarm on the 902-8 F-07 window will be received.

_____ / _____
W V Date

5.18. **TRIP** Relay 127-3-B23-1 by **OPENING** test switch TS 23-1 UV “A”

_____ / _____ _____ / _____
C V Date W V Date

5.19. **VERIFY** that relay 127-3-B23-1 trip target is illuminated.

_____ / _____
W V Date

5.20. **VERIFY** 125 VDC on VOM #2 connected across relay TDR-23-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.21 **VERIFY** 125 VDC on VOM #3 connected to TS 23-1 UV “F” and TS 23-1 UV “G”.

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays
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5.22 **VERIFY** continuity (ohms) on VOM #1 across terminal T1 and Terminal M1 of relay TDR-23-1 after 6 minutes.

_____ / _____ _____ / _____
C V Date W V Date

5.23. **VERIFY** Operations received the “4KV Bus 23-1 Voltage Degraded’’ alarm on the 902-8 F-07 window.

_____ / _____
W V Date

5.24. **RESET** Relay 127-3-B23-1 by **CLOSING** test switch TS 23-1 UV “A”

_____ / _____ _____ / _____
C V Date W V Date

5.25. **RESET** target on relay 127-3-B23-1.

_____ / _____ _____ / _____
C V Date W V Date

5.26. **RESET** Relay 127-4-B23-1 by **CLOSING** test switch TS 23-1 UV “D”

_____ / _____ _____ / _____
C V Date W V Date

5.27. **RESET** target on relay 127-4-B23-1.

_____ / _____ _____ / _____
C V Date W V Date

5.28. **VERIFY** no continuity (ohms) on VOM #1 connected across terminal T1 and Terminal M1 of relay TDR-23-1 and **REMOVE** VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.29. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-23-1 coil and **REMOVE** VOM.

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays

5.30. **VERIFY** no 125 VDC on VOM #3 connected to TS 23-1 UV “F” and TS 23-1 UV “G” and **REMOVE** VOM.

_____ / _____ C V Date _____ / _____ W V Date

6. <u>Restoration</u>

6.1. **VERIFY** no voltage across test switch TS 23-1UV “E” and then **CLOSE** test switch TS 23-1UV “E”.

_____ / _____ C V Date _____ / _____ W V Date

6.2. **INFORM** Operations that the 2/3 DG to D2 is operable.

_____ / _____ W V Date

7. <u>Return to Normal</u>

7.1. **VERIFY** all relays are reset.

_____ / _____ C V Date _____ / _____ W V Date

7.2. **VERIFY** targets are reset.

_____ / _____ C V Date _____ / _____ W V Date

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

_____ / _____ W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
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1. References

1.1. 12E-2334 Relay and Metering Diagram – 4160. Switch Group 23-1 & 24-1.

1.2. 12E-2346 Sh. 2– Schematic Diagram 4160V Bus 24-1, 4 kV Swgr 40 Feed Breaker.

1.3. 12E-2346 Sh. 3– Schematic Diagram 4160V Bus 24-1, 4 kV Swgr 40 Feed Breaker.

1.4. 12E-2656A - Wiring Diagram 4160V Swgr Bus 24-1 Cubicles 1, 2,3, 4, 5, 6, 7, & 8.

1.5. 12E-2656E – 4160V Swgr Bus 24-1 Cubicle 3 Internal Schematic and Device Location Diagram.

1.6. 12E- 2650C – Wiring Diagram 4 KV Bus 24-1 2nd Level Undervoltage Panel 2252-84.

2. Relay Isolation and Relay Removal

2.1. **VERIFY** that the data sheets for this relay agree with the Relay Setting Orders (RSO).

_____ / _____ C V Date   _____ / _____ W V Date

2.2. **INFORM** Operations that the 2 DG will be inop to D2 prior to performing the following step.

_____ / _____ W V Date

2.3. **OPEN** test switch TS 24-1UV “E”.

_____ / _____ C V Date   _____ / _____ W V Date

2.4. **INSTALL** a jumper between TS 24-1 UV “F” and TS 24-1 UV “G”.

_____ / _____ C V Date   _____ / _____ W V Date

Note: After the Jumper is installed on the relay, care shall be taken to ensure that the jumper does not become disconnected.

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
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2.5. **REMOVE** TDR-24-1 at Panel 2252-84.

_____ / _____ _____ / _____
C V Date W V Date

2.6. **OPEN** test switches TS 24-1UV “A” and “B” at Panel 2252-84.

_____ / _____ _____ / _____
C V Date W V Date

2.7. **VERIFY** that relay 127-3-B24-1 trip target is illuminated.

_____ / _____
W V Date

2.8. **REMOVE** relay 127-3-B24-1 from Panel 2252-84

_____ / _____ _____ / _____
C V Date W V Date

2.9. **OPEN** test switches TS 24-1UV “C” and “D” at Panel 2252-84.

_____ / _____ _____ / _____
C V Date W V Date

2.10. **VERIFY** that relay 127-4-B24-1 trip target is illuminated.

_____ / _____
W V Date

2.11. **REMOVE** relay 127-4-B24-1 from Panel 2252-84

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
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3. Relay Calibration

3.1. **VERIFY** room temperature is between the range of 21 to 24 Deg. C.

_____ / _____ C V Date   _____ / _____ W V Date

3.2. **SET** the Fluke 45 on the medium sampling rate.

_____ / _____ C V Date   _____ / _____ W V Date

3.3. **CALIBRATE** relay 127-3-B24-1.

_____ / _____ W V Date

Allowable Value:	110.3 VAC < VAC < 111. 5 VAC
Expanded Tolerance:	110.4 VAC < VAC < 111.0 VAC
Setting Tolerance:	110.5 VAC < VAC < 110.9 VAC
Recommended Setpoint:	110.7 VAC

Allowable Value:	5.7 seconds < Time < 8.3 seconds
Expanded Tolerance:	6.2 seconds < Time < 7.8 seconds
Setting Tolerance:	6.3 seconds < Time < 7.7 seconds
Recommended Setpoint:	7.0 seconds

3.3.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____ W V Date

3.3.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____ W V Date

3.3.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____ W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
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3.4. **CALIBRATE** relay 127-4-B24-1.

_____ / _____
W V Date

Allowable Value:	110.3 VAC < VAC < 111.5 VAC
Expanded Tolerance:	110.4 VAC < VAC < 111.0 VAC
Setting Tolerance:	110.5 VAC < VAC < 110.9 VAC
Recommended Setpoint:	110.7 VAC

Allowable Value:	5.7 seconds < Time < 8.3 seconds
Expanded Tolerance:	6.2 seconds < Time < 7.8 seconds
Setting Tolerance:	6.3 seconds < Time < 7.7 seconds
Recommended Setpoint:	7.0 seconds

3.4.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.4.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.4.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
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3.5. **CALIBRATE** TDR-24-1 relay.

_____ / _____
W V Date

Allowable Value:	279.0 seconds < Time < 321.0 seconds
Expanded Tolerance:	297.8 seconds < Time < 317.2 seconds
Setting Tolerance:	300.0 seconds < Time < 315.0 seconds
Recommended Setpoint:	307.5 seconds

3.5.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.5.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.5.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD calibration procedure.

_____ / _____
W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
Page 6 of 11

4. Relay Installation

4.1. **INSTALL** relay 127-3-B24-1 into Panel 2252-84.

_____ / _____ C V Date   _____ / _____ W V Date

4.2. **VERIFY** that relay 127-3-B24-1 power indicating light is lit.

_____ / _____ W V Date

4.3. **CLOSE** test switches TS 24-1UV “A” and “B” at Panel 2252-84.

_____ / _____ C V Date   _____ / _____ W V Date

4.4. **RESET** relay 127-3-B24-1 trip target.

_____ / _____ C V Date   _____ / _____ W V Date

4.5. **INSTALL** relay 127-4-B24-1 into Panel 2252-84.

_____ / _____ C V Date   _____ / _____ W V Date

4.6. **VERIFY** that relay 127-4-B24-1 power indicating light is lit.

_____ / _____ W V Date

4.7. **CLOSE** test switches TS 24-1UV “C” and “D” at Panel 2252-84.

_____ / _____ C V Date   _____ / _____ W V Date

4.8. **RESET** relay 127-4-B24-1 trip target.

_____ / _____ C V Date   _____ / _____ W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
Page 7 of 11

4.9. **INSTALL** TDR-24-1 relay into Panel 2252-84.

_____ / _____ C V Date _____ / _____ W V Date

5.0 Functional Testing

5.1. **CONNECT** VOM #1 to TB 1-6 and TB 1-8 in 2252-84 to monitor relay TDR-24-1 contact T1 and M1 **VERIFYING** no continuity (ohms) across contact. Do not disconnect VOM.

_____ / _____ C V Date _____ / _____ W V Date

5.2. **CONNECT** VOM #2 to TB 1-5 and TS 24-1 UV "I" to monitor TDR-24-1 coil **VERIFYING** no 125VDC across coil. Do not disconnect VOM.

_____ / _____ C V Date _____ / _____ W V Date

5.3. **REMOVE** jumper previously installed between TS 24-1 UV "F" and TS 24-1 UV "G".

_____ / _____ C V Date _____ / _____ W V Date

5.4. **CONNECT** VOM #3 between TS 24-1 UV "F" and TS 24-1 UV "G", **VERIFYING** no 125VDC. Do not disconnect VOM.

_____ / _____ C V Date _____ / _____ W V Date

5.5. **TRIP** Relay 127-3-B24-1 by **OPENING** test switch TS 24-1 UV "A"

_____ / _____ C V Date _____ / _____ W V Date

5.6. **VERIFY** that relay 127-3-B24-1 trip target is illuminated.

_____ / _____ C V Date _____ / _____ W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
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5.7. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-24-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.8. **VERIFY** 125 VDC on VOM #3 connected to TS 24-1 UV “F” and TS 24-1 UV “G”.

_____ / _____ _____ / _____
C V Date W V Date

5.9. **RESET** Relay 127-3-B24-1 by **CLOSING** test switch TS 24-1 UV “A”

_____ / _____ _____ / _____
C V Date W V Date

5.10. **RESET** target on relay 127-3-B24-1.

_____ / _____ _____ / _____
C V Date W V Date

5.11. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-24-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.12. **VERIFY** no 125 VDC on VOM #3 connected to TS 24-1 UV “F” and TS 24-1 UV “G”.

_____ / _____ _____ / _____
C V Date W V Date

5.13. **TRIP** Relay 127-4-B24-1 by **OPENING** test switch TS 24-1 UV “D”.

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
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5.14. **VERIFY** that relay 127-4-B24-1 trip target is illuminated.

_____ / _____
W V Date

5.15. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-24-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.16. **VERIFY** no 125 VDC on VOM #3 connected to TS 24-1 UV "F" and TS 24-1 UV "G".

_____ / _____ _____ / _____
C V Date W V Date

5.17. **PRIOR** to performing the next step, **NOTIFY** Operations that the "4KV Bus 24-1 Voltage Degraded'' alarm on the 902-8 H-10 window will be received.

_____ / _____
W V Date

5.18. **TRIP** Relay 127-3-B24-1 by **OPENING** test switch TS 24-1 UV "A"

_____ / _____ _____ / _____
C V Date W V Date

5.19. **VERIFY** that relay 127-3-B24-1 trip target is illuminated.

_____ / _____
W V Date

5.20. **VERIFY** 125 VDC on VOM #2 connected across relay TDR-24-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.21. **VERIFY** 125 VDC on VOM #3 connected to TS 24-1 UV "F" and TS 24-1 UV "G".

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
Page 10 of 11

5.22 **VERIFY** continuity (ohms) on VOM #1 across terminal T1 and Terminal M1 of relay TDR-24-1 after 6 minutes.

_____ / _____ C V Date _____ / _____ W V Date

5.23. **VERIFY** Operations received the "4KV Bus 23-1 Voltage Degraded'' alarm on the 902-8 H-10 window.

_____ / _____ W V Date

5.24. **RESET** Relay 127-3-B24-1 by **CLOSING** test switch TS 24-1 UV "A"

_____ / _____ C V Date _____ / _____ W V Date

5.25. **RESET** target on relay 127-3-B24-1.

_____ / _____ C V Date _____ / _____ W V Date

5.26. **RESET** Relay 127-4-B24-1 by **CLOSING** test switch TS 24-1 UV "D"

_____ / _____ C V Date _____ / _____ W V Date

5.27. **RESET** target on relay 127-4-B24-1.

_____ / _____ C V Date _____ / _____ W V Date

5.28. **VERIFY** no continuity (ohms) on VOM #1 connected across terminal T1 and Terminal M1 of relay TDR-24-1 and **REMOVE** VOM.

_____ / _____ C V Date _____ / _____ W V Date

5.29. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-24-1 coil and **REMOVE** VOM.

_____ / _____ C V Date _____ / _____ W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays
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5.30. **VERIFY** no 125 VDC on VOM #3 connected to TS 24-1 UV “F” and TS 24-1 UV “G” and **REMOVE** VOM.

_____ / _____ C V Date _____ / _____ W V Date

6. Restoration

6.1. **VERIFY** no voltage across test switch TS 24-1UV “E” and then **CLOSE** test switch TS 24-1UV “E”.

_____ / _____ C V Date _____ / _____ W V Date

6.2. **INFORM** Operations that the 2 DG to D2 is operable. _____ / _____ W V Date

7. Return to Normal

7.3. **VERIFY** all relays are reset. _____ / _____ C V Date _____ / _____ W V Date

7.4. **VERIFY** targets are reset. _____ / _____ C V Date _____ / _____ W V Date

7.4. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

_____ / _____ W V Date

ATTACHMENT 5

Procedure MA-DR-771-403, "Unit 3 – 4 kV Tech Spec Undervoltage and Degraded Voltage Relay Routines," Revision 3

UNIT 3 – 4 KV TECH SPEC UNDERVOLTAGE AND DEGRADED VOLTAGE RELAY ROUTINES

1. PURPOSE

1.1. This procedure provides the necessary administrative controls to perform testing of Dresden Unit 3 4 KV -Tech Spec Undervoltage and Degraded Voltage protective relays. This procedure also provides the guidance for the isolation, calibration, functional test, and restoration of these protective relays.

2. MATERIAL AND SPECIAL EQUIPMENT

2.1. Material - None

2.2. Special Equipment

2.2.1. Voltage Test Source

2.2.2. 4 each General Electric Test Paddles

2.2.3. Certified test equipment as required to perform quality measurements.

2.2.4. Fluke 45

2.2.5. Calibrated Thermometer

3. PRECAUTIONS, LIMITATIONS, AND PREREQUISITES

3.1. Precautions

3.1.1. **OBSERVE** personal safety precautions and treat all equipment as potentially live.

3.1.2. Foreign Material Exclusion (FME) Notice - Throughout the procedure care shall be taken to prevent the entry of Foreign Material into the protective relays and relay cases.

3.2. Limitations

3.2.1. **NOTIFY** the appropriate Operating personnel if any inadvertent operations occur during the performance of this procedure. If any inadvertent operations occur, **STOP** and **PLACE** equipment in a safe condition until the station and NOAD management makes a complete evaluation.

3.2.2. **NOTIFY** Unit Operating Engineer or Shift Manager of any discrepancies noted during this test.

3.2.3. **GENERATE** a Condition Report (CR) if any problem(s) are found.

3.2.4. **DOCUMENT** Temporary Alterations, Jumpers, Lifted Leads (LL), and other applicable items in accordance with appropriate Station Procedures.

3.2.5. **INFORM** the Unit Operator of any alarms they will receive during functional testing.

3.2.6. **MARK** N/A the steps in this procedure not required to be performed.

3.3. Prerequisites

3.3.1. Use controlled copies of schematic drawings and relay/metering diagrams to determine the function(s) of relay(s) to be tested in the associated circuit.

3.3.2. Determine if any isolating switches external to the relay package under test need to be opened to preclude unwanted operation of, or interference with equipment external to the relay package under test.

3.3.3. **SIGN** into work package.

3.3.4. **VERIFY** that test switches, panels, and relays are labeled correctly and agree with the appropriate attachment prior to the performance of any relay inspection, calibration, sensing circuit test, or trip checks.

3.3.5. **PERFORM** protective relay calibration of the relays to be tested using MA-AA-772-700 Series "Calibration of Protective Relays" and the applicable relay data sheets.

3.3.6. Attachments 1 and 2 may be performed with the Bus energized or de-energized. Attachments 3 and 4 are to be performed with the Bus energized.

4. MAIN BODY

4.1. Control Isolation

4.1.1. **LIST** any additional test switches **not** identified on the attachment that will be manipulated during the procedure, on a station approved temporary alteration sheet.

4.1.2. **LIST** all test switches that need to be isolated during the performance of any relay inspection, calibration, or trip checks to prevent any unwanted operations.

4.1.3. **LIST** all test switches that will be manipulated during the performance of any relay inspection, calibration, or trip checks.

4.1.4. **LIST** all test switches that are **not** identified on the station approve temporary alteration sheet that would be manipulated during the performance of any relay inspection, calibration, or trip checks.

4.2. Functional Testing

Acceptance Criteria: Protective relay functional testing is acceptable if relays and control devices, including all diodes in the trip circuit, perform and function per control schematic.

4.2.1. **INFORM** Operations/Control Room of any alarms they will receive during the functional testing.

4.2.2. Functionally **CHECK** the control functions of the schematic.

5. RETURN TO NORMAL

5.1. The test switches are restored and equipment is released back to service.

5.2. End of Procedure

5.2.1. **NOTIFY** Operations shift personnel that the relay routine is complete.

5.3. Evaluation

5.3.1. **INITIAL and DATE** as each attachment is completed.

6. REFERENCES

6.1. Commitments - None

6.2. Documents

6.2.1. Controlled Current and Potential Schematic

6.2.2. Controlled Tripping Schematic

6.2.3. MA-AA-772-700 Series “Protective Relay Calibration”

6.2.4. Company Instruction No. 36-0, Periodic Protective Relay Tests.

6.2.5. Generation Station Safety Rule Book

6.2.6. AD-AA-106 Corrective Action Program (CAP) Process Procedure

6.2.7. Tech Spec 3.3.8.1.1

7. ATTACHMENTS

The following is a list of relay routine attachments contained within this procedure and the completed attachments will be part of the completed work package.

7.1. Attachment 1 – 4 KV Bus 33-1 Bus Undervoltage Relays.

7.2. Attachment 2 – 4 KV Bus 34-1 Bus Undervoltage Relays.

7.3. Attachment 3 – 4 KV Bus 33-1 Degraded Voltage Relays.

7.4. Attachment 4 – 4 KV Bus 34-1 Degraded Voltage Relays.

ATTACHMENT 1
Relay Routine for 4 KV Bus 33-1 Undervoltage Relays
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1. References

1.1. 12E-3345 Sh. 2– Schematic Diagram 4160V Bus 33-1, Undervoltage Relays Control Switch Development.

1.2. 12E-3655B - Wiring Diagram 4160V Swgr Bus 33-1 Cubicles 9, 10, 11, 12, 13, & 14.

1.3. 12E-3655G – 4160V Swgr Bus 33-1 Cubicle 13 Internal Schematic and Device Location Diagram.

2. Control Isolation

CAUTION: **ISOLATE** 4 KV Bus 33-1 Undervoltage trips **BEFORE** removing Undervoltage relays for calibration:

NOTE: **If** 4 KV Bus 33-1 is de-energized, **then** Alarm 4041, Window E-03 "4 KV BUSES 33-1 & 34-1 VOLT LO" on Panel 903-8 E-03 will clear in the Control Room.

2.1 **NOTIFY** Operating that Isolating the following 3 test switches in the Isolation step of this UV surveillance will inhibit LPCI System 1 and Core Spray System 1 from starting during the performance of this surveillance.

TS 127B33-1X "H"	INTLK LPCI SYS 1
TS 127SD-3X "A"	INTLK CORE SPRAY SYS 1
TS 127SD-3X "E"	INTLK LPCI SYS 1

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 33-1 Undervoltage Relays
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2.2. **OPEN** the following test switches at Bus 33-1, Cubicle 13:

Print Number	Test Switch	Test Switch Label	CV/ Date	WV / Date
12E-3345 Sh. 2	TS 127B33-1X “B”	TRIP ILRT AIR COMP BRK		
12E-3345 Sh. 2	TS 127B33-1X “C”	TRIP CORE SPRAY PMP 3A BRK		
12E-3345 Sh. 2	TS 127B33-1X “D”	TRIP LPCI PMP 3B BRK		
12E-3345 Sh. 2	TS 127B33-1X “E”	TRIP SDC PMP 3A BRK		
12E-3345 Sh. 2	TS 127B33-1X “F”	TRIP 152-3328 BRK		
12E-3345 Sh. 2	TS 127B33-1X “G”	TRIP LPCI PMP 3A BRK		
12E-3345 Sh. 2	TS 127B33-1X “H”	INTLK LPCI SYS 1		
12E-3345 Sh. 2	TS 127B33-1X “I”	TRIP RWCU RECIRC PMP 3A BRK		
12E-3345 Sh. 2	TS 127B33-1X “J”	TRIP BUS 33-1 FEED TO BUS 23-1		
12E-3345 Sh. 2	TS 127SD-3X “A”	INTLK CORE SPRAY SYS 1		
12E-3345 Sh. 2	TS 127SD-3X “B”	TRIP BUS 33-1 FEED BRK		
12E-3345 Sh. 2	TS 127SD-3X “C”	D/G START RELAY ASR 2/3-3		
12E-3345 Sh. 2	TS 127SD-3X “D”	ALARM BUS 33-1 34-1 VOLTS LO PNL 903-8 W29		
12E-3345 Sh. 2	TS 127SD-3X “E”	INTLK LPCI SYS 1		

3. <u>Relay Calibration</u>

3.1. **REMOVE** relays from 4 KV Bus 33-1 Cubicle 13 listed below and Initial/Date.

Relay Number	Service Description	Relay Type	WV/Date
127-1-B33-1	Bus 33-1 Undervoltage Relay Phase A-B	IAV69A	
127-2-B33-1	Bus 33-1 Undervoltage Relay Phase B-C	IAV69A	

3.2. **VERIFY** that the data sheets for this cubicle agree with the Relay Setting Orders (RSO).

______ / ______ ______ / ______
C V Date W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 33-1 Undervoltage Relays
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3.3. **CALIBRATE** 127-1-B33-1.

_____ / _____
W V Date

Allowable Value:	79.91 VAC < VAC < 87.52 VAC
Expanded Tolerance:	80.86 VAC < VAC < 86.50 VAC
Setting Tolerance:	81.00 VAC < VAC < 86.40 VAC
Recommended Setpoint:	83.7 VAC

3.3.1. **IF** setting is outside the Allowable Value, **THEN NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.3.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.3.3. **IF** the setting is outside the setting tolerance, **THEN INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 33-1 Undervoltage Relays
Page 4 of 10

3.4. **CALIBRATE** 127-2-B33-1.

_____ / _____
W V Date

Allowable Value:	79.91 VAC < VAC < 87.52 VAC
Expanded Tolerance:	80.86 VAC < VAC < 86.50 VAC
Setting Tolerance:	81.00 VAC < VAC < 86.40 VAC
Recommended Setpoint:	83.7 VAC

3.4.1. **IF** setting is outside the Allowable Value, **THEN NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.4.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.4.3. **IF** the setting is outside the setting tolerance, **THEN INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

3.5. **INSTALL** relays into 4 KV Bus 33-1 Cubicle 13 listed below and Initial/Date.

Relay Number	Service Description	Relay Type	WV/Date
127-1-B33-1	Bus 33-1 Undervoltage Relay Phase A-B	IAV69A	
127-2-B33-1	Bus 33-1 Undervoltage Relay Phase B-C	IAV69A	

ATTACHMENT 1
Relay Routine for 4 KV Bus 33-1 Undervoltage Relays
Page 5 of 10

4. Functional Testing with Bus 33-1 Energized

NOTE: **If** 4 KV Bus 33-1 is de-energized, **then N/A** Section 4.0 of this procedure and perform Functional Testing using Section 5.0 of this procedure.

4.1. **PREPARE** four each GE Test Paddles by **INSTALLING** the connecting links in all terminals EXCEPT terminals 5 and 6.

_____ / _____
W V Date

4.2. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-1-B33-1 at Bus 33-1, Cubicle 13 and **REPLACE** them with two GE Test Paddle as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that Bus 33-1 Undervoltage HFA Auxiliary relays 127B33-1X1, 127B33-1X2, and 127B33-1X3 do not actuate.

_____ / _____
W V Date

4.3. **REMOVE** both GE Test Paddle from IAV69A relay 127-1-B33-1 at Bus 33-1, Cubicle 13. **REPLACE** upper and lower relay connection paddles and **VERIFY** that relay disc moves to its energized position.

_____ / _____
W V Date

4.4. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-2-B33-1 at Bus 33-1, Cubicle 13 and **REPLACE** them with GE Test Paddles as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that Bus 33-1 Undervoltage HFA Auxiliary relays 127B33-1X1, 127B33-1X2, and 127B33-1X3 do not actuate. Do not remove GE Test Paddles.

_____ / _____
W V Date

4.5. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-1-B33-1 at Bus 33-1, Cubicle 13 and **REPLACE** them with two GE Test Paddles as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that:

4.5.1. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X1 actuates.

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 33-1 Undervoltage Relays
Page 6 of 10

4.5.2. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X2 actuates.

_____ / _____
W V Date

4.5.3. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X3 actuates.

_____ / _____
W V Date

4.5.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-33-1 actuates.

_____ / _____
W V Date

4.6. **REMOVE** both GE Test Paddles from IAV69A relay 127-1-B33-1 at Bus 33-1, Cubicle 13. **REPLACE** upper and lower relay connection paddles. After relay disc moves to its energized position, **VERIFY** that Bus 33-1 Undervoltage HFA Auxiliary relays 127B33-1X1, 127B33-1X2, and 127B33-1X3 remain actuated.

_____ / _____
W V Date

4.7. **REMOVE** both GE Test Paddles from IAV69A relay 127-2-B33-1 at Bus 33-1, Cubicle 13. **REPLACE** upper and lower relay connection paddles. After relay disc moves to its energized position, **VERIFY** that:

4.7.1. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X1 resets.

_____ / _____
W V Date

4.7.2. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X2 resets.

_____ / _____
W V Date

4.7.3. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X3 resets.

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 33-1 Undervoltage Relays
Page 7 of 10

4.7.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-33-1 resets.

_____ / _____
W V Date

5. Bus 33-1 Undervoltage Relays Functional Testing with Bus De-energized

NOTE: **If** 4 KV Bus 33-1 is energized and functional tests were performed using Section 4.0 of this procedure, **then N/A** Section 5.0 of this procedure.

5.1. **VERIFY** that Bus 33-1 Undervoltage HFA Auxiliary relays 127B33-1X1, 127B33-1X2, and 127B33-1X3 are actuated.

_____ / _____
W V Date

5.2. **OPEN** test switch TS 33-1UV "E" at Panel 2253-83.

_____ / _____ _____ / _____
C V Date W V Date

5.3. **PLACE** a jumper between test switches TS 33-1 UV "F" and "G" on Panel 2253-83. **VERIFY** that Agastat relay 459X1-33-1 actuates.

_____ / _____ _____ / _____
C V Date W V Date

5.4. **ACTUATE** IAV69A relay 127-1-B33-1 at Bus 33-1, Cubicle 13 by moving relay disc to its energized position. **VERIFY** that Bus 33-1 Undervoltage HFA Auxiliary relays 127B33-1X1, 127B33-1X2, and 127B33-1X3 remain actuated.

_____ / _____
W V Date

5.5. **RELEASE** relay disc to its de-energized position.

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 33-1 Undervoltage Relays

5.6. **ACTUATE** IAV69A relay 127-2-B33-1 at Bus 33-1, Cubicle 13 by moving relay disc to its energized position, **VERIFY** that:

5.6.1. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X1 resets.

_____ / _____
W V Date

5.6.2. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X2 resets.

_____ / _____
W V Date

5.6.3. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X3 resets.

_____ / _____
W V Date

5.6.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-33-1 resets.

_____ / _____
W V Date

5.7. **RELEASE** relay disc to its de-energized position. **VERIFY** that:

5.7.1. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X1 actuates.

_____ / _____
W V Date

5.7.2. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X2 actuates.

_____ / _____
W V Date

5.7.3. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X3 actuates.

_____ / _____
W V Date

ATTACHMENT 1
Relay Routine for 4 KV Bus 33-1 Undervoltage Relays

5.7.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-33-1 actuates.

_____ / _____
W V Date

5.8. **REMOVE** jumper between test switches TS 33-1 UV “F” and “G” on Panel 2253-83. **VERIFY** that Agastat relay 459X1-33-1 resets.

_____ / _____ _____ / _____
C V Date W V Date

5.9 **CLOSE** test switch TS 33-1UV “E” at Panel 2253-83.

_____ / _____ _____ / _____
C V Date W V Date

6. <u>Bus 33-1 Undervoltage Relays Trip Restoration</u>

6.1. **VERIFY** all taps and time levers in all relays are in their "In Service" position as specified by each relay's "As Left" data.

_____ / _____
W V Date

6.2. **REPLACE** relay covers.

_____ / _____
W V Date

6.3. **REVIEW**, **INITIAL and DATE** appropriate data sheets.

_____ / _____
W V Date

CAUTION: **If** 4 KV Bus 33-1 is energized, **then VERIFY** 4 KV Bus 33-1 Undervoltage HFA Auxiliary relays 127B33-1X1, 127B33-1X2, and 127B33-1X3 are reset **BEFORE** restoring Bus 33-1 Undervoltage relays trip test switches.

NOTE: **If** 4 KV Bus 33-1 is de-energized, **then** Alarm 1539, Window E-03 “4 KV BUSES 33-1 & 34-1 VOLT LO” on Panel 903-8 will annunciate in the Control Room when Test Switch TS 127SD-3X “D” is closed.

ATTACHMENT 1
Relay Routine for 4 KV Bus 33-1 Undervoltage Relays
Page 10 of 10

6.4. **CLOSE** the following test switches at Bus 33-1, Cubicle 13:

Print Number	Test Switch	Test Switch Label	CV/ Date	WV / Date
12E-3345 Sh. 2	TS 127B33-1X “B”	TRIP ILRT AIR COMP BRK		
12E-3345 Sh. 2	TS 127B33-1X “C”	TRIP CORE SPRAY PMP 3A BRK		
12E-3345 Sh. 2	TS 127B33-1X “D”	TRIP LPCI PMP 3B BRK		
12E-3345 Sh. 2	TS 127B33-1X “E”	TRIP SDC PMP 3A BRK		
12E-3345 Sh. 2	TS 127B33-1X “F”	TRIP 152-3328 BRK		
12E-3345 Sh. 2	TS 127B33-1X “G”	TRIP LPCI PMP 3A BRK		
12E-3345 Sh. 2	TS 127B33-1X “H”	*INTLK LPCI SYS 1		
12E-3345 Sh. 2	TS 127B33-1X “I”	TRIP RWCU RECIRC PMP 3A BRK		
12E-3345 Sh. 2	TS 127B33-1X “J”	TRIP BUS 33-1 FEED TO BUS 23-1		
12E-3345 Sh. 2	TS 127SD-3X “A”	*INTLK CORE SPRAY SYS 1		
12E-3345 Sh. 2	TS 127SD-3X “B”	TRIP BUS 33-1 FEED BRK		
12E-3345 Sh. 2	TS 127SD-3X “C”	D/G START RELAY ASR 2/3-3		
12E-3345 Sh. 2	TS 127SD-3X “D”	ALARM BUS 33-1 34-1 VOLTS LO PNL 903-8 W29		
12E-3345 Sh. 2	TS 127SD-3X “E”	*INTLK LPCI SYS 1		

***Note:** The following three (3) test switches could have 125VDC across the test switch:
TS 127B33-1X “H”, TS 127SD-3X “A”, TS 127SD-3X “E”
Since these test switches are used for monitoring permissives, it is acceptable to close them.

7. Return to Normal

7.1. **VERIFY** all relays are reset (or actuated if Bus 33-1 de-energized).

_____ / _____
W V Date

7.2. **VERIFY** targets reset (or actuated if Bus is 33-1 de-energized).

_____ / _____
W V Date

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 34-1 Undervoltage Relays
Page 1 of 9

1. <u>References</u>

1.1. 12E-3346 Sh. 2– Schematic Control Diagram 4160V Bus 34-1 Standby Diesel 2 Feed & 34-1 Tie Breaker.

1.2. 12E-3656B - Wiring Diagram 4160V Swgr Bus 34-1 Cub's 9, 10, 11, 12, 13 & 14.

1.3. 12E-3656H –Internal Schematic and Device Location Diagram 4160V Swgr Bus 34-1 Cubicle 13.

2. <u>Control Isolation</u>

CAUTION: **ISOLATE** 4 KV Bus 34-1 Undervoltage trips **BEFORE** removing Undervoltage relays for calibration:

NOTE: **If** 4 KV Bus 34-1 is de-energized, **then** Alarm 4042, Window E-03 "4 KV BUSES 33-1 & 34-1 VOLT LO" on Panel 903-8 will clear in the Control Room.

2.1 **NOTIFY** Operating that Isolating the following 3 test switches in the Isolation step of this UV surveillance will inhibit LPCI System 2 and Core Spray System 2 from starting during the performance of this surveillance.

TS 127B34-1H "H"	INTLK CORE SPRAY SYS 2
TS 159SD3X "A"	INTLK LPCI SYS 2
TS 159SD3X "H"	INTLK LPCI SYS 2

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 34-1 Undervoltage Relays
Page 2 of 9

2.2. **OPEN** the following test switches at Bus 34-1, Cubicle 13:

Print Number	Test Switch	Test Switch Label	CV/ Date	WV / Date
12E-3346 Sh. 2	TS 127-B34-1X “A”	TRIP BKR 152 3424		
12E-3346 Sh. 2	TS 127-B34-1X “B”	TRIP SHUT DOWN COOLG PMP 3C BRK		
12E-3346 Sh. 2	TS 127-B34-1X “C”	TRIP LPCI PMP 3D BRK		
12E-3346 Sh. 2	TS 127-B34-1X “D”	TRIP SHUT DOWN COOLG PMP 3B BRK		
12E-3346 Sh. 2	TS 127-B34-1X “E”	TRIP CORE SPRAY PMP 3B BRK		
12E-3346 Sh. 2	TS 127-B34-1X “F”	TRIP RX BLDG COOLG WTR PMP 2/3 BRK		
12E-3346 Sh. 2	TS 127-B34-1X “G”	TRIP LPCI PMP 3C BKR		
12E-3346 Sh. 2	TS 127-B34-1X “H”	INTLK CORE SPRAY SYS 2		
12E-3346 Sh. 2	TS 127-B34-1X “I”	TRIP RWCU RECIRC PMP 3B		
12E-3346 Sh. 2	TS 159SD3X “A”	INTLK LPCI SYS 2		
12E-3346 Sh. 2	TS 159SD3X “C”	TRIP INTLK BUS 34-1 FEED BRK		
12E-3346 Sh. 2	TS 159SD3X “D”	ALARM BUS 33-1 34-1 VOLTS LO PNL 903-8 W29		
12E-3346 Sh. 2	TS 159SD3X “F”	D/G START REL ASR-3		
12E-3346 Sh. 2	TS 159SD3X “H”	INTLK LPCI SYS 2		

3. Relay Calibration

3.1. **REMOVE** relays from 4 KV Bus 34-1 Cubicle 13 listed below and Initial/Date.

Relay Number	Service Description	Relay Type	WV/Date
127-1-B34-1	Bus 34-1 Undervoltage Relay Phase A-B	IAV69A	
127-2-B34-1	Bus 34-1 Undervoltage Relay Phase B-C	IAV69A	

3.2. **VERIFY** that the data sheets for this cubicle agree with the Relay Setting Orders (RSO).

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 34-1 Undervoltage Relays
Page 3 of 9

3.3. **CALIBRATE** 127-1-B34-1.

_____ / _____
W V Date

Allowable Value:	79.91 VAC < VAC < 87.52 VAC
Expanded Tolerance:	80.86 VAC < VAC < 86.50 VAC
Setting Tolerance:	81.00 VAC < VAC < 86.40 VAC
Recommended Setpoint:	83.70 VAC

3.3.1. **IF** setting is outside the Allowable Value, **THEN NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.3.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.3.3. **IF** the setting is outside the setting tolerance, **THEN INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 34-1 Undervoltage Relays
Page 4 of 9

3.4. **CALIBRATE** 127-2-B34-1.

_____ / _____
W V Date

Allowable Value:	79.91 VAC < VAC < 87.52 VAC
Expanded Tolerance:	80.86 VAC < VAC < 86.50 VAC
Setting Tolerance:	81.00 VAC < VAC < 86.40 VAC
Recommended Setpoint:	83.7 VAC

3.4.1. **IF** setting is outside the Allowable Value, **THEN NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.4.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.4.3. **IF** the setting is outside the setting tolerance, **THEN INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

3.5. **INSTALL** relays into 4 KV Bus 34-1 Cubicle 13 listed below and Initial/Date.

Relay Number	Service Description	Relay Type	WV/Date
127-1-B34-1	Bus 34-1 Undervoltage Relay Phase A-B	IAV69A	
127-2-B34-1	Bus 34-1 Undervoltage Relay Phase B-C	IAV69A	

ATTACHMENT 2
Relay Routine for 4 KV Bus 34-1 Undervoltage Relays
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4. Functional Testing with Bus 34-1 Energized

NOTE: **If** 4 KV Bus 34-1 is de-energized, **then N/A** Section 4.0 of this procedure and perform Functional Testing using Section 5.0 of this procedure.

4.1. **PREPARE** four each GE Test Paddles by **INSTALLING** the connecting links in all terminals EXCEPT terminals 5 and 6.

_____ / _____
W V Date

4.2. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-1-B34-1 at Bus 34-1, Cubicle 13 and **REPLACE** them with two GE Test Paddle as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that Bus 34-1 Undervoltage HFA Auxiliary relays 127B34-1X1, 127B34-1X2, and 127B34-1X3 do not actuate.

_____ / _____
W V Date

4.3. **REMOVE** both GE Test Paddle from IAV69A relay 127-1-B34-1 at Bus 34-1, Cubicle 13. **REPLACE** upper and lower relay connection paddles and **VERIFY** that relay disc moves to its energized position.

_____ / _____
W V Date

4.4. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-2-B34-1 at Bus 34-1, Cubicle 13 and **REPLACE THEM** with GE Test Paddle as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that Bus 34-1 Undervoltage HFA Auxiliary relays 127B34-1X1, 127B34-1X2, and 127B34-1X3 do not actuate. Do not remove GE Test Paddles.

_____ / _____
W V Date

4.5. **REMOVE** upper and lower relay connection paddles from IAV69A relay 127-1-B34-1 at Bus 34-1, Cubicle 13 and **REPLACE** them with two GE Test Paddle as modified in step 4.1. After relay disc moves to its reset position, **VERIFY** that:

4.5.1. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X1 actuates.

_____ / _____
W V Date

4.5.2. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X2 actuates.

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 34-1 Undervoltage Relays
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4.5.3. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X3 actuates.

_____ / _____
W V Date

4.5.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-34-1 actuates.

_____ / _____
W V Date

4.6. **REMOVE** both GE Test Paddles from IAV69A relay 127-1-B34-1 at Bus 34-1, Cubicle 13. **REPLACE** upper and lower relay connection paddles. After relay disc moves to its energized position, **VERIFY** that Bus 34-1 Undervoltage HFA Auxiliary relays 127B34-1X1, 127B34-1X2, and 127B34-1X3 remain actuated.

_____ / _____
W V Date

4.7. **REMOVE** both GE Test Paddles from IAV69A relay 127-2-B34-1 at Bus 34-1, Cubicle 13. **REPLACE** upper and lower relay connection paddles. After relay disc moves to its energized position, **VERIFY** that:

4.7.1. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X1 resets.

_____ / _____
W V Date

4.7.2. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X2 resets.

_____ / _____
W V Date

4.7.3. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X3 resets.

_____ / _____
W V Date

4.7.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-34-1 resets.

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 34-1 Undervoltage Relays

5. Bus 34-1 Undervoltage Relays Functional Testing with Bus De-energized

NOTE: **If** 4 KV Bus 34-1 is energized and functional tests were performed using Section 4.0 of this procedure, **then N/A** Section 5.0 of this procedure.

5.1. **VERIFY** that Bus 34-1 Undervoltage HFA Auxiliary relays 127B34-1X1, 127B34-1X2, and 127B34-1X3 are actuated.

_____ / _____
W V Date

5.2. **OPEN** test switch TS 34-1UV "E" at Panel 2253-84.

_____ / _____ _____ / _____
C V Date W V Date

5.3. **PLACE** a jumper between test switches TS 34-1 UV "F" and "G" on Panel 2253-84. **VERIFY** that Agastat relay 459X1-34-1 actuates.

_____ / _____ _____ / _____
C V Date W V Date

5.4. **ACTUATE** IAV69A relay 127-1-B34-1 at Bus 34-1, Cubicle 13 by moving relay disc to its energized position. **VERIFY** that Bus 34-1 Undervoltage HFA Auxiliary relays 127B34-1X1, 127B34-1X2, and 127B34-1X3 remain actuated.

_____ / _____
W V Date

5.4. **RELEASE** relay disc to its de-energized position.

_____ / _____
W V Date

5.6. **ACTUATE** IAV69A relay 127-2-B34-1 at Bus 34-1, Cubicle 13 by moving relay disc to its energized position. **VERIFY** that:

5.6.1. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X1 resets.

_____ / _____
W V Date

5.6.2. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X2 resets.

_____ / _____
W V Date

5.6.3. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X3 resets.

_____ / _____
W V Date

ATTACHMENT 2
Relay Routine for 4 KV Bus 34-1 Undervoltage Relays
Page 8 of 9

5.6.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-34-1 resets.

_____ / _____
W V Date

5.7. **RELEASE** relay disc to its de-energized position. **VERIFY** that:

5.7.1. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X1 actuates.

_____ / _____
W V Date

5.7.2. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X2 actuates.

_____ / _____
W V Date

5.7.3. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X3 actuates.

_____ / _____
W V Date

5.7.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-34-1 actuates.

_____ / _____
W V Date

5.8. **REMOVE** jumper between test switches TS 34-1 UV “F” and “G” on Panel 2253-84. **VERIFY** that Agastat relay 459X1-34-1 resets.

_____ / _____ _____ / _____
C V Date W V Date

5.9. **CLOSE** test switch TS 34-1UV “E” at Panel 2253-84.

_____ / _____ _____ / _____
C V Date W V Date

6. <u>Bus 34-1 Undervoltage and Degraded Voltage Trip Restoration</u>

6.1. **VERIFY** all taps and time levers in all relays are in their "In Service" position as specified by each relay's "As Left" data.

_____ / _____
W V Date

6.2. **REPLACE** relay covers.

_____ / _____
W V Date

6.3. **REVIEW**, **INITIAL and DATE** appropriate data sheets.

_____ / _____
W V Date

CAUTION: **If** 4 KV Bus 34-1 is energized, **then VERIFY** 4 KV Bus 34-1 Undervoltage HFA Auxiliary relays 127B34-1X1, 127B34-1X2, and 127B34-1X3 are reset **BEFORE** restoring Bus 34-1 Undervoltage relays trip test switches.

ATTACHMENT 2
Relay Routine for 4 KV Bus 34-1 Undervoltage Relays
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NOTE: **If** 4 KV Bus 34-1 is de-energized, **then** Alarm 4042, Window E-03 "4 KV BUSES 33-1 & 34-1 VOLT LO" on Panel 903-8 will annunciate in the Control Room when Test Switch TS 159SD3X "D" is closed.

6.4. **CLOSE** the following test switches at Bus 34-1, Cubicle 13:

Print Number	Test Switch	Test Switch Label	CV/ Date	WV / Date
12E-3346 Sh. 2	TS 127B34-1X "A"	TRIP BKR 152 3424		
12E-3346 Sh. 2	TS 127B34-1X "B"	TRIP SHUT DOWN COOLG PMP 3C BRK		
12E-3346 Sh. 2	TS 127B34-1X "C"	TRIP LPCI PMP 3D BRK		
12E-3346 Sh. 2	TS 127B34-1X "D"	TRIP SHUT DOWN COOLG PMP 3B BRK		
12E-3346 Sh. 2	TS 127B34-1X "E"	TRIP CORE SPRAY PMP 3B BRK		
12E-3346 Sh. 2	TS 127B34-1X "F"	TRIP RX BLDG COOLG WTR PMP 2/3 BRK		
12E-3346 Sh. 2	TS 127B34-1X "G"	TRIP LPCI PMP 3C BKR		
12E-3346 Sh. 2	TS 127B34-1X "H"	*INTLK CORE SPRAY SYS 2		
12E-3346 Sh. 2	TS 127B34-1X "I"	TRIP RWCU RECIRC PMP 3B		
12E-3346 Sh. 2	TS 159SD3X "A"	*INTLK LPCI SYS 2		
12E-3346 Sh. 2	TS 159SD3X "C"	TRIP INTLK BUS 34-1 FEED BRK		
12E-3346 Sh. 2	TS 159SD3X "D"	ALARM BUS 33-1 34-1 VOLTS LO PNL 903-8 W29		
12E-3346 Sh. 2	TS 159SD3X "F"	D/G START REL ASR-3		
12E-3346 Sh. 2	TS 159SD3X "H"	*INTLK LPCI SYS 2		

***Note:** The following three (3) test switches could have 125VDC across the test switch:
TS 127B34-1X "H", TS 159SD-3X "A", TS 159SD-3X "H"
Since these test switches are used for monitoring permissives, it is acceptable to close them.

7. Return to Normal

7.1. **VERIFY** all relays are reset (or actuated if Bus 34-1 de-energized). _____ / _____
W V Date

7.2. **VERIFY** targets reset (or actuated if Bus 34-1 de-energized). _____ / _____
W V Date

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

_____ / _____
W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
Page 1 of 11

1. References

1.1. 12E-3334 Relay and Metering Diagram – 4160. Switch Group 33-1 & 34-1.

1.2. 12E-3345 Sh. 2– Schematic Diagram 4160V Bus 33-1, 4 kV Swgr 40 Feed Breaker.

1.3. 12E-3345 Sh. 3– Schematic Diagram 4160V Bus 33-1, 4 kV Bus 33-1 & 23-1 Tie Breaker.

2.3. 12E-3655B - Wiring Diagram 4160V Swgr Bus 33-1 Cubicles 9, 10, 11, 12, 13, & 14.

2.4. 12E-3655G – 4160V Swgr Bus 33-1 Cubicle 13 Internal Schematic and Device Location Diagram.

2.5. 12E-3650B – Wiring Diagram 4 KV Bus 33-1 2nd Level Undervoltage Panel 2253-83.

2. Relay Isolation and Relay Removal

2.1. **VERIFY** that the data sheets for this relay agree with the Relay Setting Orders (RSO).

_____ / _____ _____ / _____
C V Date W V Date

2.2. **INFORM** Operations that the 2/3 DG will be inop to D3 prior to performing the following step.

_____ / _____
W V Date

2.3. **OPEN** test switch TS 33-1UV “E”.

_____ / _____ _____ / _____
C V Date W V Date

2.4. **INSTALL** a jumper between TS 33-1 UV “F” and TS 33-1 UV “G”.

_____ / _____ _____ / _____
C V Date W V Date

Note: After the Jumper is installed on the relay, care shall be taken to ensure that the jumper does not become disconnected.

ATTACHMENT 3
Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
Page 2 of 11

2.5. **REMOVE** TDR-33-1 at Panel 2253-83.

_____ / _____ _____ / _____
C V Date W V Date

2.6. **OPEN** test switches TS 33-1UV “A” and “B” at Panel 2253-83.

_____ / _____ _____ / _____
C V Date W V Date

2.7. **VERIFY** that relay 127-3-B33-1 trip target is illuminated.

_____ / _____
W V Date

2.8. **REMOVE** relay 127-3-B33-1 from Panel 2253-83

_____ / _____ _____ / _____
C V Date W V Date

2.9. **OPEN** test switches TS 33-1UV “C” and “D” at Panel 2253-83.

_____ / _____ _____ / _____
C V Date W V Date

2.10. **VERIFY** that relay 127-4-B33-1 trip target is illuminated.

_____ / _____
W V Date

2.11. **REMOVE** relay 127-4-B33-1 from Panel 2253-83

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
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3. Relay Calibration

3.1. **VERIFY** room temperature is between the range of 21 to 24 Deg. C.

_____ / _____ _____ / _____
C V Date W V Date

3.2. **SET** the Fluke 45 on the medium sampling rate.

_____ / _____ _____ / _____
C V Date W V Date

3.3. **CALIBRATE** relay 127-3-B33-1.

_____ / _____
W V Date

Allowable Value:	110.3 VAC < VAC < 111.5 VAC
Expanded Tolerance:	110.4 VAC < VAC < 111.0 VAC
Setting Tolerance:	110.5 VAC < VAC < 110.9 VAC
Recommended Setpoint:	110.7 VAC

Allowable Value:	5.7 seconds < Time < 8.3 seconds
Expanded Tolerance:	6.2 seconds < Time < 7.8 seconds
Setting Tolerance:	6.3 seconds < Time < 7.7 seconds
Recommended Setpoint:	7.0 seconds

3.3.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.3.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.3.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
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3.4. **CALIBRATE** relay 127-4-B33-1. _____ / _____
W V Date

Allowable Value:	110.3 VAC < VAC < 111.5 VAC
Expanded Tolerance:	110.4 VAC < VAC < 111.0 VAC
Setting Tolerance:	110.5 VAC < VAC < 110.9 VAC
Recommended Setpoint:	110.7 VAC

Allowable Value:	5.7 seconds < Time < 8.3 seconds
Expanded Tolerance:	6.2 seconds < Time < 7.8 seconds
Setting Tolerance:	6.3 seconds < Time < 7.7 seconds
Recommended Setpoint:	7.0 seconds

3.4.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.4.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.4.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
Page 5 of 11

3.5. **CALIBRATE** TDR-33-1 relay.

_____ / _____
W V Date

Allowable Value:	279.0 seconds < Time < 321.0 seconds
Expanded Tolerance:	297.8 seconds < Time < 317.2 seconds
Setting Tolerance:	300.0 seconds < Time < 315.0 seconds
Recommended Setpoint:	307.5 seconds

3.5.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.5.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.5.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD calibration procedure.

_____ / _____
W V Date

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Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
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4. Relay Installation

4.1. **INSTALL** relay 127-3-B33-1 into Panel 2253-83.

_____ / _____ C V Date   _____ / _____ W V Date

4.2. **VERIFY** that relay 127-3-B33-1 power indicating light is lit.

_____ / _____ W V Date

4.3. **CLOSE** test switches TS 33-1UV “A” and “B” at Panel 2253-83.

_____ / _____ C V Date   _____ / _____ W V Date

4.4. **RESET** relay 127-3-B33-1 trip target.

_____ / _____ C V Date   _____ / _____ W V Date

4.5. **INSTALL** relay 127-4-B33-1 into Panel 2253-83.

_____ / _____ C V Date   _____ / _____ W V Date

4.6. **VERIFY** that relay 127-4-B33-1 power indicating light is lit.

_____ / _____ W V Date

4.7. **CLOSE** test switches TS 33-1UV “C” and “D” at Panel 2253-83.

_____ / _____ C V Date   _____ / _____ W V Date

4.8. **RESET** relay 127-4-B33-1 trip target.

_____ / _____ C V Date   _____ / _____ W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
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4.9. **INSTALL** TDR-33-1 relay into Panel 2253-83.

_____ / _____ _____ / _____
C V Date W V Date

5.0 <u>Functional Testing</u>

5.1. **CONNECT** VOM #1 to TB 1-6 and TB 1-8 in 2253-83 to monitor relay TDR-33-1 contact T1 and M1 **VERIFYING** no continuity (ohms) across contact. Do not disconnect VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.2. **CONNECT** VOM #2 to TB 1-5 and TS 33-1 UV "I" to monitor TDR-33-1 coil **VERIFYING** no 125VDC across coil. Do not disconnect VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.3. **REMOVE** jumper previously installed between TS 33-1 UV "F" and TS 33-1 UV "G".

_____ / _____ _____ / _____
C V Date W V Date

5.4 **CONNECT** VOM #3 between TS 33-1 UV "F" and TS 33-1 UV "G", **VERIFYING** no 125VDC. Do not disconnect VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.5. **TRIP** Relay 127-3-B33-1 by **OPENING** test switch TS 33-1 UV "A"

_____ / _____ _____ / _____
C V Date W V Date

5.6. **VERIFY** that relay 127-3-B33-1 trip target is illuminated.

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
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5.7. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-33-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.8. **VERIFY** 125 VDC on VOM #3 connected to TS 33-1 UV "F" and TS 33-1 UV "G".

_____ / _____ _____ / _____
C V Date W V Date

5.9. **RESET** Relay 127-3-B33-1 by **CLOSING** test switch TS 33-1 UV "A"

_____ / _____ _____ / _____
C V Date W V Date

5.10. **RESET** target on relay 127-3-B33-1.

_____ / _____ _____ / _____
C V Date W V Date

5.11. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-33-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.12. **VERIFY** no 125 VDC on VOM #3 connected to TS 33-1 UV "F" and TS 33-1 UV "G".

_____ / _____ _____ / _____
C V Date W V Date

5.13. **TRIP** Relay 127-4-B33-1 by **OPENING** test switch TS 33-1 UV "D".

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
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5.14. **VERIFY** that relay 127-4-B33-1 trip target is illuminated.

_____ / _____
W V Date

5.15. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-33-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.16. **VERIFY** no 125 VDC on VOM #3 connected to TS 33-1 UV “F” and TS 33-1 UV “G”.

_____ / _____ _____ / _____
C V Date W V Date

5.17. **PRIOR** to performing the next step, **NOTIFY** Operations that the “4KV Bus 33-1 Voltage Degraded’’ alarm on the 903-8 C-04 window will be received.

_____ / _____
W V Date

5.18. **TRIP** Relay 127-3-B33-1 by **OPENING** test switch TS 33-1 UV “A”

_____ / _____ _____ / _____
C V Date W V Date

5.19. **VERIFY** that relay 127-3-B33-1 trip target is illuminated.

_____ / _____
W V Date

5.20. **VERIFY** 125 VDC on VOM #2 connected across relay TDR-33-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.21. **VERIFY** 125 VDC on VOM #3 connected to TS 33-1 UV “F” and TS 33-1 UV “G”.

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 3
Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
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5.22 **VERIFY** continuity (ohms) on VOM #1 across terminal T1 and Terminal M1 of relay TDR-33-1 after 6 minutes.

_____ / _____ _____ / _____
C V Date W V Date

5.23. **VERIFY** Operations received the "4KV Bus 33-1 Voltage Degraded'' alarm on the 903-8 C-04 window.

_____ / _____
W V Date

5.24. **RESET** Relay 127-3-B33-1 by **CLOSING** test switch TS 33-1 UV "A"

_____ / _____ _____ / _____
C V Date W V Date

5.25. **RESET** target on relay 127-3-B33-1.

_____ / _____ _____ / _____
C V Date W V Date

5.26. **RESET** Relay 127-4-B33-1 by **CLOSING** test switch TS 33-1 UV "D"

_____ / _____ _____ / _____
C V Date W V Date

5.27. **RESET** target on relay 127-4-B33-1.

_____ / _____ _____ / _____
C V Date W V Date

5.28. **VERIFY** no continuity (ohms) on VOM #1 connected across terminal T1 and Terminal M1 of relay TDR-33-1 and **REMOVE** VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.29. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-33-1 coil and **REMOVE** VOM.

_____ / _____ _____ / _____
C V Date W V Date

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Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays
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5.30. **VERIFY** no 125 VDC on VOM #3 connected to TS 33-1 UV "F" and TS 33-1 UV "G" and **REMOVE** VOM.

_____ / _____ _____ / _____
C V Date W V Date

6. Restoration

6.1. **VERIFY** no voltage across test switch TS 33-1UV "E" and then **CLOSE** test switch TS 33-1UV "E".

_____ / _____ _____ / _____
C V Date W V Date

6.2. **INFORM** Operations that the 2/3 DG to D3 is operable. _____ / _____
W V Date

7. Return to Normal

7.1. **VERIFY** all relays are reset. _____ / _____ _____ / _____
C V Date W V Date

7.2. **VERIFY** targets are reset. _____ / _____ _____ / _____
C V Date W V Date

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

_____ / _____
W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays
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1. <u>References</u>

1.1. 12E-3334 Relay and Metering Diagram – 4160. Switch Group 33-1 & 34-1.

1.2. 12E-3346 Sh. 1– Schematic Diagram 4160V Bus 34-1, 4 kV Diesel 3 Feed Breaker & 24-1 Tie Breakder.

1.3. 12E-3346 Sh. 2– Schematic Diagram 4160V Bus 34-1, Diesel 3 Feed Breaker & 24-1 Tie Breaker.

1.4. 12E-3656A - Wiring Diagram 4160V Swgr Bus 34-1 Cubicles 1, 2,3, 4, 5, 6, 7, & 8.

1.5. 12E-3655G – 4160V Swgr Bus 34-1 Cubicle 13 Internal Schematic and Device Location Diagram.

1.6. 12E-3650C – Wiring Diagram 4 KV Bus 34-1 2nd Level Undervoltage Panel 2253-84.

2. <u>Relay Isolation and Relay Removal</u>

2.1. **VERIFY** that the data sheets for this relay agree with the Relay Setting Orders (RSO).

_____ / _____ _____ / _____
C V Date W V Date

2.2. **INFORM** Operations that the 3 DG will be inop to D3 prior to performing the following step.

_____ / _____
W V Date

2.3. **OPEN** test switch TS 34-1UV "E". _____ / _____ _____ / _____
C V Date W V Date

2.4. **INSTALL** a jumper between TS 34-1 UV "F" and TS 34-1 UV "G".

_____ / _____ _____ / _____
C V Date W V Date

Note: After the Jumper is installed on the relay, care shall be taken to ensure that the jumper does not become disconnected.

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Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays
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2.5. **REMOVE** TDR-34-1 at Panel 2253-84.

_____ / _____ _____ / _____
C V Date W V Date

2.6. **OPEN** test switches TS 34-1UV “A” and “B” at Panel 2253-84.

_____ / _____ _____ / _____
C V Date W V Date

2.7. **VERIFY** that relay 127-3-B34-1 trip target is illuminated.

_____ / _____
W V Date

2.8. **REMOVE** relay 127-3-B34-1 from Panel 2253-84

_____ / _____ _____ / _____
C V Date W V Date

2.9. **OPEN** test switches TS 34-1UV “C” and “D” at Panel 2253-84.

_____ / _____ _____ / _____
C V Date W V Date

2.10. **VERIFY** that relay 127-4-B34-1 trip target is illuminated.

_____ / _____
W V Date

2.11. **REMOVE** relay 127-4-B34-1 from Panel 2253-84

_____ / _____ _____ / _____
C V Date W V Date

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Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays
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3. Relay Calibration

3.1. **VERIFY** room temperature is between the range of 21 to 24 Deg. C.

_____ / _____ _____ / _____
C V Date W V Date

3.2. **SET** the Fluke 45 on the medium sampling rate.

_____ / _____ _____ / _____
C V Date W V Date

3.3. **CALIBRATE** relay 127-3-B34-1.

_____ / _____
W V Date

Allowable Value:	110.3 VAC < VAC < 111.5 VAC
Expanded Tolerance:	110.4 VAC < VAC < 111.0 VAC
Setting Tolerance:	110.5 VAC < VAC < 110.9 VAC
Recommended Setpoint:	110.7 VAC

Allowable Value:	5.7 seconds < Time < 8.3 seconds
Expanded Tolerance:	6.2 seconds < Time < 7.8 seconds
Setting Tolerance:	6.3 seconds < Time < 7.7 seconds
Recommended Setpoint:	7.0 seconds

3.3.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.3.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.3.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays
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3.4. **CALIBRATE** relay 127-4-B34-1.

_____ / _____
W V   Date

Allowable Value:	110.3 VAC < VAC < 111.5 VAC
Expanded Tolerance:	110.4 VAC < VAC < 111.0 VAC
Setting Tolerance:	110.5 VAC < VAC < 110.9 VAC
Recommended Setpoint:	110.7 VAC

Allowable Value:	5.7 seconds < Time < 8.3 seconds
Expanded Tolerance:	6.2 seconds < Time < 7.8 seconds
Setting Tolerance:	6.3 seconds < Time < 7.7 seconds
Recommended Setpoint:	7.0 seconds

3.4.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V   Date

3.4.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V   Date

3.4.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

_____ / _____
W V   Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays
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3.5. **CALIBRATE** TDR-34-1 relay.

_____ / _____
W V Date

Allowable Value:	279.0 seconds < Time < 321.0 seconds
Expanded Tolerance:	297.8 seconds < Time < 317.2 seconds
Setting Tolerance:	300.0 seconds < Time < 315.0 seconds
Recommended Setpoint:	307.5 seconds

3.5.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

_____ / _____
W V Date

3.5.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

_____ / _____
W V Date

3.5.3. **IF** the setting is outside the setting tolerance, Then **INITIATE** a Condition Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD calibration procedure.

_____ / _____
W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays
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4. Relay Installation

4.1. **INSTALL** relay 127-3-B34-1 into Panel 2253-84.

_____ / _____ C V Date _____ / _____ W V Date

4.2. **VERIFY** that relay 127-3-B34-1 power indicating light is lit.

_____ / _____ W V Date

4.3. **CLOSE** test switches TS 34-1UV “A” and “B” at Panel 2253-84.

_____ / _____ C V Date _____ / _____ W V Date

4.4. **RESET** relay 127-3-B34-1 trip target.

_____ / _____ C V Date _____ / _____ W V Date

4.5. **INSTALL** relay 127-4-B34-1 into Panel 2253-84.

_____ / _____ C V Date _____ / _____ W V Date

4.6. **VERIFY** that relay 127-4-B34-1 power indicating light is lit.

_____ / _____ W V Date

4.7. **CLOSE** test switches TS 34-1UV “C” and “D” at Panel 2253-84.

_____ / _____ C V Date _____ / _____ W V Date

4.8. **RESET** relay 127-4-B34-1 trip target.

_____ / _____ C V Date _____ / _____ W V Date

ATTACHMENT 4
Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays
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4.9. **INSTALL** TDR-34-1 relay into Panel 2253-84.

_____ / _____ _____ / _____
C V Date W V Date

5.0 Functional Testing

5.1. **CONNECT** VOM #1 to TB 1-6 and TB 1-8 in 2253-84 to monitor relay TDR-34-1 contact T1 and M1 **VERIFYING** no continuity (ohms) across contact. Do not disconnect VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.2. **CONNECT** VOM #2 to TB 1-5 and TS 34-1 UV "I" to monitor TDR-34-1 coil **VERIFYING** no 125VDC across coil. Do not disconnect VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.3. **REMOVE** jumper previously installed between TS 34-1 UV "F" and TS 34-1 UV "G".

_____ / _____ _____ / _____
C V Date W V Date

5.4. **CONNECT** VOM #3 between TS 34-1 UV "F" and TS 34-1 UV "G", **VERIFYING** no 125VDC. Do not disconnect VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.5. **TRIP** Relay 127-3-B34-1 by **OPENING** test switch TS 34-1 UV "A"

_____ / _____ _____ / _____
C V Date W V Date

5.6. **VERIFY** that relay 127-3-B34-1 trip target is illuminated.

_____ / _____ _____ / _____
C V Date W V Date

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Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays
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5.7. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-34-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.8. **VERIFY** 125 VDC on VOM #3 connected to TS 34-1 UV “F” and TS 34-1 UV “G”.

_____ / _____ _____ / _____
C V Date W V Date

5.9. **RESET** Relay 127-3-B34-1 by **CLOSING** test switch TS 34-1 UV “A”

_____ / _____ _____ / _____
C V Date W V Date

5.10. **RESET** target on relay 127-3-B34-1.

_____ / _____ _____ / _____
C V Date W V Date

5.11. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-34-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.12. **VERIFY** no 125 VDC on VOM #3 connected to TS 34-1 UV “F” and TS 34-1 UV “G”.

_____ / _____ _____ / _____
C V Date W V Date

5.13. **TRIP** Relay 127-4-B34-1 by **OPENING** test switch TS 34-1 UV “D”.

_____ / _____ _____ / _____
C V Date W V Date

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Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays
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5.14. **VERIFY** that relay 127-4-B34-1 trip target is illuminated.

_____ / _____
W V Date

5.15. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-34-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

5.16. **VERIFY** no 125 VDC on VOM #3 connected to TS 34-1 UV “F” and TS 34-1 UV “G”.

_____ / _____ _____ / _____
C V Date W V Date

5.17. **PRIOR** to performing the next step, **NOTIFY** Operations that the “4KV Bus 34-1 Voltage Degraded’’ alarm on the 903-8 D-04 window will be received.

_____ / _____
W V Date

5.18. **TRIP** Relay 127-3-B34-1 by **OPENING** test switch TS 34-1 UV “A”

_____ / _____ _____ / _____
C V Date W V Date

5.19. **VERIFY** that relay 127-3-B34-1 trip target is illuminated.

_____ / _____
W V Date

5.20. **VERIFY** 125 VDC on VOM #2 connected across relay TDR-34-1 coil.

_____ / _____ _____ / _____
C V Date W V Date

ATTACHMENT 4
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5.21. **VERIFY** 125 VDC on VOM #3 connected to TS 34-1 UV "F" and TS 34-1 UV "G".

_____ / _____ _____ / _____
C V Date W V Date

5.22 **VERIFY** continuity (ohms) on VOM #1 across terminal T1 and Terminal M1 of relay TDR-34-1 after 6 minutes.

_____ / _____ _____ / _____
C V Date W V Date

5.23. **VERIFY** Operations received the "4KV Bus 33-1 Voltage Degraded'' alarm on the 903-8 D-04 window.

_____ / _____
W V Date

5.24. **RESET** Relay 127-3-B34-1 by **CLOSING** test switch TS 34-1 UV "A"

_____ / _____ _____ / _____
C V Date W V Date

5.25. **RESET** target on relay 127-3-B34-1.

_____ / _____ _____ / _____
C V Date W V Date

5.26. **RESET** Relay 127-4-B34-1 by **CLOSING** test switch TS 34-1 UV "D"

_____ / _____ _____ / _____
C V Date W V Date

5.27. **RESET** target on relay 127-4-B34-1.

_____ / _____ _____ / _____
C V Date W V Date

5.28. **VERIFY** no continuity (ohms) on VOM #1 connected across terminal T1 and Terminal M1 of relay TDR-34-1 and **REMOVE** VOM.

_____ / _____ _____ / _____
C V Date W V Date

5.29. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-34-1 coil and **REMOVE** VOM.

_____ / _____ _____ / _____
C V Date W V Date

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Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays
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5.30. **VERIFY** no 125 VDC on VOM #3 connected to TS 34-1 UV “F” and TS 34-1 UV “G” and **REMOVE** VOM.

_____ / _____ _____ / _____
C V Date W V Date

6. Restoration

6.1. **VERIFY** no voltage across test switch TS 34-1UV “E” and then **CLOSE** test switch TS 34-1UV “E”.

_____ / _____ _____ / _____
C V Date W V Date

6.2. **INFORM** Operations that the 3 DG to D3 is operable.

_____ / _____
W V Date

7. Return to Normal

7.1. **VERIFY** all relays are reset.

_____ / _____ _____ / _____
C V Date W V Date

7.2. **VERIFY** targets are reset.

_____ / _____ _____ / _____
C V Date W V Date

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

_____ / _____
W V Date