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RS-06-004

January 13, 2006

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

Exelon

Nuclear

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

 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

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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,

Simpson Patrick R. Simpson

Manager – Licensing

Attachments:

- 1. Response to Request for Additional Information
- Calculation 8982-13-19-6, "Second Level Undervoltage Relay Setpoint Unit 2," Revision 005
- 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.

<u>Response</u>

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.

<u>Response</u>

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.

<u>Response</u>

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)(i)(A) sets forth the criteria for safety limits, and 10 CFR 50.36(c)(1)(i)(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 < 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.

Reactor Core Safety Limits (Thermal Power & MCPR) and LOP Instrumentation

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	2-13-19-6		Revision	005		
EC/ECR No.	3503	35 & 350336		Revision	000		
Title:	Sec	ond Level Under	voltage Relay S	Setpoint –	Unit 2		
Station(s)		Dresden		Compon	ent(s)		
Unit No.:		2					
Discipline		E					
Description	Code/						
Keyword		E07, E13					
Safety Class	5	Safety Related					
System Cod	e	67					
Structure		N/A					
CONTROLL	ED DOC	UMENT REFERE	NCES				······
Document N	lo.		From/To	Docum	nent No.		From/To

Is this Desig	n Analy	sis Safeguards?	<u></u>		Yes 🗌 No 🖂		
Does this De	esign Ar	nalysis Contain U	nverified Assur	nptions?	Yes 🗌 No 🖂	ATI/AR# N/	/A
ls a Supplen	nental R	eview Required?			Yes 🗌 No 🖂	lf yes, com Attachment	
Preparer	Patricia A	A. Ugorcak		Patricio	e A. Ugorak		7-21-04
	Print Nam			Sign Nam			Date
Reviewer	Richard I			Rich	hard to	w	7-21-04
Method of Re	Print Nam	e 🛛 Detaileo	1 Review	Sign Name	e nate Calculations	Testing	Date
Review Notes							
Approver		uvi		11 ACK	HAM		B.16.04
	Print Nam			Sign Name	e		Date

8-16-04 **Exelon Reviewer** DALE EAMAN Date Sign Name Print Name QA COPY MADE Approver araba 8-18-24 Ru Sign Name Print Name Date 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

(For External Analyses Only)

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

DESIG	N 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?	\boxtimes		
4.	Are design inputs correct and reasonable?	\boxtimes		
5. ⁻	Are design inputs compatible with the way the plant is operated and with the licensing basis?	区米		
6.	Are Engineering Judgments clearly documented and justified?			
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?	\boxtimes		
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?	\boxtimes		
11.	Have any limitations on the use of the results been identified and transmitted to the appropriate organizations?	\boxtimes		
12.	Are there any unverified assumptions?		\boxtimes	
13.	Do all unverified assumptions have a tracking and closure mechanism in place?			\boxtimes
EXEL O	NREVIEWER: DALE ERMAN / Pale Erman		8-14-	<i>∽¥</i>

EXELON REVIEWER: DALE ERMAN / Dale Eaman DATE: 8-16-04

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

NES-G-14.01 Effective Date: 04/14/00

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DESIGN ANALYSIS NO. 8982-13-19-6

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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 safetyrelated 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.

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nverted to 1σ values and ethod. The outcome of t	I combined by the he SRSS is then c	"Square loubled t	root of the sum of to a 2σ value.
ill be added together by s	straight addition.		
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dor specifications (DTIv) i ccuracy (RA), calibration	is determined by o error (CAL), settir	alculatin g tolerar	ng the square root sum of nce (ST), and drift (DR).
ft are not provided by the ing cycle for mechanical o ponents is assigned (Sec	components and :	0.5% of	ndom [2ơ] value of span per refueling
be determine utilizing the licable:	e following equation	ons base	d on Appendix C of
av⁺│ [lower limit]			
Zav [upper limit]			
allowable value			
calculated setpoint			
rror (positive, negative) a	pplicable during c	alibratior	า.
e terms in the generic equic loop designations.	uations shown abo	ove may	be modified in
uded for the determinatio ation. Thus, only referen drift (DR) and if applicabl _, ST and DR errors will b	nce accuracy (RA) e, the input error (, calibrat σin) are	ion errors (CAL), included. If DTIc is
(ET)			
re determined as follows:	:		
ST) + ST], where ST is us	sed at a 2σ value.		
ces determined using the e that is less than the set			
e is specified as an accepration setting tolerance is			

DESIGN ANALYSIS NO. 8982-13-19-6

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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)

Setpoint Ranges (p	er Ref. 6.1.3)
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).
Operating Ranges (per Refs. 6.5, 6.1.3, and 6.13)
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: #0.01% for volt. range 100-140 Vdc: #/-0.1% for volt. range 100-140 Vdc: #/-0.4% 0 to +55°C: #0 to +55°C: #/-0.4% 0 to +55°C: #/-0.4% 0 to +55°C: #/-0.4% 0 to +55°C: #/-0.4% .20 to +70°C: #/-1.50% -20 to +70°C: #/-1.6% .30 to +55°C, as indicated in Reference 6.2 and 6.13) The stolerance over temperature range, the repeatability effect is linear over the range of 0 to +55°C, as indicated in Reference 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 3 ovalue 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 Zon	IGN A	ANALYSIS NO. 8982-13-19-6 REVISION 005 PAGE	E NO. 6 of 15
@ const temp & const control volt: +/-0.1% for volt. range 100 - 140 Vdc: +/-0.4% 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. S.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: 3000 Vac, 5 digits Minimum Gradation: 0.01 V S.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. S.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. 6.13) Temperature Range: +18.33 + +39.44°C (see Ref. 6.11) 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. 6.13) Temperature Range: +18.33 + +39 44°C (see Ref. 6.11) Humidity Range: 0 - 100% non-condensing As noted in Reference 6.1.2, the maximum actual temperature inside the cubicle where the		Pressure: Atmospheric, to 5000 ft Radiation: Gamma 100k rads over 40 yrs	ion 10.3)
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 30 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		@ 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%	
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 3 or value per the methodology in Reference 6.14. 5.5. Station Data The setting to 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. 6.13) Temperature Range: +18.33 - +39.44°C (see Ref. 6.11) 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. 6.13) 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 2.38°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		The 3 tolerances are cumulative and are taken as 2σ values per Reference	e 6.7).
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 3 o 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		For the tolerance over temperature range, the repeatability effect is linear to +55°C, as indicated in Reference 6.7.	over the range of 0
 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 3ơ 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 	5.3.	3. Calibration Instrument Data (per References 6.2 and 6.13)	
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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		Full Scale: 300 Vac, 5 digits	
 which is taken as a 3ơ 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 vill 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	5.4.	Calibration Procedure 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		The setting tolerance when setting the trip unit voltage is ± 0.2 V (Ref. 6.13, 6.15 a which is taken as a 3σ value per the methodology in Reference 6.14.	nd 6.18
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	5.5.	5. Station Data	
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		Environment Zone 26 per Reference 6.1.2. The following are the conditions that t	he circuits
Temperature Range:+18.33 - +39.44°C (see Ref. 6.11)Humidity Range:0 - 90%Radiation Level:<10k rads over 40 years		Normal 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		Temperature Range: +18.33 - +39.44°C (see Ref. 6.11) Humidity Range: 0 - 90%	
 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 		Accident Conditions	
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		Temperature Range: +18.33 - +39 44°C (see Ref. 6.11)	
		relays are installed will be approximately 2.78°C higher than the ambient temperat the cubicle. The minimum actual temperature inside the cubicle where the relays installed will be approximately 0.39°C higher than the ambient temperature outside cubicle. Therefore, the relays will experience temperatures in the range, of 18.72°	ure outside are e the

DESIGN ANALYSIS NO. 8982-13-19-6 PAGE NO. 7 of 15 REVISION 005 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. REFERENCES 6. 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. User's Manual for Fluke 45 Dual Display Multimeter, Appendix A, Rev. 4, dated 7/97 (Attachment B). 6.2. S&L Calculation Number 9198-18-19-1, Rev. 3, entitled "Calc. for Dresden 2/I Safety-related 6.3. 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" S&L Interoffice Memorandum from J. F. White, entitled "Seismic Qualification of ITE/ABB 6.5. Undervoltage Relay Model 27N, Series 411T," which references ABB document number RC-5039-A. entitled "Equipment Performance Specifications, 27N Undervoltage Relay," (Attachment C) GE document 7910, page 131, providing information for type JVM-3 Potential Transformer, dated 6-6.6. 20-77 (Attachment D). Memorandum of Telephone Conversation between S. Hoats of ABB and A. Runde of S&L concerning 6.7. 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

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).

requirement.

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- 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

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7. CALCULATIONS

7.1. Per inputs 5.1 and 5.2.1, the PT has a standard published error of \pm 0.3% and the burden of the PT is within the standard test burden of the PT. Therefore, the maximum error of \pm 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 1 σ error value is \pm 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 \pm 0.1% of voltage reading [2 σ]. Dividing by 2 to take to a 1 σ value:

RA = 0.05% of reading $[1\sigma]$.

7.2.2. Calibration Instrument error (CAL):

The reference accuracy at medium sampling rate (Reference 6.13) of a 60 Hz voltage signal is \pm (0.2% of reading + 10 least significant digits), to a 2 σ 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 2 σ reference accuracy is \pm (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:

 $CALv = \pm (0.2\% \times 112 V + 10 \times 0.01V)/2 = 0.162 V [1\sigma]$

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

CAL = CALv/112 V = 0.162 V / 112 V = 0.145% of reading [1 σ]

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 $\pm 0.2 \text{ V} [3\sigma]$. Converting this to terms of % of reading, for a 112V reading, and dividing by 3 to get the 1σ value:

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

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,

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		the rela drift to 9	y functions % of readin	over a voltage range g, by conservatively s	of 70 V to 120 V, setting the reading	for a spa j at 112∨	an of 50 V. Converting the \prime , and taking to a 1 σ value:		
		DR = (±	DR = (± 0.5% of span) * (120 V – 70 V) / (112 V) / 2 = ± 0.112% of reading						
	7.2.5.	Randor	n Input Erro	or (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:						
		σ	in = 0.15%	of reading $[1\sigma]$					
	7.2.6.	Drift To	lerance Inte	erval (DTIv)					
		DTIv =	\pm (RA ² + C	$AL^{2} + ST^{2} + DR^{2})^{1/2}$					
		Where	RA CAL ST DR	= reference accura = calibration error = = setting tolerance = drift = 0.112% pe	= 0.145% per Sect = 0.060% per Sec	ion 7.2.2	2		
		Thus:		2		2,1/2			
		$DTIv = \pm \left[(0.050\%)^2 + (0.145\%)^2 + (0.060\%)^2 + (0.112\%)^2 \right]^{1/2}$							
		$DTIv = \pm 0.199\%$ of reading [1 σ]							
	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:					ctions 7.2.1 through 7.2.6.		
		σ = ± (F	۲A ² + CAL ²	$+ ST^{2} + DR^{2} + \sigma in^{2})^{1}$	/2				
		$\sigma = \pm \left[(0.050\%)^2 + (0.145\%)^2 + (0.060\%)^2 + (0.112\%)^2 + (0.150\%)^2 \right]^{1/2}$					²) ^{1/2}		
		$\sigma = \pm 0.$.249% of re	ading [1ơ]					
7.3.	Relay I	Non-Ran	dom Errors						
	7.3.1.	Temper	rature effec	t (eT):					
		tempera	ature range es or decre	of 0 to +55°C. Per R	eferences 6.7 and nearly with tempe	16.9, the rature.	effect is 1.5% over the relay operating voltage Applying the 1.5% linearly 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.

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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 $\pm 0.1\%$ over the dc control voltage range of 100-140 Vdc. This is classified as a non-random error.

 $CV = \pm 0.1\%$ 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:

 $\Sigma e_{-} = -eT + (-CV) = (-0.579\%) + (-0.1\%) = -0.679\%$ 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:

 $\Sigma e + = +eT + (+CV) = (+0.144\%) + (+0.1\%) = +0.244\%$ of reading

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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

 $Z_{-} = TPE$

Σe+ = Negative Non-Random Errors = 0.679% of reading

 Σ_{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,

 $\sigma_{AV} = DTIv = \pm 0.199\%$ 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

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7.5.	Setpoint Determination			
	The setpoints for 4160 V Switchg	gear 23-1 (Div. I) and 24-1 (Div. 2	2) are ca	lculated as:
	Nominal Trip Setpoint for E	Dropout (NTSP _{DO})= Analytical Lin	nit (AL) ·	+ TNE
	NTSP _{DO} = AL	+ TNE (Using values from Sect	tions 5.6	and 7.4)
	= 38	20 V + 46 V = 3866 V at 4.19 kV	' bus	
	Converting to voltage read	at the relay by multiplying by the	e voltage	ratio:
		^r SP _{DO} * (120 V) / (4200 V) = (386 0.46 V ≈ 110.5 V at relay	66 V) * (120 V)/(4200 V)
		^r SP _{DO-R} / 0.995 = 110.5 V / 0.995 1.06 V ≈ 111.1 V at relay	5	
	From the nominal dropout,	the maximum dropout and picku	p voltag	es can be determined:
	•	ITSP _{DO} + TPE = (3866 V) + (0.74 895 V at 4.16 kV bus	1% * 386	6)
	Converting to terms	of voltage at the relay: (3895 V)	* (120 V	/)/(4200 V) = 111.3 V
		um Dropout / (dropout/pickup rat 915 V at 4.16 kV bus	io) = 389	95 V / 0.995
	Converting to terms	of voltage at the relay: (3915 V)	* (120 V	/)/(4200 V) = 111.9 V
	(The Max. Pickup i	s the relay Max. Reset Voltage)		
7.6.	Allowable Value Determination			
	Per Section 2.6, the Allowable Va			
	The lower allowable value for the		as:	
	$AV_{DOL} \ge SPc - Z_{AV}+ $ [lower]			
		.16 kV bus (Section 7.5)		
	Z_{AV} + = 0.398% of rea	,		
	AV _{DOL} ≥ (3866 V) – (0.398%			
	Converting to voltage at the relay			
		/ (4200 V) = 110.029 V ≈ 110.0 V		
	Applying the applicable uncertain		out AV:	
	$AV_{DOU} \le SPc + Z_{AV}+ $ [lowe			
	$AV_{DOU} \le (3866 \text{ V}) + (0.398\%)$			
	Converting to voltage at the relay	, by multiplying by the voltage ra / (4200 V) = 110.886 V ≈ 110.9 \		

NES-G-14.02 Effective Date: 04/14/00

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7.7. Expanded To	olerance Determir	nation					
Per Section	2.7, the Expanded	l Tole	rance is	determi	ned as:		
ET = ± [().7 * (Z _{AV} + - ST	.) + S_	T]	where	ST is taken t	o a 2σ va	lue
;	Z_{AV} + = 0.398% of	readir	ng (Secti	ion 7.4)			
:	ST = 0.2 V [3σ] (S	Sectio	n 5.4)				
Taking th	ne ET at a reading	of 11	I2V at th	e relay:			
-	-			•		+ (0.2 V *	*2/3) = ± 0.352 V at relay
	.35 V at relay		0, (, ,	,,,	(,
	w checked to ens	ure th	at the ar	oplicable	e limits are m	naintaineo	t:
Check 1:			-	•			
	± 0.35 V			r	PASS		
Check 2:	SPc – ET	≥	AV ?	[lower	imit]		
	110.5 – 0.35 V	≥	110.0 \	/			
	110.15 V	≥	110.0 \	/	PASS		
Check 3:	SPc + ET	≤	AV ?	[upper	limit]		
	110.5 + 0.35 V	≤	110.9 \	/			
	110.85	≤	110.9 \	/	PASS		

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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	Field Calibration Setpoint	≥ 110.5 V
127-3(4)-B24-1	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.

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DIT DR-EPED-0671-00

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that contains assumptions or	This information is approved for use. I is preliminary or requires further verific IPRCVED FOR USE	
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MINOR PLANT CHANGE DESIGN PACKAGE

FOR

COMMONWEALTH EDISON COMPANY

DRESDEN STATION

UNIT 2

REPLACEMENT OF SECOND LEVEL UNDERVOLTAGE RELAYS

January 15, 1992

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W.R. No.: D-97548/D-97549 Rev.: 0 Date: January 15, 1992 Page 1 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: AE: P.O./Release 327125/NED 753 Project No. 8982-58 W.R./Function # D-97548, D-97549/59139-2084 (Other) Budget # N/A AIR # N/A Mod # N/A **PROJECT MANAGEMENT:** CECo. Phone Number B. M. Viehl Project Eng. (815) 942-2870 Cog. Eng. C. M. Collins (815) 942-2873 Tech. Staff Eng. <u>I. Rivera</u> (815) 942-2549 AE: Project Mgr. R. H. Jason (312) 269-6480 Proj. Mech. Eng. N/A N/A Senior Struct. T. J. Ryan (312) 269-7098 T. R. Eisenbart Senior Elect. (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 Non-Safety-Related Reliability Related Environmental Qualification Calculation No. 8982-13-19-6 Regulatory-Related 005 Revision Attachment:

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REVISION STATUS

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

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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	<u>Standard</u>
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.

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E) ANSI N45.2.2-1978 Packaging, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants.

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- F) *IEEE-308-1980 Criteria for Class 1E Power Systems for Nuclear Power Generating Stations.
 - *IEEE-323-1983 Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.

lE Equipment.

Quality Assurance.

- H) *IEEE-344-1975 Recommended Practices for Seismic Qualification of Class
- I) 10 CFR 21 Reporting of Defects and Noncompliance.
- J) 10 CFR 50, App. A General Design Criteria.
- K) 10 CFR 50, App. B
- L) 10 CFR 50.49

G)

- M) Specification K-4080 Rev. 5
- N) Specification 13524-068-N102, Rev. 3
- 0) DC-SE-002-DR, Rev. 2
- P) Specification 13524-068-N101, Rev. 1
- Q) Nuclear Station Work Procedures

Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants.

General Work Specification for Maintenance/Modification Work.

Equipment Qualification Specification (by Bechtel).

Dresden Seismic Design Criteria.

Bechtel Radiation Study

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- 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 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 bused 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 IE 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

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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	<u>Normal</u>	LOCA
Temperature	104°F	104°F
Pressure	14.7 psia	14.7 psia
Humidity	<90 %	100% (non-condensing)
Radiation	<1.0E04	*
Duration	40 years	l 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:

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Panel No.	<u>Distance From</u> Pipe 1404-12"	<u>Dose (rads)</u>
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.

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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.

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1.12 ELECTRICAL REQUIREMENTS

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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:

Туре:	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.

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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

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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

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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 IE 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.

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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

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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.

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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 <u>ALARA</u>

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.

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1.29.4 <u>Environmental Qualification</u>

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 <u>Fire Protection</u>

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 <u>Designer's Walkdown</u>

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.

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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 <u>COMPONENT CLASSIFICATION</u>

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 <u>Material Specifications</u>

No material specifications are required for this Minor Plant Change.

7.4 <u>Equipment_Requirements Schedules (ERS)</u>

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

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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 <u>Calculations</u>

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

10.2 <u>Technical Reports</u>

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

10.3 <u>Stress Reports/Overpressure Protection Report</u>

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

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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

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ATTACHMENTS 11.0

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ATTACHMENTS 11.1

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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

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SYSTEMS INTERACTION CHECKLIST

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	eral Evaluation	Yes	No	<u>N.A.</u>
Α.	Does this modification connect non-safety- related equipment (piping, electrical, etc.) to safety-related equipment? Documents reviewed during determination of answer to this question; <u>Station Drawings</u>	*	<u> </u>	*
в.	Does this modification result in the in- terconnection of safety-related systems that provide the same safety function? Documents reviewed during determination of answer to this question; Station Drawings	*	<u> X </u>	*
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	<u>*X</u>		*
D.	Does this modification add equipment that increases the floor loading? Documents reviewed during determination of answer to this question; <u>Structural</u> Calculation 8900-03-EE-S, ECN 12-00470E	*	<u> </u>	_
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	<u>*x</u>		*
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	*	<u></u>	*

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<u>sys</u> 1	EMS INTERACTION CHECKLIST	Yes	No	<u>N.A.</u>
Ι.	G. Does this modification effect other modifi- cations or temporary alteration? Documents reviewed during determination of answer to this question; <u>Verification with</u> <u>Mod. Coord. and Temp. Alt. Log</u>	*	<u> </u>	
	H. Does this modification result in (or cause) increased system or component operating volt- age 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; <u>ABB Instruction</u> <u>Manual, IB 7.4.1.7-7, Issue D</u>	*	<u>_X</u>	<u>*</u>
Π.	Mechanical Interaction Have the following been considered for their affect on nearby safety-related equipment? A. Missile Generation B. Pipe Whip C. High Energy Equipment D. Fire in the Equipment E. Primary Containment Penetrations F. Secondary Containment Penetrations G. Structural Loading or Alteration of Structure (core holes, anchor bolts, expansion anchors, steel beams, RVAC seals etc.) H. HELB Analysis (including EQ) I. MSLB/LOCA Analysis (including EQ) J. Any Attachments to Masonry Walls (conduit, supports, fire protection, etc.) K. Damage to Safety-Related Equipment Due to Seismic	X X X	★ ★ ★ ★ ★ ★ ★ ★ ★	
111.	Electrical Interactions Have the following been considered for their affect on nearby safety-related equipment? A. Cable Qualifications B. Cable Separation C. Additional Diesel Loading D. Additional Battery Loading E. Load Shed Coordination F. Fault Trip Coordination G. Electromagnetic Capability (EMC) H. Additional Loading to a Safety-Related AC Distribution Circuit I. Damage to Safety-Related Equipment due to Seismic	X X X X X X X	* * * * * *	

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SYSTEMS INTERACTION CHECKLIST

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			Yes	No	<u>N.A.</u>
IV.	Fire	Protection			
10.	A.	Will this modification impact the safe			
		shutdown analysis?	*	Х	
	в.	Will this modification add significantly		**********	
		to the fire loading determined in the			
		fire hazards analysis?	*	<u> X </u>	
	c.	Will this modification add a fire hazard			
		not considered in the fire hazard analysis?	*	<u> X </u>	
	D.	Is additional fire detection and protection			
		required?	*	<u> </u>	
	Ε.	Are new fire stops or fire seals required?	*	<u> </u>	
	F.	Is the need to repair existing fire stops		•	v
		documented?		*	<u> X </u>
	G.	Has the cable tray fill density in an	*		X
		electrical fire stop been exceeded?			<u>~</u>
v.	Secu	rity			
۷.	A.	Will this modification alter barriers to allow			
		unauthorized access to protected or vital areas	? *		X
	Β.	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?	*		<u> </u>
	C.	Will, this modification create holes in			
		protected or vital area barriers to			v
	-	facilitate construction? Will this modification leave vital area	*		<u> X </u>
	D.	door alarms in access mode after work			
		completion?	*		Х
•	Ε.	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			v
		sensitive facilities, such as storage vaults?	*		<u> </u>
	_				
VI.	•	ct on Plant Simulator			
	Α.	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?	*		Х
	Β.	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
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SYSTEMS INTERACTION CHECKLIST

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

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.

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

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RADIOLOGICAL SCREENING

Complete Parts 1 And 2

1.	PART	1: INSTALLATION	Ye		NO	
	1.1	Is any work performed inside radiologically controlled areas? Comment	()	(]	[]	
		[If "Yes" continue. If "No" go to Item 1.6.]				
	1.2	Is there a possibility of coming into contact with contaminated liquids? Comment	ſ]	[X]	
		[If "Yes" go to Item 1.5. If "No" continue.]				
		Is there a possibility of coming into contact with airborne contamination?	[]	[x]	
		[If "Yes" go to Item 1.5. If "No" Continue.]				
	•	Is the estimated installation dose from this modification greater than 1.0 man-rem (calculation below)? Comment	ſ]	[X]	
		Documents reviewed during determination of answer to this question; <u>Conversation with station ALARA Coordinator and</u> S&L EPED				
		[If "Yes" go to Item 1.5. If "No" go to Item 1.6.]				

INSTALLATION DOSE CALCULATION

Area Description Panels 2252-83* 2252-84 Unit 2 Reactor Building El 545'-6"	Dose Rate Rem .004	Men-brs 200	Dose Man-Rem
Total Estimated Dose			0.8
nel 2252-83 will be moved to .5 If questions 1.2, 1.3, or	1.4 are answered "y		

*Pan

1. significant modification. A level 2 ALARA INSTALLATION review must be completed and attached.

Prepared By:___

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

Prepared By:_____

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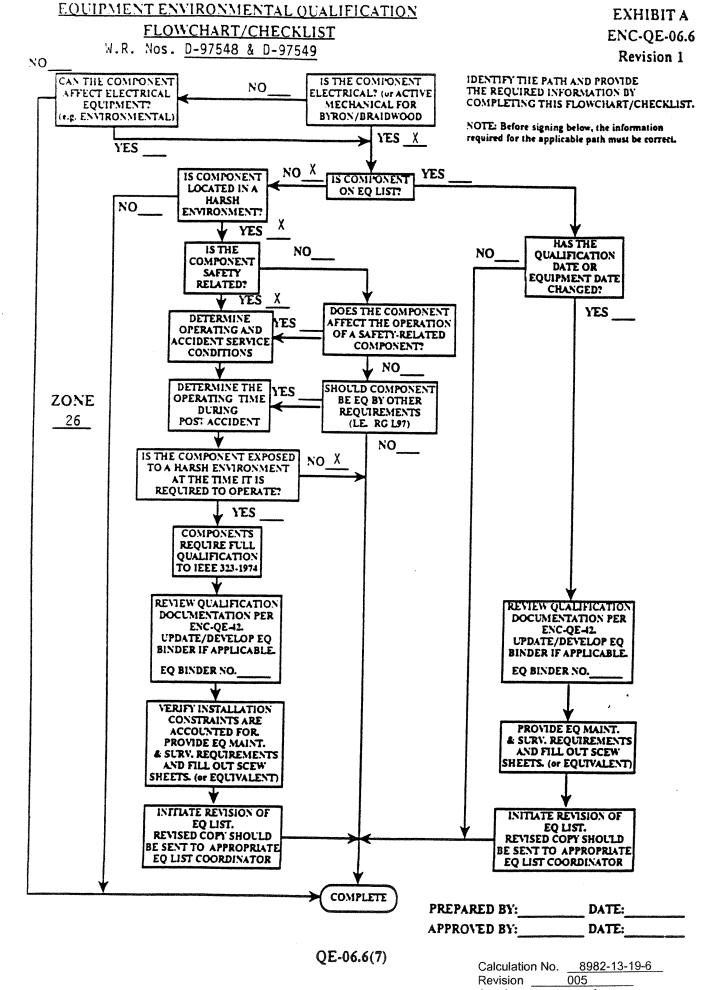
ALARA	REVIEW	CHECKLI	ST		
LEVEL	1 REVIE	WR WR	No.	D-97548	
Modifi	cation	No.: WR	NO.	D-97549	

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		RADIC	DLOGICAL SCREEN	ING		
2.	PART	2: DESIGN			Yes	NO
	2.1	Does this modification alto contain radioactivity (e.g. waste; EVAC in contaminated systems, etc.)? Comment	., liquid, gase	ous, or solid rad-	[]	[X]
		[If "Yes" go to Item 2.5.	If "No" cont	inue.]		
	2.2	Does this modification alte be in a flow path leading t Comment			[]	[X]
		[If "Yes" go to Item 2.5.	If "No" cont	laue.]		
	2.3	Does this modification alte	r or add radia	tion shields?	[]	[x]
		[If "Yes" go to Item 2.5.	If "No" conti	inue.]		
	2.4	Is the estimated additional modification greater than 1 Comment No anticipated mai	.0 man-rem (cal		[]	[X]
		[If "Yes" go to Item 2.5.		1tem 2.6.]		
		ADDITIONAL OPER	ATING DOSE CALC	ULATION		
	U	Area Description nit-2 Reactor Bldg.	Dose Rate	Man-brs/yr	Dose	
		1 545'-6"	.001	0	0_	
					•	
		Total Estimated Dose				0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
	2.5	If questions 2.1, 2.2, 2.3, radiologically significant a must be completed and attac	modification.	wered "yes," this is A level 2 ALABA DESI	i a GN rev ie	
		Prepared By:		Date		
	2.6	This modification does NOT	require a level	2 ALARA INSTALLATIO	N review	5
		Prepared By:		Date	and then	
		×	QE-06.5(6)			
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FIRE PROTECTION REVIEW CHECKLIST

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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.

			<u>YES</u> *	<u>NO</u> *	<u>N/A</u>
Ι.	POS	T FIRE SAFE SHUTDOWN ANALYSIS			
	Α.	Will the modification alter the function or location of a safe shutdown system or component as described in the safe shut- down report? See the attached sheet.	<u> </u>	9	
	Β.	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.	<u> </u>		
		 Will operation of a hot or cold post fire shutdown system be affected by a circuit fault in any way? 		<u> </u>	
		 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?		<u>X</u>	
		4. Does the circuit create a safe shut- down "common enclosure" problem?	enelaganiniganange ugad	<u>×</u> –	
	С.	If any question I.B.l through I.B.4 is answered "Yes" continue. Otherwise go to Question I.D.			
		 Are the physical separation and electrical isolation commitments in the post fire safe shutdown report violated? 	uday, ganaly, yana unin		andhesanahan -

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FIRE	PROTECTION REVIEW CHECKLIST	
		<u>YES* NO* N/A</u>
I. C.	 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
Ε.	Will this modification block access to or egress from plant areas for post fire safe shutdown equipment operation or fire fighting?	<u>X</u>
II. FI	RE HAZARDS ANALYSIS	
Α.	Will the modification significantly alter the fire loading considered in the fire hazards analysis?	X
Β.	Will this modification create any new fire hazards not considered in the fire hazards analysis?	X
С.	Will this modification violate the separation requirements of the station?	X
III. <u>F</u>	IRE PROTECTION MEASURES	
Α.	Are the fire detection or suppression systems, rated fire barriers, or curbs being modified or proposed? If "No", go to Question III.B.	· · · · · · · · · · · · · · · · · · ·
	 Have any deviations to applicable NFPA code commitments been identified? 	
	 If a new water suppression system is installed, is drainage inadequate? 	

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MOD.	HO.	<u>W.R. Nos D-97548</u> , D-97549	Exhibit A ENC-QE-06.7 Revision 2 Page 3 of 7
FIRE	PROT	FECTION REVIEW CHECKLIST	
			<u>YES* NO* N/A</u>
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.)	
Β.	mea	performance of existing fire protection sures may be degraded by any of the lowing:	
	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).	<u> </u>
		See the attached sheet.	

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FIRE PROT	ECTION REVIEW CHECKLIST	
		<u>YES</u> * <u>NO</u> * <u>N/A</u>
III.B. 2.	Will the modification block access to or reduce coverage of any of the following manual fire protection equipment.	
	a. hose stations b. fire extinguishers	<u>X</u>
	 c. fire protection control panels d. fire system valves e. manual pull stations. 	X
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 install- ation, removal, or modification of a penetration or penetration seal?	X
	<pre>i. fire doors ii. pipe and HVAC ducts penetration seals</pre>	<u> </u>
	<pre>iii. fire dampers iv. electrical penetration seals of trays, conduits, risers v. access openings</pre>	X
4.	a. Will the modification route cables through cable tray fire break (Dresden only)?	<u>X</u>
	b. Do modification design drawings reflect the passage of cables through (not around) cable tray fire breaks (Dresden only)?	<u> </u>
5.	New cables do not pass through fire breaks a. Will the modification require the disturbance of a cable tray wrap?	X

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FIRE PROTECTION REVIEW CHECKLIST

			<u> </u>	<u>NQ</u> *	N/A
III.B.	5.	b. Does the modification involve routing items above fire-wrapped conduits or cable trays or their supports.		<u> X </u>	
(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?		<u>X</u>	
7	7.	a. Has smoke removal capability been affected?		X	
		b. Will the modification affect the hold time or concentration of a gaseous suppression system?		<u> </u>	

IV. CONTROL OF COMBUSTIBLES

- A. Identify Fire Zone(s) associated with this change. <u>1.1.2.3</u>
- B. Identify fire protection documentation which might be affected by this change:

FIRE ZONE	SER	DEVIATION/	SAFE SHUTDOWN	FHA
		EXEMPTION	ANALYSIS	
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?

<u>X</u>

If YES, identify per the following table:

If NO, proceed to D.

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FIRE PROTECTION REVIEW CHECKLIST

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

* This is negligible compared to existing heat load of 2.1 x 10⁸ BTU. FHA need not be revised.

YES* NO* N/A

Χ___

 Is fixed combustible heat load higher than that identified in the Appendix R SERs and/or Exemption Requests?

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)?

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
					·····

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FIRE	PROTECTION REVIEW CHECKLIST	
V. <u>D</u> (CUMENTATION MAINTENANCE	<u>YES</u> * <u>NO</u> * <u>N/A</u>
Α.	Does this modification change a fire prot commitment to the NRC or change a justifi in an approved Appendix R exemption or de	cation
Β.	Is a revision to the Fire Protection Report Safe Shutdown Report or a supporting document necessary (e.g., hydraulic analysis)?	
Ċ.	Is a revision to NFPA code deviation repornecessary?	rt <u>X</u>
D.	Will this modification require a revision the fire protection drawings? (Dresden and Quad Cities only.)	toX
E.	Will this modification change plant condit as currently described in the Fire Hazards Analysis?	
. F.	Will this modification impact any other pa of the fire protection documentation not addressed in Questions A through E above?	rt X
G.	Will the modification impact the Station's Pre-Fire Plans?	X
Н.	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?	nX
If	of the questions which are answered "yes" s a change to the design is made so that a que ", then this change should also be explained	estion can be answered
PRE	PARED BY: I	DATE:
APPI	ROVED BY: D	ATE:
	QE-06.7(12 - LAST)	
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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.

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ATTACHMENT 11.2

Walkdown Checklists

Designer's Walkdown Installer's Walkdown

Exhibit	С,	ENC-QE-62
Exhibit	D,	ENC-QE-62

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DESIGNER'S WALKDOWN-PARTICIPANTS

	DRUSDEN	2	6705		D975	49
	Station	Uni	t System	1	lification	
Mod	lification De	scription:	Replacement	of Second	l Level L	Indervoltage
	ticipants		Rélays	Date:	1/3/92	and the second
	Name (Please	Print)	Firm/De	Dartment		hone
_(LARIS Carcas	2	Apt	, Ne	2 2	8-28
7	CH RIVER	F	_Ceto	17	t. 25	49
A	AL JUDA	Rol	Sal	• • •	29	
7	SEF Swor	*	Colo I	PRESOUNI H	<u>M_28</u>	98
	STRY JURB	<u>**</u>	CECo	DEUSDUNI EI	4. 24	45
K	VET LA Voic	<u> </u>	CECO D	<u> </u>	A. az	49
				· · · · ·		
* 5	EE LAST	PALE -T	LESOLUTION ?	25202D 4		Management of the one
		WA	Ikdown Instruct	Lions		
1.	The designer	(Station	or NED) is res participants,	ponsible fo	r arrangin	g this
•	activity wit	h NED.	•		1 .	
2.	The assigned all necessar	I Station r y access c	epresentative learances and	is responsi notifying S	ble for ar tation wal	ranging kdown
3.	participants	1	sible for prep	1		
	Walkdown Che	cklist (to	be completed	fully N/A	A in advand	te as
4.	Each observe	tion shoul	ecording walkd d be clearly i	dentified.	including	
	location, su	ich as buil	ding, room num	ber, elevat:	lon, plant	
5.	coordinates,		or sketches s	hould be ut	119 ad when	•
	appropriate.	_				
5.	Individual o	bservation	s should not be	e lumped int	o single e	intries.
7.	observations		sible for the a	resolution (
8.	Copies of pr	evious wall	kdown checklist	t with atta	ichments sh	all be
9.			t walkdown refe n checklist sha		ded to the	
7.	applicable P	roject Plan	3° Phacyfiel 209	TT DE INCLU	ned in cua	£

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DESIGNER'S WALKDOWN CH D & ZJYS Modification Number: <u>D & ZJYS</u>	ECKLIST	
Walkdown Questions	Yee No N/A	Is resolution required? (Yes or No)
 Are there special work area access problems? (Bulky or heavy equipment, limited access of work spaces, etc.) 	<u> </u>	Νο
2. Do work areas require special considerations for construction, operation, or maintenance? (Respirators, temporary work enclosures, radiation access, Jecurity, job specific radiation work permits or clearances.)		No
3. Is there need to temporarily remove grating, handrails, structural steel, conduit, tubing, piping, supports, equipment, or instruments to facilitate final installation?	<u> × </u>	No
4. Is there need to permanently remove grating, handrails, structural steel, conduit, tubing, piping, supports, equipment, or instruments to facilitate final installation?	×	NOOD TO ZOMOUN EXISTNA GNCLOSURE 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?	<u>×</u>	No
QE-62(16)	Calculation No. Revision Attachment: PageA43	<u>8982-13-19-6</u> 005 A of <u>A72</u>

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Mod	DESIGNER'S WALKDOWN (097548 iification Number: 092549	HECKLIST	
	Walkdown Questions	Ine No N/	Is resolution A required? (Yes or No)
7.	Will temporary shielding be required	<u> </u>	No
8.	Will permanent shielding be required?	<u> </u>	No
9.	Will the design increase radiation/ contamination levels?	<u>×</u>	No
10.	Will the design increase radiation/ contamination spread?	X	No
11.	Is instrumentation or operating equip located to minimize installation and operating personnel radiation exposur	. /	No
12.	Are alternate designs feasible to red potential radiation exposure?	uceX	No POTENTA RADIATION EXPOSUES
13.	Does the routing (conduit, tray, pipi tubing) provide the clearest route relative to installing supports, restraints, etc?	ng, _X	No
14.	Does the design provide for efficient maintenance of existing equipment/ system?	<u>×</u>	SEE RELOLUTION RECORD
15.	Does the design provide for efficient maintenance of new equipment/system?	<u>×</u>	See "Iceloly They Record "
16.	Does the design provide for efficient operation of existing equipment/system	n <u>× </u>	SEF "TEBLOLUTER
0235	QE-62(17) g-17	Calculation No. Revision Attachment: PageA44	<u>8982-13-19-6</u> 005 A of <u>A72</u>

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DESIGNER'S WALKDOWN CHECKLIST 097548 097549 Modification Number: Is resolution Yes No Walkdown Questions N/A required? (Yes or No) 5 67 17. Does the design provide for efficient "RESOLUTION X operation of new equipment or systems? RECORDY 18. Does the design provide for efficient No _X_ testing of new equipment or systems? 19. Does the design provide for efficient testing of existing equipment or systems? N. X No ISI 20. Does the design provide for efficient EQUIPMENT ISI of new equipment or systems? Å ASSOLIATED WITH X NoIS 21. Does the design provide for efficient EQUIPHINT ISI of existing equipment or systems? DELLATED WITH 22. Are flammable materials being added V. ν_{\circ} to the area? 23. Does the equipment being installed or altered increase fire hazards in the $\mathcal{P}_{\mathbf{a}}$ X ALGA? 24. If the equipment is safety-related, do fire hazards exist in the area which may \mathcal{U}_{\bullet} impair its operability? 25. Are fire barriers being breached by the N. X design? 26. Are security barriers being breached \mathcal{N}_{\bullet} by the design? Calculation No. 8982-13-19-6 QZ-62(18) Revision 005 Attachment: : A A72

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DESIGNER'S WALKDOWN C 097548 Modification Number: <u>097549</u>	HECKLIST	
Walkdown Questions	Ice 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?	<u> </u>	No
28. If new equipment is a high energy system, is it located near safety-rel equipment whose operability could be impaired due to failure of the new equipment?	atedX	NEW 502 UIPMON 15 NOT MLGH ENGRLY SYSTEM
29. If the new equipment is safety-relate are there existing non-seismic items located such that their failure could impair the new equipment's safety function?		No
0. If the new equipment is non-seismic, its failure impair adjacent safety-re- equipment functions?		HOU TOUPMENT AND DESILN IS SETEMIC
1. Have adequate measures been taken to maintain required separation between redundant equipment?	<u> </u>	No
2. Can existing structures accommodate ne equipment; e.g., are the existing stee beams to be used for supporting the equipment still available?		No
3. Has all adjacent equipment been identi that may affect new equipment; e.g., access requirements?	fied	SEE "RESOLUTION ZETORD"
QE-62(19) 235g-19	Calculation No Revision Attachment: PageA46	<u>8982-13-19-6</u> 005 A of <u>A72</u>

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DESIGNER'S WALKDOWN CH	ECKLIST	
097548 Modification Number: 097549	ungennen Artikannaense	
Walkdown Questions	Ies No N/A	<pre># resolution required? (Yes or No)</pre>
34. What are Installer's requirements, e.g types of installation drawings, specia installation equipment, partial modifi- cation requirements and modification installation sequence?	ני i הו ס V	POR ECNS - 004705 AND - 004715-100 THER SPECIAL - SEQUIRENTS.
35. Is interface information available, e., tie-ins?	×	No
36. Are spares available, e.g. penetrations?	<u> </u>	No
37. Is electrical and I&C information avail able e.g. spare/correct size MCC compartment?	- <u>X</u>	No
38. What are Station practices - electrical I&C, piping and structural?	" <u>×</u>	ELECTRICAL AND GTRUCTUALL
39. What are warehouse inventory stock items?	<u>×</u>	RELAYS, ANCHOR BONS, UNISTRUT
0. Does design provide appropriate tolerances?	×	No
1. Have partial modification packages been scoped properly?		THIS 13 A MILLOR DESIGN MANGE.
42. For electrical modifications, do the drawings reflect actual field installed conditions for all terminal points which will be utilized for the modification?	×	No
Note: Develop additional or revised question modification scope prior to conduction	ons depending on is the walkdown.	the
Q Z-62 (20)	Calculation No Revision Attachment: PageA47	8982-13-19-6 005 A of A72

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DESIGNER'S WALKDOWN RESOLUTION RECORD

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097549

Modification Number:

Question No.	Observation (Attach Sketch if Required)	Question No.	Resolution (Attach Sketch if Required)
		1	

* AT THE TIME OF THE DESIGNERS WALLDOWN THE INSTALLER WAS NOT KNOWN. No SMADN MAINTENANCE GROUP WAS AVAILABLE TO WALK DOWN THE DESIGN. I HAD REQUESTED JEFF SWORD AND JERRY JURGER TO INDEPENDENTLY WALK DOWN THE CONCEPTUAL DESIGN TOSES IF THE NEW LOCATION OF THE ENCLOSE MOULD , MART THE MAINTON ANES OF OTHOR GRUIPMONT OR THE ENCLOSURE ITSELF. THIS WAS ALSO REQUESTED OF KURT LAVOIS FROM AN OPGRATIONS STAND POINT. ALL THREE INDIVIDUALS WERE GIVEN SKETCHES OF THE NEW DOBIGN. BOTH JURSER AND LAGONS WORD FAMILIAR WITH THE REPLACEMENTS ON DWIT 3 SO THE DETHILLED WIRING WAS NOT AS IM PORTHUT TO ISBUIGED BORAUSE IT IS COUTICAL TO THAT OF UNIT 35 REPLACEMENTS.

ON 1/3/92 JEFF SWORD CONTACTOR ME TO SAY HE MAD NO PROBLEM WINH THE NEW LOCATION OF THE ENALGURO FROM MAINTENNANCE OF EQUIPMENT STAND ADINT. ON 1/3/92 I CONTACTED LAVOIE - HE SAID THE NEW ENCLOSEDED LOCATION SHOULD BE NO PROBLEM FROM AN OPERATIONS STAND POINT. OF 62/21) Calculation No. 8982-13-19-6

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ATTACHMENT 11.3

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ENC-QE-12.1 Forms

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

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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>

00

*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.

<u>127-3-B23-1, 127-4-B23-1, 127-3-B24-1, and 127-4-B24-1</u>

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).

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

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.

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QE-12.1(12)

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CLASSIFICATION OF COMPONENT

6.	Must	the	component	maintain	the	pressure	boundary	of	a
	safet	:y-re	elated syst	cem.					

No.		 	 	

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

N/A_____

00

*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 undervoltage 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.)

<u>Seismic Test Report, Certified Test Report for Dielectric and Surge</u> 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.

QE-12.1(13)

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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

0

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: _____

QE-12.1(14)

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

COMMONWEALTH EDISON COMPANY

STATION: Dresden

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UNIT: _____2

DATE: 01-15-92

EID Number	P	DESCRIPTION	DESCRIPTION	DESCRIPTION	DESCRIPTION	DESCRIPTION	DESCRIPTION	SAF CLS	EQ	CODE DATA		S C	REFERENCE DRAWING	MFR COD	MODEL NUMBER	SOURCE
					SEC	YEAR	сс									
127-3-B23-1		Second Level	SR						12E-2334	A738	ABB ITE-27N					
		Undervoltage Relay					 	ļ		<u> </u>	(CAT. NO. 411T4375-L-HF-DP)					
			_				 									
127-4-823-1		Second Level	SR	┨────			<u> </u>		12E-2334	A738	ABB ITE-27N					
nan galafaan ka ku		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)					
127-4-824-1		Second Level	SR						12E-2334	A738	ABB 1TE-27N					
		Undervoltage Relay									(CAT. NO. 411T4375-L-HF-DP)					
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			- 	 	 											
									<u> </u>							
Prepared by: 9	 ·.ω.	Hen	Ch	ecked	by:	Nhon	hal	.L	Approved by:			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

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	SAFETY RELATED		LOAD	ALA FU	JRM	PA		4
UTIL	ITY: <u>CECo</u>	STATION:	DRE	SDEN	UNIT	2. PROJ. N	10.: <i>8982</i>	-58
ITEM	DESCRIPTIC	N			DATA		NOTE	S
∴ , ⊳	LOAD NAME	1	27-3	- 82	3-1			
8.	LOAD STATUS (E.N. OR	<u>м</u>) м						
С	INRUSH CURRENT - AM	PS 🛛						
D	INRUSH DURATION - SE	ECONOS						
: Е	CONTINUOUS LOAD CURR	ENTS - AMPS	.05 A	mps	·			
~ F.% X	TINE LOAD STARTS - M	M. 33	0.0	0				
G	LOAD DURATION - ML		40.0	a				
н	SOURCE BUS OR PANEL	R	B DI	STA	NLZ			
1	SYSTEM CODE							
	MODIFICATION NUMBER							
N	CABLE NUMBER						•	
	CAT. No. 41 From ABB	•		IB	7:4.1.7.7	T (Issu	JE D)	
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UTILI	ITY: CECo	STATIO	N: DRE	SDENİ	UNIT: 2	PROJ.NC	.: <u>8782</u>	5
ITEM	DESCRIPT	ION			DATA		NOTE	S
	LOAD NAME		127-4	- 82	3-1			
8	LOAD STATUS (E.N. C	DR M)	M	•	······			
C	INRUSH CURRENT -	AMPS						
0	INRUSH DURATION -	SECONDS						
E	CONTINUOUS LOAD CU	RRENTS - AMPS	.05 A	MPS.				
F	TIME LOAD STARTS	- ML 38		d.				
G	LOAD DURATION - M	1.58	240.0					
н	SOURCE BUS OR PANE				NL 2			
1	SYSTEM CODE							
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	SAFETY RELATED	DC LOAD	DATA F	ORM	P	AGE 3 OF 4
UTIL	ITY: CECo ST	TION: DR	ESDEA	J UNIT:	3 PROJ.	NO.: 8982-58
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. A	LOAD NAME	127-	3-Ba	4-11		Ť
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D	INRUSH DURATION - SECONDS					
≈ E ⊗	CONTINUOUS LOAD CURRENTS - A	PS . 05	AMPS			
F	TINE LOAD STARTS - ML 33	0.	00			1
G	LOAD DURATION - ML 35	240.				
н	SOURCE BUS OR PANEL			US 28-		
1	SYSTEM CODE		**************************************			
M	MODIFICATION NUMBER					
N	CABLE NUMBER					
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ITEM	DESCRIPT	ION			DATA		NOT	ES
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8	LOAD STATUS (E.N. (N (M RC						
C	INRUSH CURRENT -	AMPS						_
D	INRUSH OURATION -	SECONOS						
∴ E ™	CONTINUOUS LOAD CU	RRENTS - AMPS	.05 A	MPS				
F	TINE LOAD STARTS		0.0					
G	LOAD DURATION - M	4 ss 2	40.0	d				
Н	SOURCE BUS OR PANE				US 2B-11			
I	SYSTEM CODE							
M	MODIFICATION NUMBE	R					-	
N	CABLE NUMBER							
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	CAT. No. 2 From ABB	HIIT4375 Instructor ol Input	-HF tions			s. (M	AX.)	
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	CAT. No. 2 From ABB Contr DATA FORM P	HIIT 4375 Instruction	- HF Tions - Cur	rent	= .05 Amp DATA ENTRY I	s, (M	AX.) .MS)	
	CAT. No. 2 From ABB Contr DATA FORM P PREPARER	HIIT 4375 Instructor of Input	- HF Tions - Cur	rent	= .05 Amp DATA ENTRY I	s, (M	AX.) .MS)	
	CAT. No. 2 From ABB Contr DATA FORM P PREPARER	HIIT 4375 Instructor of Input	- HF Tions - Cur	rent	= .05 Amp DATA ENTRY I	s, (M	AX.) .MS)	
	CAT. No. 2 From ABB Contr DATA FORM P PREPARER	HIIT 4375 Instructor of Input	- HF Tions - Cur	rent	= .05 Amp DATA ENTRY I	s, (M	AX.) .MS)	
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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 10F4 Status (E,N, or M) M (Existing, New, or Modified) Inrush current - amps 32.749 Inrush duration - sec 5 2.749 Cont load current - amps00 Time load starts - MM.ss Load duration - MM.ss10 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

ROUTING:

COMMENTS :

PREPARED BY: **REVIEWED BY:** APPROVED BY:

Modification Cable number

Celc. No. 7056 -00 Rev. 72 Page Proj/No.

Calcula	ation No.	898	<u>32-13-19-6</u>
Revision		005	
Attach	ment:	A	۱
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UTILITY : CECO PROJECT NO. 5982-53 STATION : DRESDEN(FILE: D3D5YLS.M13 2nd level UV) UNIT NO. 3 DC LOAD TICKET ****************** BAITERY NAME : UNIT 3 125VDC BATTERY NOMINAL VOLTS = 125.0 *** Record number = 56 *** Load name 4KV BUS 24-1 MN 10F4 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.ss00 Load duration - MM.ss10 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:

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Ľ	Cato No. 7056-00-19-5
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PREPARED BY: **REVIEWED BY:** PPROVED BY:

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Proposal for 4160 Volt Switchgear For 4000 Volt Auxiliaries, Cont. Dresden Units 2 and 3

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			these columns
SWITCHGEAR DATA, Cont.	1200 A	2000	A 3000 A
H. Percentage of water absorbed in bus ports per ASTM Test D570 (plastic) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	ot	.ams	
I. Minimum clearance between buses:			
a. Phase-to-phase(Inches)	4.5	i
b. Phase-to-ground(i	Inches)	3.0	
J. Bus spacing center-to-center(i	nches)	5.0	,
K. Tap spacing center-to-center(i	.nches)	6.0	
L. Type and description of bus joints.	Bolt	ed, Silv	er plated
M. Size and material of main bus	Alum	irum	
N. Size and material of ground bus	2 x	3 8 Copp	er
	Manufactu	rer	Туре
0. Watthour meter			
P. Circuit breaker control switch	• • • • • •		SBM
Q. Overcurrent relay	Al	1	IAC
R. Overcurrent ground relay	Genera	al	IAC
S. Undervoltage relay	Elect	ric	IAV
T. Elapsed time meter			к т
U. Potential transformer	••••••		
Accuracy	•••••		
V. Current transformer			JCS-0
Accuracy	····· ASA.6 B		-0.2, B-0.5,
W. Cubicle Space Heaters:		2.4 1	.3-2
Watts per cubicle			
Voltage rating			
. BUS DUCT ASSEMBLIES (Furnish informatic both indoor and outdoor designs, where different):	on for		_
A. High potential withstand test at fac on assembled structure:	tory	ļ	
60-cycle (1 minute)	· · · Calculation		-19-6
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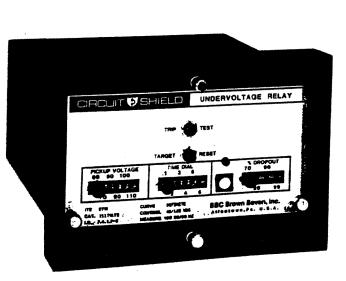
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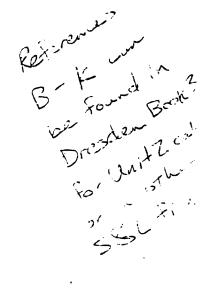
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INSTRUCTIONS

Single Phase Voltage Relays

Type 27N	HIGH ACCURACY UNDERVOLTAGE RELAY	
Type 59N	HIGH ACCURACY OVERVOLTAGE RELAY	
Type 27N	Catalog Series 211T Standard Case	9
Type 27N	Catalog Series 411T Test Case	9
Type 59N	Catalog Series 211U Standard Case	e
Type 59N	Catalog Series 411U Test Case	e







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PrecautionsPage	2
Placing Relay into ServicePage	2
Application DataPage	4
TestingPage	10

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.

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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 70x, 80x, 90x, and 99x of pickup, or, 30x, 40x, 50x, and 60x 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 : lay 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.

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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

			Time	Delay	Catalog	Numbers
Туре	Pickup Range	Dropout Range	Pickup	Dropout	Std Case	Test Case
27N	60 - 110 v	70 % - 99%	Inst	Inst	211T01x5	411T01x5
			Inst	1 - 10 sec/	211T41x5	411T41x5
			Inst	0.1 - 1 sec	211T61x5	411T61×5
	70 - 120 v	70% - 99%	Inst	Inst	211T03x5	411T03x5
			Inst	1 - 10 sec	211T43x5	
			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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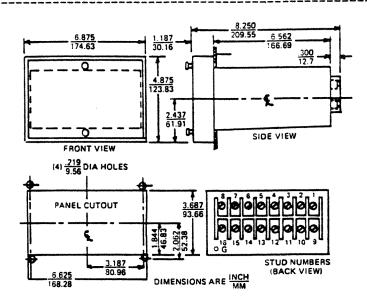
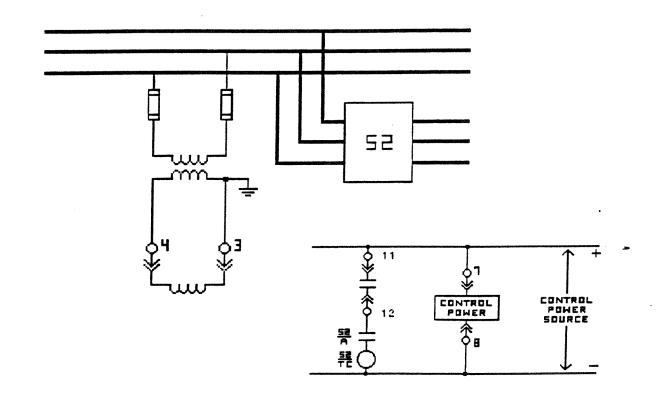
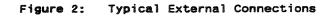


Figure 1: Relay Outline and Panel Drilling



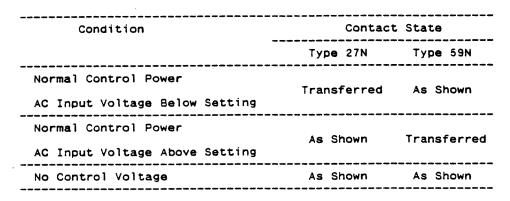


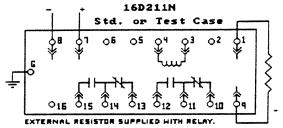
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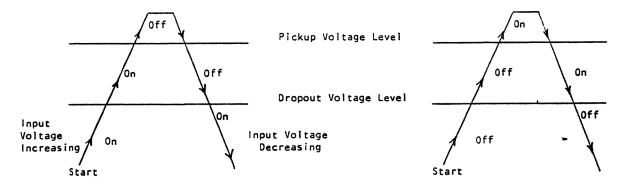
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Figure 3: INTERNAL CONNECTION DIAGRAM AND OUTPUT CONTACT LOGIC

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.







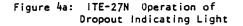


Figure 4b: ITE-59N Operation of Pickup Indicating Light

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

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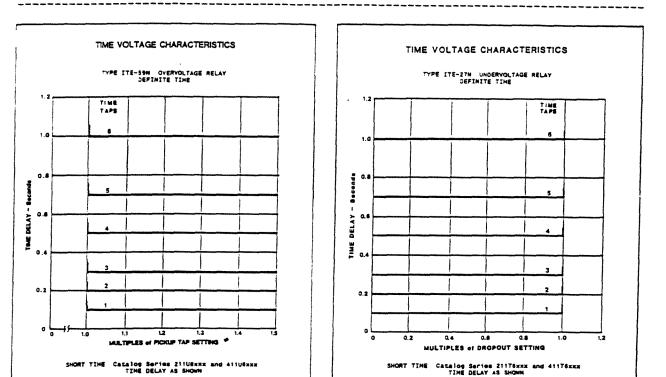
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- NOT TO EXCEED INPUT RATING

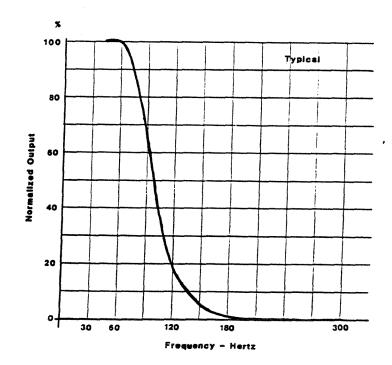


Figure 5: Normalized Frequency Response - Optional Harmonic Filter Module

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MEDIUM TIME Catalog Series 21174xxx and 41174xxx MULTIPLY TIME DELAY SHOWN BY 10

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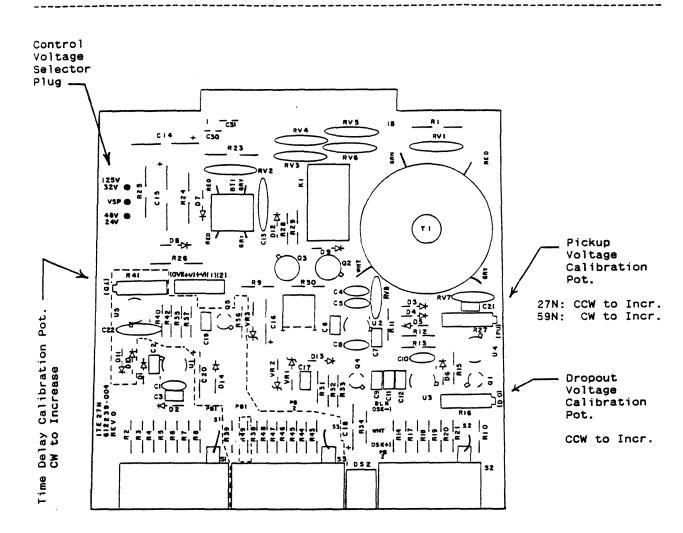


Figure 6: Typical Circuit Board Layouts, types 27N and 59N

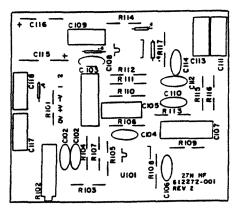


Figure 7: Typical Circuit Board Layout - Harmonic Filter Module

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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.

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4. ACCEPTANCE TESTS

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Follow the test procedures under paragraph 5. ... det inter-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. 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.

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)

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ABB Power Transmission Inc.Protective Relay Division35 N. Snowdrift Rd.Allentown, Pa. 18106215-395-7333Supersedes Issue C

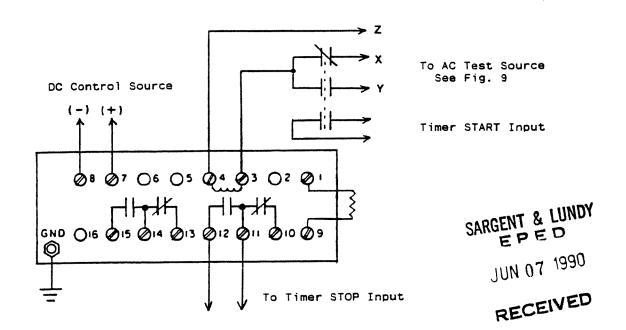


Figure 8: Typical Test Connections

T1, T2Variable Autotransformers(1.5 amp rating)T3Filament Transformer(1 amp secondary)VAccurate AC Voltmeter

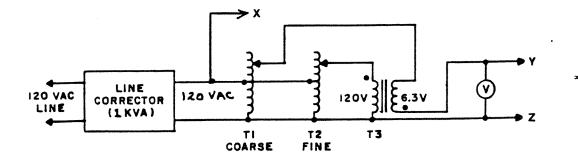


Figure 9: AC Test Source Arrangement

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.

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ATTACHMENT B

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

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Users Manual

PN 855981 January 1989, Rev. 4, 7/97 © 1999 Fluke Corporation, All rights reserved. Printed in USA All product names are trademarks of their respective companies.

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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 k Ω 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

RS-232 and IEEE-488 Reading Transfer Rates

	Reading Per Second				
Rate	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.

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DC	Vo	ltage	
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Range		Resolution		Accuracy	
	Slow	Medium	Fast	(6 Months)	(1 Year)
300 mV	_	10 <i>µ</i> V	100 <i>µ</i> V	002 % + 2	0.025 % + 2
3 V		100 <i>µ</i> V	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 <i>μ</i> V			0.02 % + 6	0.025 % + 6
1000 mV	10 <i>µ</i> V		_	0.02 % + 6	0.025 % + 6
10 V	100 <i>µ</i> V			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 M Ω in parallel with <100 pF

Note

In the dual display mode, when the volts ac and volts dc functions are selected, the 10 M Ω dc input divider is in parallel with the 1 M Ω 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 Volta	ge While Measuring D	C Voltage or (AC + DC)
Voltages		

Range		Max Allowable Peak AC	Peak Normal Mode Signal	
		Voltage	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

Common Mode Rejection Ratio

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

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Maximum Input

1000V dc or peak ac on any range

True RMS AC Voltage, AC-Coupled

Range	Resolution			
Kange	Slow	Medium	Fast	
300 mV		10 <i>µ</i> V	100 μV	
3 V		100 <i>µ</i> V	1 mV	
30 V		1 mV	10 mV	
300 V		10 mV	100 mV	
750 V		100 mV	1 V	
100 mV	1 <i>µ</i> V	_		
1000 mV	10 <i>µ</i> V			
10 V	100 <i>µ</i> V		_	
100 V	1 mV			
750 V	10 mV			

Accuracy

	Linear Accuracy dB Accuracy					Max		
Frequency	Slow	Medium	Fast	Slow/Med	Fast	Power*	Input at Upper Freq	
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			

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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 M Ω in parallel with <100 pF

Maximum Crest Factor

3.0

Common Mode Rejection Ratio

>60 dB at 50 Hz or 60 Hz (1 k Ω 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.

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DC Current

D		Resolution	Resolution		Burden
Range	Slow	Medium	Fast	Accuracy	Voltage
30 mA		1 µA	10 <i>µ</i> A	0.05 % + 3	0.45 V
100 mA		10 <i>µ</i> A	100 <i>µ</i> A	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

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

		Resolution				
Range	Slow	Medium	Fast	Voltage*		
10 mA	100 nA			0.14 V		
30 mA		1 µA	10 <i>µ</i> A	0.45 V		
100 mA	1 <i>µ</i> A	10 <i>µ</i> A	100 <i>µ</i> A	1.4 V		
10 A	100 µA	1 mA	10 mA	0.25 V		

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Danas	Engrandia	Accuracy				
Range	Frequency	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 1	5,000 and 99,999 co	unts (full range)			
Medium Reading Rate: Between 1,500 and 30,000 counts (full range)						
Fast Reading Rate:	Between 1	50 and 3,000 counts	(full range)			

Accuracy

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 $.003\Omega$.

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Ohms

	Resolution				Typical Full	Max Current
Range	Slow	Medium	Fast	Accuracy	Scale Voltage	Through the Unknown
300 Ω		10 mΩ	100 MΩ	0.05 % + 2 + 0.02Ω	0.25	1 mA
3 kΩ		100 MΩ	1Ω	0.05 % + 2	0.24	120µA
30 kΩ	_	1Ω	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			$0.05 \% + 8 + 0.02 \Omega$	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	1Ω			0.05 % + 8	0.11	1.5 μA
1000 kΩ	10 Ω			0.06 % + <u>.</u> 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 M Ω (slow) and 300 M Ω (medium and fast) ranges cannot measure below 3.2 M Ω and 20 M Ω , 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 $\Omega,$ 300 $\Omega,$ 30 M\Omega, 100 M\Omega, and 300 M\Omega 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 <i>µ</i> V
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.

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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 $< 2 \ k\Omega$, 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	Res			
Kanye	Slow & Medium	Fast	Accuracy	
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	

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Specifications

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 $<2 k\Omega$, 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	To 90 % at 0 °C to 28 °C (32-82.4 °F),		
(non-condensing)	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.		

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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, 2 11.27 in deep)	28.6 cm deep (3.67 in high,8.5 in wide,		
Weight	Net, 2.4 kg (5.2 lbs) without 3.2 kg (7.0 lbs) with bat Shipping, 4.0 kg (8.7 lbs) with 4.8 (10.5 lbs) with batter	tery; thout battery;		
Power		ng required), 50 Hz and 60 Hz < 15 VA		
Standards	maximum 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, 600,1200,2			
	Odd, even or no parity One stop bit			
Options				
Battery (Option -01 K)	Туре	8 V, Lead-Acid		
	Operating Time	8 hours (typical). 🖃 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		

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ATTACHMENT C

S&L Interoffice Memorandum from J. F. White

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

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<u>,</u> , , , INTEROFFICE MEMORANDUM

From <u>J. F. White</u> Dept./Div. <u>Mech./C</u>		Project No. cation Spec. No. File No. 9	25t 14, 1991 2. 8900-03 COD-052214 Rev. 01 1 of 1
Client <u>Commonwealt</u>	h Edison Co. S	tn. Dresden	Unit <u>2 & 3</u>
Subject <u>Seismic O</u>	ualification of	ITE/ABB Undervoltad	re Relay
Model 27N	, Series 411T		
To: J. Sinnappan	- 22 (1/0)		
CC: K. L. Adlon R. W. Fermier			
E. Zacharias CQD File	· · · · · · · · · · · · · · · · · · ·		

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 "Indervoltage 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.

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ATTACHMENT D

GE Document 7910 Dated 6-20-77

 Calculation No.
 8982-13-19-6

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 005

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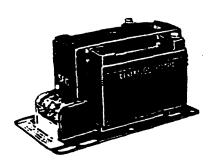
2400 to 4800 Volts



BIL---60 Kv

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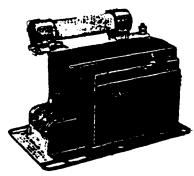
June 20, 19



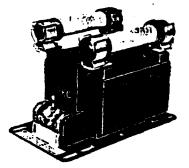
(Phote 1234873) Fig. 1. Type JVM-3 voltage transformer (unfused)

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



(Phase 1 234875) Fig. 3. Type JVM-3 voltage transformet (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

	Olimensians in Inches				
Description	Height	Longth	Width		
Unfuned	51410	10%	636		
With one primary fuse	74.	10%	6%		
With two primory fuses	74.	10%	61710		

DATA TABLE (For Pricing Information, see Section 7901)

Transformer Zating O			Thermal Bating in Volt-amperes		ANSI	ANSI Accuracy Classification, 60 Hz		AN	dication		Prima	ry Fuses	App
				T	Burden Pe	M ANSI	Jurden				_	r	
Primory Yonage	t atio	Cat. No.	55 C Rise obeve 30 C Ambient	30 C Rive above 55 C Ambient	Operated at Rated Voltage	Operated at 58% Rated Valage	impedance as et Rated Veltage, but Operated at 58%, Rated Voltage *		Permissible Trans- former Primery Connec- tion	Veh- oge taing	Amp	Fue Cat. Ne.	Ship.
INFUS	ED												
2400 4200	20,1 35,1	643X83 643X90	750 750 750	500 500 500	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 0.3 W, X, M, Y, 1.2 Z	4200					35 35 35
4800 1	AD:1	643X95 RIMARY FUS			i insulation to groun	and the second se	0.3 W, X, M, Y; 1.2 Z	4800	∆ or ¥	<u></u>	•••		12
2400 2400 4200 4800	20:1 20:1 35:1 40:1	763X21G42 643X85 643X91 643X91 643X96	750 750 750 750	500 500 500 500	0.3 W, X, M, Y, 1.2 Z 0.3 W, X, M, Y, 1.2 Z	C. W. X. 1.2 M. Y 0.3 W. X. 1.2 M. Y		4160	Yonly	2400 4800 4800	1.5	9760AA8001 9760880001 9760880905 9760880905	37 37 37 37
VITH T	NO PI	RIMARY FUS	ES										
	35.1	763X21G40 643X92 643X97	750 750 750	500 500 500	0.3 W, X, M, Y, 1.2 Z	0.3 W. X. 1.2 M. Y	0.3 W.X.M.Y. 127 0.3 W.X.M.Y. 127 0.3 W.X.M.Y. 127	4200	⊼ a r ¥1	2400 4800 4800	1 0.5 0.5	9760880905 9760880905 9760880905	38 38 38
		: symbol (') d to standar			ly that these burde		conditions, overvolta primary-voltage ratio		t be limite	d to	1.25 1	imes the trai	nsfor

 On transformers with one primary fuse the neutral terminal insulation to ground is 2500 volts. primary-voltage rating.
For Y connections, it is preferred practice to connect one lead from eacy 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.

OFor continuous operation, the transformer-rated primary voltage should not be exceeded by more than 10%. Under emergency

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HY-BUTE / 60% MOLDED . FUSED AND UNFUSED MODELS

Type JVM-3 50-60 Hz

2400 to 4800 Volts June 20, 1977

RY TERMINALS-The primary ter-.....s 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 scaling the cover.

BIL---60 Kv

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

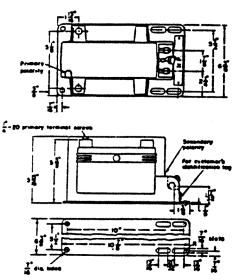
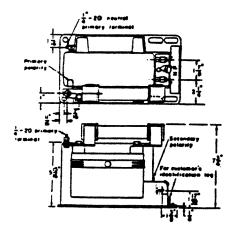


Fig. 4. Dimensions of JVM-3 (unfused)



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

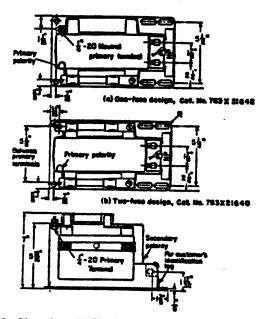


Fig. 5. Dimensions of JVM-3 Cat. No's. 763X21G42 and 763X21G40. (See Fig. 4 for base)

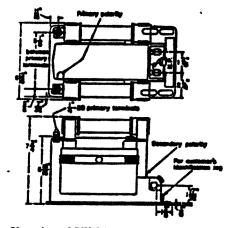
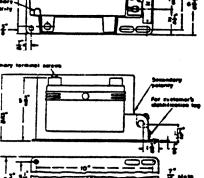


Fig. 7. Dimensions of JVM-3 (two-fuse design), Cat. No's. 643X92 and 643X97. (See Fig. 4 for base)

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ATTACHMENT E

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

Calcula	ation No.	898	2-13-19-6	
Revision		00	5	
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Page	E1	of	E2	

AJR/chimo Dest

Memorandum of Telephone Conversation

SARGENT & LUND

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

AJR: 1sc c: \ead\ms-tele-ajr

andrew

A.J. Runde

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ATTACHMENT F

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

Calcu	lation No.	No. <u>8982-13-19-6</u>		
Revisi	on	00	5	
Attach	iment:			
Page	F1	of	F6	

Memorandum of Telephone Conversation

consersation date only March 21, 1992) à

SARGENT & LUNDY

	Date 3/30/92 / Time 11:15 a.m.
Person Called Cliff Downs	Company PKX (215) 395-1055 ABB (215) 395-7333
Person Calling H. Ashrafi	Company 861 (312) 269-2041
Project Qued Cities	Project No. 8913-73 - DVPK01
Subject Discussed: Effect of TRelays with	Temperature on the ITE-27N A 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 verse.

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 Marmonic Filter Unit in the ITE 27N Relays. He pointed out that the test results for the ITE 27N Relay without Marmonic 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 Marmonic 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-ABS File: Relays Ai Relays. HA

Shrafi

TRANSMISSION REPORT

THIS DOCUMENT (REDUCED SAMPLE ABOVE) WAS SENT

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March 21, 1992

Memorandum of Telephone Conversation

SARGENT & LUNDY

			Date 3/30	/92		Time	11:15	a.m.
Person Ca	lled	C	Company	FAX	(215)			
	Cliff I	owns		ABB	(215)	395-	-7333 _	
Person Ca	lling	C	Company					
	H. Ashr	afi		S&L	(312)	269-	-2041	
Project		F	roject No.					
_	Quad Ci	ties	_	8913	3-73	- D1	VPM01	
Subject D		ect of Temper ays with Harm						

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cc: C. Downs-ABB File: Relays

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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 / 19	6/92	Total	Pages: 2
TO: Andy	Runde	•	
•			performance

c**c:__**

Andy. Please find in the attachment the TYPE TEST certificaty for 27N relay our These the arp actual test results from our laboratory tests 04 the results thèse tests <u>as</u> can SEP are in our I.L.'s Doubled when published I hope this document will Help satis problems ands ea

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Temperature Tests:

Temperature	Pickup Voltage	Variation from Room Temperature	Dropout Voltage	Variation from Room Temperature
25°C	100.04v		9 9. 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%
5 5	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 f.om Room Temperature	Dropout Voltage	Variation from Room Temperature
22º 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%	9 9. 25	-Ō.78 %

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

Relay Tested:	211T0175-HF	Date of Tester:	

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Person Called	LIFE Downs K	Company	гах (: Авв ()	215) 398 215) 399	5-1055 5-7333	
Person Calling	Ashrafi	Company	Sel (312) 26	9-2041	
Project	ad Cities	Project No	. 8913-	73 -)	VPM01	
Subject Discussed:	: Effect of Tem Relays with H	perature on araonic Filt	the ITE-2' er Units	7N		

Summary of Discussion, Decisions, and Commitments:

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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 JBW

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ATTACHMENT G

Calculation MLEA 91-014

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January 23, 1992 Serial No. 92-024

Mr. Boris Pikeiny 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:

prollell Annette M. McHugh

Senior Project Engineer

. Us I. Crane

Approved by:

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

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	MAIN LINE EMONECTION				Page 1 of 20	
					Safety Related # Yes [] No
Client: Com	morweath Ediso	n Company		Carry Taraka Managara	Discipline: Environmen Qualification	
Project Title Equipment	: 4KV Second Le	vei Undervoltag	e Protection		Project No. M0071	
Calculation Equipment	Title: Environmer for FWCU Line Br	tal Qualification sak Environme	n of Dresder Intal Conditio	Second	Level Undervoltage Syst	em and
Status 🗆 P	reliminary 🛚 Fin	al 🗆 Void				
Computer P	rogram: NA	Version	NA	Verified		
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Calculation Sheet

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Preparer & Reviewer (/C

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- 1.0 Purpose of the Evaluation
- 2.0 Statement of Qualification and Summary of the Evaluation
- 3.0 List of References
- 4.0 Qualification Criteria
- 5.0 Method of Qualification and Test Sequence
- 6.0 Equipment Description and Similarity to Tested Equipment
- 7.0 Safety Function and Required Operating Time
- 8.0 Qualified Life
- 9.0 Qualification for Radiation
- 10.0 Qualification for High Temperature Steam Environments
 - 10.1 Plant Accident Environmental Profile
 - 10.2 Equipment Performance Characteristics
 - 10.3 Effects of Humidity
 - 10.4 Accident Simulation Testing
 - 10.5 Margin
- 11.0 Synergistic Effects
- 12.0 Maintenance and Surveillance

Attachment 1 - References

MLEF-103/3 Rev. 0

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	Calculation Sheet	Calculation No. MLEA-81-014
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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 harah 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. Reference 3.4 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 Dreeden 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 tasted 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, Dreeden 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 ETR14D38003 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", Selamic

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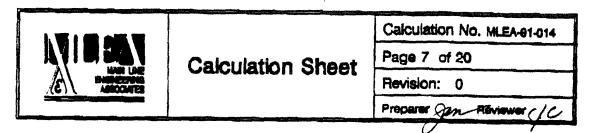
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Summary Report for Mechanically Equivalent Device Model 47D, (DIT-71-032)

- 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/Dreaden) 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 79-018, 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: Thermai Aging Data for Polycarbonate. (DIT-71-035)
- *3.21 Main Line Engineering Associates Report M0064-8, Justilication 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 Circuity 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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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.8.e.
- X IEEE 323-1974, "IEEE Standard for Qualifying Class 1E Electrical Equipment for Nuclear Power Generating Stations".
- ____ Other, Specify:

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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 26 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 ETR14038003 relay was closed to verily 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 venified,
- 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

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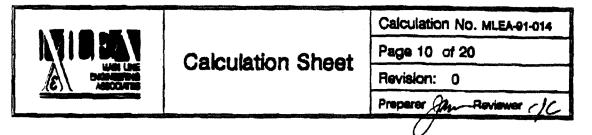
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specimens were monitored for any unintended change of state during the HELB test.

- 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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6.0 Equipment Description and Similarity to Tested Equipment

The following table lists the equipment installed in Dreeden 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

A88 Type 270 Relay Cat. 211R4175 A88 Type 27N Relay Cat. 411T4375-L-HF-DP Westinghouse FT-1 Switch Style 129A501G01 Agastat Time Delay Relay ETR14D3N002 Agastat Time Delay Relay ETR14D3B002 Agastat Control Relays (2) EGPD002 Marathon 1600 Series Terminal Blocks Hoffman Junction Box Cat. A302420LP Junction Box Back Panel Cat. A30P24 Agastat Relay Socket Base ECR0095001 Agastat Locking Strap ECR0155001 Amer-tite 3' Flex Conduit Top Entry 3' conduit Fitting GE Vulkene 14 AWG SIS Wire Rockbestos 14 AWG Firewall Wire ABB Type 27D Relay Cat. 411R4175 ABB Type 27N Relay Cat. 411R4175 ABB Type 27N Relay Cat. 411T4375-HF-DP Westinghouse FT-1 Switch Style 129A501G01 Agastat Time Delay Relay ETR14D3N002 Agastat Time Delay Relay ETR14D3B003 Agastat Control Relays (2) EGPD002 Marathon 1600 Series Terminal Blocks Hoffman Junction Box Cat. A302420LP Junction Box Back Panel Cat. A30P24 Agastat Relay Socket Base ECR0095001 Agastat Locking Strap ECR0155001 Anaconcia Sealite 3" Flex Concluit Top Entry 3" O-Z/Gedney concluit Fitting 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 requision, 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.

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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 braak.

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7.0 Salety 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 ourrent 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 aeconds, 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 dissel generator is started, the incoming breakers are tripped, load shedding is initiated, and the dissel generator breakers close when all permissives are satisfied Ref. 3.3).

In the event of FWCU 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 FWCU 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).

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8.0 Qualfied Lie

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

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 Anhenius 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 data 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 Westinchouse 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 a 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.

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9.0 **Qualification for Radiation**

The second level undervoltage circuitry and equipment for Dreeden Station 4 KVac butes 24-1, 33-1, and 34-1 are located in a mild radiation environment in the event of LOCA. Dreaden 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 Cualification 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 Dreeden 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 fails 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 atter 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 stearn 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 stearn 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

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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).

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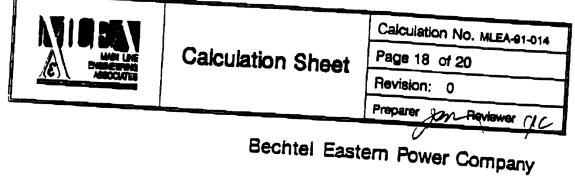
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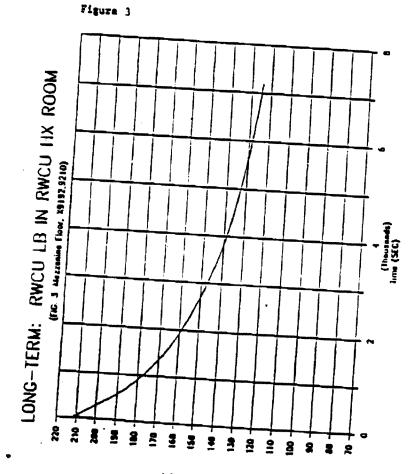
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11.0 Synargistic Effects

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 war 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 ASB Type 27D and Type 27N Solid State Undervoltage Releys:

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.

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12.2 Agestat 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, America 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:

Dreaden Station EQ Binder, EQ-48D, Tab E, contains the maintenanc... 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.

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ATTACHMENT H

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10.11.2 DESCRIPTION

The plant heating, ventilating and air conditioning system consists of the alements 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

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ATTACHMENT I

S&L Interoffice Memorandum from B. Desai

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DRESDEN STATION

UNITS 2 AND 3

DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

3

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

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Incorporate assumption verification in the calculation.

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RELAY SET	TING ORDER	FROM-	_ STA. ELEC.		
C.E.CO. 88-4800			SYST. PLAN.		UI0. 2174.
STATION /	1-DREEDE	$Bu \leq 2$	<u>3-/</u> ĸ	V7.16 THE	TE 17N-HF
	: 🔀 HEL 🗌	=	STALL	ия. 🗌 сна	
• <u>S</u> e	SECOND LEVEL (NOFR - VOLTAGE				
ZONE OR EL.(CHARAC)	IUV		UV	ы U	
P.T. (P.D.) BATIO	35:1		35.1	The Kan	
C.T. TUEN RATIOS	NA		NA	WT CHANNE	
RANGE L	70-120V	Li	70-1/2V		UNLY
SETTING	3820	হ	3835		
SEC. SET'S	109.15 1	.1V .0	109.57	+2V	
COMPUTED TAPS	110 VOLTS		HO VOLTS		
TEST A-V CUR. LAG DEG	RESET TAP (99%	RESETTAP	0,99%	
TIMING	FSECS (US	ESTAP)	FSECS	SE STA	A
KESET	- V. MAY	NOT EXCE	ED 110.12	VOLTS	
OAD R	ECORD KES		109.58V	B-C: 10	9.60V
SUPERSEL	ES RSO ISSUE	-27-905WI	-2-92,1	COM	53 w6 AM2

1

DESIGNATIONS NOT COVERED ACOVE OR CELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

	TING ORDER	N ONLY	STA. ELEC.	on	
STATION /	1- DRESAL		ibt-	16 TYPEZ7	E 17N-HF
	ONO LEVE		2 - VOLTA'S		
ZONE OR EL.(CHARAC)	IUV		UV	$\sim r_{m_{eff}}$	
P.T. (P.D.) BATIO	35:1		35:1	<u> </u>	
C.T. TURN	NA		NA	•	· · · ·
BANGE (BATING)	70-120V	34 8	70-16V		7-4-4-
PRIMARY VI SETTING	3784	×	3820		•.
SEC. SET'G	108.1	r L	109.15 7	I yours	
COMPUTED	110 VOLTS		+10 VOLTS		
TEST A-V CUR LAG DEG	RESETTAR	P.99%	RESET TAP	C99%	
TIMING	FSECSUS	TAP)	7 SECS (VS	ESTAP)	
RESET V. MAY NOT EXCEED 109.7 VOLTS					
OAD	RECORD	RESET	V: ABreloy=1	B. 22 BC re	lay = 10919
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PELAY SETTING	REFATION					
C.E.CO. 48-4404 5-13		FROM SYST	. PLAN.	or		Y. ENG.
STATION 72-	RESNER B	1.321	KV <i>4,</i> /	ATLAY TYPE TY	F-12,	115
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· <u>Seco</u>	UN LEVEL	- /	LTAGE			
ZONE OR EL.ICHARACI	V		V Tr	<i>i</i> •.		IE
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C.T. TURN	A		A		TION ,	
PANGE 2 70 -	11.0	m 70-	1201			**ZY 2
SETTING 4387	0	38	84			
SEC. SET'G	51 721	19 110.	.97 1/-	.21		(x)
COMPUTED //O	VOLTS	TTC	Volts .			
TEST A-V CUE LAG DEG RESE	TAPR97	RES	ET TAR	79%		
TIMING 75EC	SUSE STAP	7se	CS (VSE	5 TOP	7	
RESET V MA	IY NOT E	XCEED _///	1.53) VO	LTS		
CAD RECS.			10,96V		10.99V	
SUPERSEDES REV L	SVED 2-11-92	- 155UE 5-2-9	12. MC	COM-	4B ' ar ' 6/	9/92
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RELAY SET				:.	· .	
RELAY SET	TING ORDER	FROM			OR	DIV. ENG
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	TING ORDER 5-43 12 DRECDE	کار این کار	STA. ELEC	кv 4.16 кері. 🗆	OR	DIV. ENG
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#### 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

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Calcul	ation I	No	8982	13-19-6
Revisi	on _	005		
Attach	ment:			
Page	15	of	142	

Calc. For Minimum Control Power Voltage at The Te

of The Second Level Undervoltage Relays

SARGENT & LUNDY

ENGINEERS L

Safety-Related

Non-Safety-Relat__

Client	Commonwealth Edison Company	Prepar	ed by
Project	Crescen Station - Units 2 and 3	Review	ed by
Proj. No.	9198-42 Equip. No.	Aprov	ed by

Prepared by	Date
Reviewed by	Date
Approved by	Date

- I. The battery chargers are rated at 200A (Reference 16) and are set to currenlimit 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.

> Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page I6 of I42

Calc	FOF	Minimum	Control	Power	Voltage	28	The	T
	101	PT 1133300,000		runer				•

of The Second Level Undervoltage Relays

SARGENT & LUNDY

X Safety-Related

Non-Safety-Reis

Client	Commonwealth Edis	on Company	Prepared by	Date
Project	Oresden Station -	Units 2 and 3	Reviewed by	Date
Proj. No.	9198-42	Equip. No.	Approved by	Date

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 coltages 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. <u>RECOMMENDATIONS</u>

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

Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>17</u> of <u>142</u>



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DATE: 10/14/93

A A A Calc. No. 8982-17-19-2 = Rev. 2 Page R25 of Project No. 8982-64 A Teleconome: 215-395-7333 Telecony: 215-395-7355 PAGES INCLUDING COVER SHEET: 1 KULAGA S+L

KULAGA 17 TO: VOWNS - PRODUCT MOR CLIFF FROM: ZIN REFERENCE: MESSAGE: PER YOUR REQUEST THIS IS TO THAT THE ALLOWABLE CONFIRM VOLTAGE RANGE FOR TYPE DC CONTROL WITH HARMONIC FILTER IS 95-140V 27 N AND A 1 SECOND EXCURSION TO T + A T89100 AFFECT ITS OPERATION. WILL NOT THE RESISTOR INSTALLED THIS ASSUMES BETWEEN TERRINALS 1 AND 9 HAS A OF 4000 OHAS VALUE

Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page 18 of 142

#### 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  $70^{\circ}$  and  $75^{\circ}$ 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.

Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>19</u> of <u>142</u>

1. · · · · ·

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:

Reset Bandwidth	: 3835 volts nominal : 109.57 volts +/2 volts : set to minimum achievable by device, approximately .5% (.55 volts) above trip setpoint i.e. 110.12 volts
Timing	7 seconds +/- 20%
Timing :	7 seconds +/- 20%

// /,/5-2 Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>110</u> of <u>142</u> 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

Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>111</u> of 142

In Reply, Refer to

#### CHRON # 190945

# Subject: Second Level Undervoltage Protection Relav 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:

Sucke

Date: Electriz

Approved: M. Filmspuski Date: 8-26-92 M.F. Pietraszewski E/I&C Design Supervisor

8-31

cc: M.L. Reed T.S. Kriz

D. VanPelt MIKE PER YOUR REQUEST AM ROUNUG SIS ROUNUG X7760 H.S. Mirchandani

Page 1 of 1 RSOREQST.DOC

Calcu	lation N	lo	8982-	 	/? -
Revisi	ion	005			
Attach	ment:	I			
Page		_ of _	142		

# InterOffice Memo

To:	Bipin Desai
From:	Mike Tucker
Date:	September 2, 1992
Subject:	Calculation Assumptions, Relay Setting Orders Degraded Voltage

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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, we¹ are going to have to determine an alternate course of action.

If you have any questions, please call me on ext. 7648.

7051

CC: M.L Reed

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Calculation No. <u>8982-13-19-6</u> /* -Revision <u>005</u> Attachment: <u>I</u> Page <u>113</u> of <u>142</u>

¹The term "we" in this context should be best interpreted to mean "you."

STATION 4	Quad Ci	ties = 1 L	IN	14.16 TTPE IT	E-27N-HF
· BUS	23-1 2-	Level 11	ndervoitag	1	1
EL.(CHARAC)		<u> </u>			·
P.T. (P.D.) RATIO	35:1		I CK INEC	h	
C.T. TURN RATIOS	N/A			WHATION C	
RANGE (EATING)	70-120V		4		NEY
PRIMARY	3886				
SEC. SET'G	111.03 ∨	7-0.2V			
COMPUTED TAPS	110 V Ta	p			-
TEST A-V CUR. LAG DEG					
TIMING	7.0 Sec -	Tap 5			
Dropr		1.570 use	99 % Tai	>	
				т. ң.	÷.,,
Per Calc	8913-73-1	9-4 Rei Opate	4-10-92 + G	MK PLETED 4-16	97 . DEllan
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STATION 4	Quad Cit	Lies			TYPE ITE-	
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· Bus Z	4-1 ZND	Level Uno	lervo Ita	ge		
ZONE OR EL.ICHARACI						
P.T. (P.D.) RATIO	35:1					
C.T TURN RATIOS	MA					
BANGE (EATING)	70-120V	/ r	UR INFOR	A 4-		
PRIMARY	3.886				N OWLY	
SEC. SET G	111.03 V	+1-02V				
COMPUTED TAPS	110 V To	P				
TEST A-V CUE LAG DEG		1		1		
TIMING	7.0 Sec -	Tap 5			)	
Propou	t at 99	,570 use	9990 Ta	<u>P</u>	nacus communiter in Roman construction	
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Par Cale	8913-73-19	-4 Pour Dissue	4-10-92, 0	SHK SOM	104-16-9Z	IT QUIBRIA

Por Calc. 8913-73-19-4 Rev. O DATE 4-10-92 or GHK COM. 4-16-92 or Call Baug. Designations not covered above or selow. Such as line no., New or old setting. Etc.

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Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>114</u> of <u>142</u>

	1- DRESDEN BU	533-1 KV 4.16 THELTE-17	NHF
	1 III	AL NALL REPL CHG. TO DEACT	
*	Second LEVEL U.	NOER-VOLTAGE	
LICHARACI	UV	33:/ NA X0/ X0/ X0/ X0/ X0/ X0/ X0/ X0/ X0/	
P.T. (P.D.) RATIO	35:1	35:/ " Ring	
T. TURN	NA	NA MA	Ou
ANGE ATING	70-1201	m 70-1201	147
TIMARY . M	3870	3884	
OP. VALUE	110.5V 72V	R 110.97 72V	
OMPUTED	110 VOLTS	110 VOLTS	
EST A-V	RESETTAP R9976	RESET TARE 99%	
IMING	FSECS (USE STAP)	7SECS (VSE STOP)	
RESET		CEED 111.53 VOLTS	
OAN	RECORD RESET	1: AB- 110,96V BC - 110,99	V
WARESEDES	REN 1551FO 2-11-92		6/8/92

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RELAY SET	TTING ORDER		STA. ELEC.		□ • <b>¤</b> _	DIV. ENG
STATION	12 DRESDE	2	ONLY	KV 4.16	RELAY I	re-27~HF
	c 🕅 🛛 🛤 🗌	=		REPL.	снд. [	
• Bus	37-1 Sec	LENA LEVEL	LIND FR VOLTA	6E		
ZONE OR EL.(CHARAC)	low UV	NEW UV			1	
P.T. (P.D.) BATIO	35/1	35/1	FCRIN	ORNIA	ilun.	
C.T. TURN RATIOS			•		1014	ONLY
BANGE (BATING)	70-120%	70-120V				
PEIMARY	37841	38704		1		
SEC. SET'G	108.10	110,6v (±	.21)	SET	& TAP	= 79%
COMPUTED	1100	llov	110.4			///.lv
TEST A-V CUE LAG DEG	120-2-201	120V->OV		1		
TIMING	7 SEC(STAP)	7 spec (5 t	A.P.	Actua	i heret	= 110.61
CAS TO	RECEN REN	ET VOLTAGE.	SETT	NES B	ASES OF	I NED
REcon	TE, LARTIEN L	ETTER OF	2/10/92	TUCKE	e To	HERWATH
-	17180284	ISSUE DATE	2/11/2 11 0	RS PLE	Contraction of the local division of the loc	1920× 117

"DESIGNATIONS NOT COVERED ABOVE OR CELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.

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Calculation No. _____8982-13-19-6___ :9_ Revision 005 Attachment: ____I Page 115 of 142

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RELAY SETTING ORDER	PROM STA. ELEC. STST. PLAN.
STATION 12-DEFORT	BUS 23-1 KVF.16 TTM ITE 171-HF
· SECOND LEVEL	UNDER - VOLTAGE
ZONE OR EL.ICHARACI	
P.T. (P.D.) RATIO 35:/	SS'I WALK
C.T. TURN RATIOS I NA	$\frac{1}{33'}$
RANGE - 70-120	4) 70-1/21 Vivi
SETTING W 3820	4 3835
SEC. SETTO 4 109, 15 74.21	V 109.57 7-11
TAPS 110 VOLTS	T 110 VOLTS
CUR LAG DES RESET TAP 299	% RESET TAPE, 99%
TIMING FEES (LAES	TAP) FSECS (USE STAR)
KESET V. MAY NOT	EXCEED 110.12 VOLTS
OAD RECORD RESET	V: A-B: 109.58V B-C: 109.60V
SUPERSEDES RSO 1554ED 1-2	17-9346 6-2-92 WIC SOM BB 16/9-
"DESIGNATIONS NOT COVERED ADOVE OF	R SELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.
	· •·
RELAY SETTING ORDER	PRON STA. ELEC. DOR DIV. ENG.
STATISTICS INFORMATION OF	
STATION 12 - RESAEN	BUS 14-1 KVA. 16 MINILTE 17N-HF
· SFEULO LEVEL	UNDER-VOLTAGE
ZONE OR EL.ICHARACI	
P.T. (P.D.) RATIO 35:/	35:1
C.T. TUEN LA NA	NA NA
BANGE - 70-1201	
SETTING U 3784	3820
SEC. SETG (VILLE) (08.1	F107.15 7- 1 1003
COMPUTED 110 VOLTS	110 VOLTS
CUE LAG DEG RESET TARC 99	9% RESET TAP 899%
TIMING FSECS SEST	TOP FSECS (VSESTAP)
	EXCEED 109.7 VOLTS
OAD RECORD RE	SET V: ABrelow=109.22 BC relay = 109.19
	DATE 1-27-92 AT DC COM- 1/20/97 AT WARK

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

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 Calculation No.
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Commonwealth Edison Dresden Nuclear Power Station R.R. #1 Morris, Illinois 60450 Telephone 615/942-2920

20022 /1 T 121- 2010

# FACSIMILE TRANSMITTAL SHEET

DATE: 4/3/92
TO: Mike Tucker
TELECOPIER NUMBER: 7299
FROM: J. Grates
COVER SHEET PLUS PAGE(S)
DO YOU WANT TELECOPY BACK? YES SHOL
IF YOU HAVE ANY PROBLEMS RECEIVING YOUR TELECOPY, Please Call (815) 942-2920 EXT0-
Telecopy # 815-942-2920 Excension 2265

Mille, I'll look for the appropriate CAM/ACAD procedures and for them

Sent	
Timer	Tennesia anti anti anti anti anti anti anti an

By :

11, 12, 17, 18-

Calculation No. 8982-13-19-6 Revision 005 Attachment: | Page 117 of 142

### TESTING OF ECCS UNDERVOLTAGE AND DEGRADED VOLTAGE RELAYS

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Requirements:

Technical Specifications Section 4.2, Table 4.2.1

1	Special Contro	ols/Reviews:	
	NONE.		, 1
			а., <b>не_{не}</b>
	ند _		1
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		I. Rivera	
		Originator	
	• •	S. Rhee ependent Reviewer/Verifier (If Applica	
	1040	ependent kaviawer/veriliar (if Applic)	rd te )
		<u>1. Fiedler</u> Department Procedure Writer	
		<u> </u>	APPROVED
			AUG 05 '92
	ZDOS/137 ZW/198	1 of 8	D.O.S.R.

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#### 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.

#### 8. 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 4 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 6 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 Dissel 2 Feed 4 34-1 Tie Breaker.
  - 12E-3334, Relaying and Metering Diagram 4160 V Switch Group 33-1 4 34-1.
  - g. 12E-3335, Relay and Metering Diagram 480 V Switch Groups 35, 36, 37, 38, 39, 4 30 and 4160 V SWGR CUB 15.
  - h. 12E-3344, Schematic Control Diagram, 4160 V Buses 33-1 4 34-1 Main Feed BKRS.
  - 12Z-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.

ZDOS/137 ZN/198

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 Calculation No.
 8982-13-19-6

 Revision
 005

 Attachment:
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#### C. SUPPLEMENTA:

- 1. Checklist A, ECCS Bus Relay Test.
- D. <u>EOUIPMENT REOUIRED</u>:
  - 1. Timer (Calibrated per DAP 11-12). Record Serial Number and Calibration Due Date on Checklist A.
  - ●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 Hultimeter 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.
- E. 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.

ZDOS/137 ZW/198

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Ξ.	3.	Acceptance	criteria	is	annotated by	acceptance	criteria	(AC)
		before the	step.					

I. PROCEDURE:

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 		DK	 TE		
1	Indication of by completing	completion of Checklist A.	the relay	tests is ac	compliahed
I					

- 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 (TE 33-1 UV) and TE 24-1 UV (TE 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 (TE 33-1 UV) or TS 24-1 UV (TS 34-1 UV) directly below the relay.

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- 1. 4. c. Connect the trips by closing Test 5 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.
  - (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)_____

 Notify the Operations Shift Supervisor of test completion and give him the completed checklist.

#### J. DISCUSSION:

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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 IZ 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.
- S & L Calculation 8982-17-19-2 Rev. 1, Second-Level Undervoltage Relay Setpoint.

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#### CRECKLIST A ECCS BUS RELAY TEST

Prerequisites Complete: Initial/Date__/___ Unit _____

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# ECCS Bus Undervoltage Relay Test (Tap setting is 93)

Relay	Lever Setting Relay 1.0 Nominal		Voltag	Closure (UV) 67.9 volta	Time to Contact Closure 120 to OV 1.89 to 2.31 sec	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-1-23-1(33-1)			L			
127-2-23-1(33-1)			ļ			
227-1-28 (38)						
227-2-28 (38)						

#### ECCS Bus Degraded Voltage Relay Testa*

Ambient Temperature _____'F

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Relay	Lever Setting 5.0 Nominal		Contact Closure Voltage (UV) 109.37 to 109.77 V		Time to Contact Closure 120 to 0 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 0 5.6 to 8.4 sec	
*	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-3-33-1			1			
127-4-33-1						

	Time to Contact Closure 5 min to 5 min. 15 met
TDR 23-1 (33-1)	
	Time to Contact Closure 1.8 tp 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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#### CHECKLIST A (Continued) ECCS BUS RELAY TEST

#### Prerequisites Complete: Initial/Date_____

Unit _

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#### ECCS Bus Undervoltage Relay Test (Tap setting is 93)

Relay	Lever Setting 1.0 Nominal		Contact Closure Voltage (UV) 79.6 to 87.9 volte		Time to Contact Closure 120 to C 1.89 to 2.31 and	
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-1-24-1(34-1)			ļ			L
127-2-24-1(34-1)						
227-1-29 (39)						
227-1-29 (39)	[					

# ECCS Bus Degraded Voltage Relay Tests*

Ambient Temperature

Lever Setting Relay 5.0 Nominal		Volta	Closure (UV) 109.35 V	Time to Contact Closure 120 to 00 5.6 to 5.4 am			
	FOUND	LEFT	FOUND	1207	FOUND	LEFT	
127-3-24-1				<u> </u>			
127-4-24-1						<u>}</u>	
Relay	Lever Setting 5.0 Nominal		Contact Closure Voltage (UV) 110.4 to 110.8 V		Time to Contact Closure 120 to OV 5.6 tp 8.4 acc		
*	FOUND	LEFT	FOUND	LETT	FOUND	LEFT	
127-3-34-1							
127-4-34-1	· · · · · · · · · · · · · · · · · · ·						

	Time to Contact Closure 5 min to
TDR 24-1 (34-1)	<u>5 min. 15 sec</u>
	Time to Contact Closure
	1.8 to 2.2 sec
27570 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. ۰

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CHECKL	IST	A	(Con	tinue	d)
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# ECCS BUS RELAY TEST

Abnormal Findings and Comments:		
Cimer Serial Number	Voltmeter Serial Number	
alibration Due Date	Calibration Due Date	
AD Representative	Digital Thermometer Serial Numbe:	
	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 evaluatic. 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.

Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>126</u> of <u>142</u>

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CHRON # 179957

Mr. C.W. Schroeder Station Manager Dresden

FOR DEFECTION - SE AF

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/ISC 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: 7

M.S. Tucker Senior Engineer

/ulka Date: 2/2/92 

Date: 2/2/92

Approved: ______ Reed

E/I&C Design Superintendent

DRSDN EDSFI\SADVA.DOC MT:mst attachments cc: C.A. Grier R. Radtke B.M. Viehl M.C. Strait S.A. Lawson NEDCC

M.F. Pietraszewski M.H. Richter G.A. Gates

# 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.

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> Calculation No. <u>8982-13-19</u>, /?-; Revision <u>005</u> Attachment: <u>I</u> Page <u>128</u> of <u>142</u>

# 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.

.CCSW Pump	ESS Division	In Vault?	CCSW Cubicle Cooling Fans
A	Division I	No	None
В	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

Table 1

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 x  $10^{-12}$  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.

Attachment B to SADVA.DOC Page 1 of 6 DRSDN EDSFINATTB.DOC 2/2/92 11:00 AM

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Calculation No. <u>8982-13-19</u>26 ³--Revision <u>005</u> Attachment: <u>I</u> Page <u>129</u> of <u>142</u>

### 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 calculation 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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> Calculation No. <u>8982-13-1936.</u> / <del>? - :</del> Revision <u>005</u> Attachment: <u>I</u> Page <u>130</u> of <u>142</u>

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

Attachment B to SADVA.DOC Page 3 of 6 DRSDN EDSFINATTB.DOC 2/2/92 11:00 AM

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Calculation No. <u>8982-13-19-6</u> 7_ Revision <u>005</u> Attachment: <u>I</u> Page <u>131</u> of <u>142</u> 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  $130V \pm 1\%$  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.

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> Calculation No. <u>8982-13-19-6</u>3, /9- · Revision <u>005</u> Attachment: <u>I</u> Page <u>132</u> of <u>142</u>

# 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  $3820 \pm 7$  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.

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/3,/7-Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>133</u> of <u>142</u> 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.

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Calculation No. <u>8982-13-19-6</u>/3./⁴; Revision <u>005</u> Attachment: <u>I</u> Page <u>134</u> of <u>142</u>

In Reply, lefer to

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Mr. C.W. Schroeder Station Nanager Dresden

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Subject: Safety Assessment Degraded Voltage Drasdan Unit 3

#### Dear Mr. Schroeder:

The Electrical/ISC group of the Nuclear Engineering Department has assessed the affacts of degraded voltage on plant equipment not bounded by the setpoint of the Second Level Under Voltage relay. These assessments address the Division II CCEW onhicle cooling fans, the battery chargers, certain 120V contactors being subjected to a lower voltage than the samufacturer's recommanded 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.

Propared Ter Joskan X.S. Tucker

Senior Engineer

Data: 2/2/92

Approved: 177/Res

Date: 2/11/92

M.L. Reed

XIEDCC

Z/IIC Design Superintendent

DREDM EDENT VISADVA.DOC TIMET attachments cc: C.A. Grier E.L. Massin R.M. Radtke D.L. Taylor X.C. Strait B.M. Viahl S.A. Laveos

M.F. Pietraszewski M.E. Richter G.A. Gates

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### 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 Cubicie 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.

•		
ESS Division	In Vauit?	CCSW Cubicle Cooling Fans
Division I	No	None
Division 4	Yes	A Fan 1, A Fan 2, B Fan 1 and 8 Fan 2
Division II	Yes	C Fan 1, C Fan 2, D Fan 1 and D Fan 2
Division II	No	None
	Division ( Division ( Division ()	ESS Division In Vault? Division I No Division I Yes Division II Yes

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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 O. However, setting the relay to assure starting of the Division II fans (C and D) would result in an

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  $9.9 \times 10^{-12}$  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.

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unacceptably high relay setpoint.

Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>136</u> of <u>142</u>

### 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 sempoint have determined that the swing DGCWP has an available terminal voltage of 342.7 Volta under starting conditions. This is 74%% 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 Volta available for starting (76% of rated).

The vendor of the Diesel Generator Cooling Water Pumps (DGCWP), Champump 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 Drasden'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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Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>137</u> of <u>142</u> 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 teating 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 diasel 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 1/6/82.

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

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> Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>138</u> of <u>142</u>

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conservative margin in the calculated result. This will accelerate the pump

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

Therefore, at 70% voltage, the motor has adequate torque to start and no undesired protective trip will occur.

#### 125 and 250 Volt Battery Chargers

current.

to operating speed in 1.65 seconds.

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  $130V \pm 1\%$  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 Bettery 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.

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### 120 Volt Contactors

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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  $3870 \pm 7$  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. Reising 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.

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The minimum expected voltage on the 4kV bus is 3924 Volta (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.

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> Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>141</u> of <u>142</u>

### DRESDEN STATION

# UNITS 2 AND 3

### DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

### Assumption - 14

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"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.

Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>I</u> Page <u>142</u> of <u>142</u>

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# ATTACHMENT J

# RSOs for 2nd Level UV Relays

Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>J</u> Page <u>J1</u> of <u>J3</u>

RELAY SETTIN	C OPDED				
C.E.CO. 84-404 3-8	3	FROM	STA. ELEC.		DIV. ENG.
STATION 12	- DRES	roen		W4.16 mm 1	TEZTN
A図・□ C図	ыг 🗌	= [] M []	HALL D	NT . OK	
	23-1	SECOND L	EVEL UND	UNDLTAGE	
ZONE OR EL.ICHARACI	XISTING		To BE	-1	1
P.T. (P.D.) BATIO	35:1		35:1		
C.T. TURN BATIOS	-				
BANGE 7	0-1200		70-120 V	702-99%	A ACHIO
PRIMARY -	3835 V		3872		ar Incryp
SIE. SITO	19.57 V		110.63		DAOPOUT
COMPUTED TAPS			110 V PKK		CO POUT
TEST. A-V CUE. LAG DEC	·	A		OUT/PICK I RA	Vin 20990
TIMING .7	NSAC		INST 1		10-0.115
· PER (	CALCULA	TION #		-19-6	
OAD	AECOND	RESET VA			T EXTOWAL
TIMER TO T	sec /±2		-27-96 7		i
DESIGNATIONS NOT	COVERED AD	OVE OR DELOW.	NCH AS LINE NO	NEW DE OLO 187	TING, ETC.

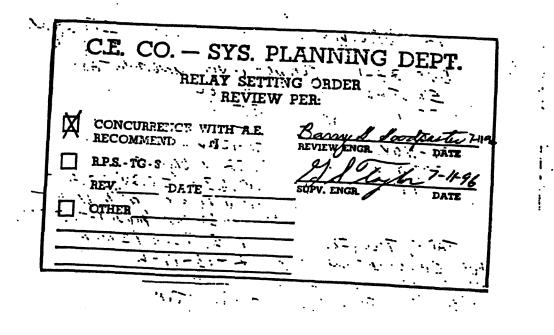
#### NOTE:

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.

Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>J</u> Page <u>J2</u> of <u>J3</u>

RELAY SET	TING ORDER	FROM	TA. ELEL.	[] 0R	DIA. E	NG.
STATION	12 DR	eron		VIIG RELAT	ITEZ7NI	<u>R</u>
AD . D .		=				] {
*	BUS 24-	·1 SECON	10 Levor	unoowa	LT MG8	
ZONE OR EL.ICHARACI	EXISTING		To 85	1		
P.T. (P.D.) PATIO	35:1		35:1			
C.T. TURN			-		· .	
IANGE	70-1200		70-1204.	·		_
PEIMARY	3820 V	4	3872 V	NOPOUT		
SEC. SET'G	109.15 v		110,630	(± 0,2v)	DROPOUT	
COMPUTED			110 V 11014		6 photout	
TEST A-V CUR. LAG DEG			DJUST GROP	out/Incial	ATTO > 0.99	51
TIMING	TAP 5, 7sec	1520%	TAP 5: 7	sec (12	02)	_
		(on # 89	132-13-	19-6		
		JOT, VALUC			•	
SULORSON	OT RSO PATO	6/27/96350E	7-11-96 . 7	JM COM	67	
OF RIGHATION	NOT COVERED A		UCH AS LINE NO.	NEW OR OLD	ETTING. ETC.	



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> Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>J</u> Page <u>J3</u> of <u>J3</u>

# ATTACHMENT K

# DOC ID 0006191944

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# Dresden Station Design Information Transmittal

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[X]Safety-Related	Design Information Transmittal	DOC ID	_0006191944				
[]Non-Safety-Related	Dresden Station	Revision	a – 05	18			
[ ]Augmented Quality	Unit(s): 2 and 3	Page _1	of _ 3_				
To: Mr. William A	Barasa						
Organization: Sargent & Lundy LLC							
Address/Location: 55 E. Monroe, Chicago, IL 60603-5780							
Subject: Improved Techni	al Specification (ITS) Analytical Limits		######################################	1			
Status of Information:	Verified Unverified			7			
	the Method and Schedule of Verification in the "De ed for verification of "Unverified" information:	scription of ]	Information."				
included in the Methodolo Undervoltage (Degraded V 9198-18-19-3 Rev. 3 & 91 LOCA) Setpoint and Tole frequency for Condensate	the current Technical Specification LCO values of the current Technical Specification LCO values of section of each calculation prepared. Rev. 70 tage) value to 3820 volts per Calc. # 9198- 98-18-19-4 Rev.3. Rev. 3 of this DIT changes rance per page 3. Rev. 4 of this DIT changes Storage Tank Level. Rev. 5 of this DIT changes # 990552) and 8982-17-19-2 (DCR# 990560)	v. 2 change -18-19-1 R es 4160V l device typ ges the cal	4160V ESS Bus ev.3, 9198-18-19-2 Rev.3, ESS Time Delay (No e and calibration ibration frequency of	PS			
Purpose of Issuance: Thi entirety. For use in determ	Design Information Transmittal supersedes ining Allowable Values for the ITS calculati	Revision ( ons submit	3 dated 7/05/00 in its tal.				
Limitations: None							
References (Source of Int Current Technical Specific	ormation): ation/DCR#990552 & 990560			IRS			
Prepared by: Sujal J	Patel / STACLA	Date:	9/5/00				
Reviewed by: Dale R	Earnan / Dale Earnan Printed Name / Signature	Date:	9-6-00				
Approved by: Steve V	Tutich / Jun Victure	Date:	9-6-00				
	, R. Peak, DG Central File, D. Earnan, T. Th	and a second					

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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 VsI 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	28	≤ 9 seconds (Note 1)	Time Delay Relay	24M
Dresden	LPCI Recirc Pump dP Time Delay Relay	3.3.5.1-1	21	Deleted. See DRE00-0035 for new values.	Time Delay Relay	24M
Dresden	LPCI Rx Vsi Dome Pressure Time Delay Relay	3.3.5.1-1	2]	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
	HPCI Steam Line Flow Timer	3.3.6.1-1	зь	≥ 3 seconds and ≤ 9 seconds	Time Delay Relay	92D
Dresder	Low Set RV Reactuation Time Delay	3.3.6.3-1	1b	$\geq$ 8.5 seconds and $\leq$ 11.5 sec.(Note 1)	Time Delay Relay	24M
Dresder	4160V ESS Bus Undervoltage (Loss of Voltage)	3.3.8.1-1	1	≥ 2784 volts and ≤ 3076 volts	Protective Relay	24M
	4160V ESS Bus Undervoltage Time Delay	3.3.8.1-1	2a	$\geq$ 5.6 seconds and $\leq$ 8.4 sec.	Time Delay Relay	24M
	4160V ESS Bus Undervoltage (Degraded Voltage)	3.3.8.1-1	2a	≥ 3820 volts (Note 3)	Protective Relay	Note 4
	n 4160V ESS Time Delay (No LOCA)	3.3.8.1-1	2b	≥ 270 seconds and ≤ 330 sec (See page 3	) Time Delay Relay	24M
	n RPS Elec. Power Monitoring - Overvoltage Trip	3.3.8.2	SR 3.3.8.2.2a	≤ 129.6 volts	Protective Relay	24M
	n RPS Elec. Power Monitoring - Undervoltage Trip	3.3.8.2	SR 3.3.8.2.2b	≥ 105.3 volts	Protective Relay	24M
	n RPS Elec. Power Monitoring - Underfrequency Trip	3.3.8.2	SR 3,3.8.2.2c	55 A Hz	Protective Relay	24M
	n RPS Elec. Power Monitoring-Overvoltage Time Delay	3.3.8.2	SR 3.3.8.2.2a	( A seconds (Note 2)	Time Delay Relay	24M
	n RPS Elec. Power Monitoring-Undervoltage Time Delay		SR 3.3.8.2.2b	< A seconds (Note 2)	Time Delay Relay	24M
Dresde	IDDO Flore Devention in the Local day	3.3.8.2	SR 3.3.8.2.20	< A seconde (Note 2)	Time Delay Relay	24M

Calculation No. Revision <u>005</u> Attachment: <u>1</u> Page <u>K3</u> of X 8982-13-19-6

* 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

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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).

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Subject:

Second Level Degraded Voltage 5-Minute Time Delav 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 restorationof normal bus voltage. The 5-minute timer is bypassed on high drywell pressure / lowlow 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 : 1 him."

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.

JJAKOVACH

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# ATTACHMENT L

Telecon Between J. Kovach (ComEd) and C. Tobias (S&L)

 Calculation No.
 8982-13-19-6

 Revision
 005

 Attachment:
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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----craig_tobias@mail.sargentlundy.com > From: > [SMTP:craig_tobias@mail.sargentlundy.com] Thursday, April 20, 2000 9:15 AM > Sent: john.g.kovach@ucm.com > To: Telecon Documenting RSOs > Subject: > > 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 Issued 2/11/86 Completed 3/1/86 > Bus 23-1 > Bus 24-1 Issued 2/11/86 Completed 3/1/86 Issued 2/11/86 Completed 3/1/86 > Bus 33-1 Issued 2/11/86 Completed 3/1/86 > Bus 34-1 > Degraded Voltage Relay RSOs > Issued 6/27/96 > Bus 23-1 Issued 7/11/96 > Bus 24-1 Issued 3/16/94 Completed 4/28/94 > Bus 33-1 Issued 10/31/96 > Bus 34-1 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

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Calculation No. <u>8982-13-19-6</u> Revision <u>005</u> Attachment: <u>L</u> Page <u>L2</u> of <u>L3</u>

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> being
> performed.
>
> Thank you for your time and support.
>
> Yours truly,
> Craig Tobias
> Sargent & Lundy, LLC
> 312-269-6577
*************
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# ATTACHMENT M

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	DESIGN INFORMAT:	
SAFETY-RELATED	NON-SAFETY-RELATED	DIT No. BB-EPED-0178
	th Edison Company	Page 1 of 1
	dwood UNIT (8) 1 & 2	To <u>J.B.Wisniewski-2</u>
OJECT NO(8) <u>8915-8</u> BJECT Undervolta	ge Relay Accuracy Calculation	n Input Data
	GN CHANGE NUMBER(S) N/A	1 211940 Juck
J. J. Bojan	EPED Mon	<u>5-7-92</u>
ATUS OF INFORMATION	N(This information is approved for use. Design Information.	
summy or requires further vertication (	(review) shall be so identified.)	
is information is a	approved for use and requires	no further verification.
following informa	ents attached to DIT by its title, revision and/or issue date, at ation is for use in the prepa Cy calculation:	••
e following informa ltage Relay Accurace <u>Switchgear Room</u> - Minimum Temp. - Maximum Temp. - Relative Humi - Radiation exp. - Internal Switch <u>Potential Transfor</u> - Westinghouse - Accuracy = 0.3 <u>References</u>	ation is for use in the prepar- cy calculation: Environmental Conditions $= 65^{\circ} F = 10^{\circ}$ $= 108^{\circ} F = 108^{\circ} F = 108^{\circ} F = 108^{\circ} F$ dity $= 8 \text{ to } 708^{\circ}$ osure $= \le 10^{4} \text{ rad}$ chgear Temp. Rise $= \le 5^{\circ} F$ <u>ormer Data</u> 4200 - 120 V; Model 9146D46G0 3W, X, Y and 1.2 Z	ration of the Degraded
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<pre>a following informa tage Relay Accuracy <u>Switchgear Room</u> - Minimum Temp. - Maximum Temp. - Relative Humi - Radiation exp. - Internal Switch <u>Potential Transfo</u> - Westinghouse 4 - Accuracy = 0.3 <u>References</u> 1. UFSAR Section a) 9.4.5.4.2 b) 3.11 (Tab 2. Westinghouse 3. Specification 4. Byron Station</pre>	ation is for use in the prepar- cy calculation: Environmental Conditions $= 65^{\circ} F = \frac{10}{2}$ $= 108^{\circ} F = \frac{10}{2}$ dity $= 8 \text{ to } 70^{\circ}$ osure $= \le 10^{4} \text{ rad}$ chgear Temp. Rise $= \le 5^{\circ} F$ <u>ormer Data</u> 4200 - 120 V; Model 9146D46G0 3W, X, Y and 1.2 Z	(Dwg. EN018-6A)
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Calculation No.	8982-13-19-6
Revision	005
Attachment:	M
Page <u>M2</u>	of <u>M3</u>

a °

B-IRON WALKDOWN

DATA COLLECTED USING INSTR BY 444 - LIKE BOZAB MULTI METER W/FLUKE BOT-150 TEMP. PRO: OUTSIDE AIR TEMP (NEAR UNIT I TRACKWAY) 79.8° AT 1:25 INSIDE SWAR CUB OUTSIDE SUSA CUB 805 86.3° 89.3 141 84.2° 85.5 142 87.5° 88.40 241 89.20 89.90

* WITH DOOR CLOSED TO ALLOW TEMPERATURE TO STABILIZE, THEN MOR WAS OPENED & TEMPERATURE READ IMMEDIATELY. TEMPERATURE TAKEN INSIDE CUBICLE WHICH CONTAINS ITE DEGRADED NOLTAGE 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 COLEST TEMPERATURE (RESULTING IN THE GREATEST TEMPERATURE DIFFERENTIAL) WAS RECORDED.

PREPARED: 5-11-92 Paul 3 5-11-92 VERIFIED

242

Calculation No.	8982-13-19-6	
Revision	005	
Attachment:	M	
Page <u>M3</u>	of M3	

## **ATTACHMENT 3**

Calculation 8982-17-19-2, "Second Level Undervoltage Relay Setpoint – Unit 3," Revision 004



Nuclear

		7-21-04		Last Page No. 15
Analysis No.			Revision 004	
EC/ECR No.	<del>349539</del> 350337 £3	50338 F	Revision 000	
Title:	Second Level Underv	oltage Relay Se	etpoint – Unit 3	
Station(s)	Dresden		Component(s)	
Unit No.:	3			
Discipline	E			
<b>Description</b> C	ode/			
Keyword	E07, E13			
Safety Class	Safety Related			
System Code	67	F		
Structure	N/A			
CONTROLLED	DOCUMENT REFEREN	ICES		
Document No.	, 	From/To	Document No.	From/To
	n a a a a fhirinn an an an Annaich ann ann a fhirinn an tar an fhannaich an an Annaich ann an Annaich ann an An			
Is this Design	Analysis Safeguards?		Yes 🗌 No 🛛	
Does this Des	ign Analysis Contain Ur	verified Assum	ptions? Yes 🗌 No 🖂 ATI	/AR# N/A
ls a Suppleme	ntal Review Required?			es, complete
			Atta	achment 3
	atricia A. Ugorcak		Patricia A-llgarcak	7-16-04
	int Name		Sign Name	Date
	cott Shephard			7/14/04
Method of Revi		Review		Date Testing
Review Notes:				looang
Approver 4	R.M. MIN		1 AMARIA	8.16.04
	int Name	V	Sign Name	Date
				СК жай за на селед с СК жило Соссулии С 2000 мини се на до СК и на рода и ца Кимин и Царан и Ца за СК жи за на селед с СК жило Соссулии С 2000 мини се на до СК и на рода и ца Кимин и Царан и Ца за с
(For External Analyses O Exelon Review)		N	Dale Egman	8-16-04
	Print Name		Sign Name QA CO	PY MADE Date
Approver	1 2013.1		- fuel	818 01
	int Name		Sign Name - ITS DCR 990560	(EC 13955) Date
Description of F	kevision (list attected paged determine new setucint	es for partials): In Allowable Values	corporate ^d minor revision [®] 3A <del>and</del> and Expanded Tolerances. Refo	H3B. Apply latest 74944
			nat or section numbering changes	
			2 Revision 3, 3A, 3Be 7tu 1.19.1	

.

CC-AA-309

Revision 3 | Page 15 of 15 |

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

DESIG	N ANALYSIS NO. 8982 - 17-19-2 REV: 004			
		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?	$\boxtimes$		
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?			X ZNONE.
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?	$\boxtimes$		
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?	$\boxtimes$		
11.	Have any limitations on the use of the results been identified and transmitted to the appropriate organizations?	$\boxtimes$		
12.	Are there any unverified assumptions?		$\boxtimes$	
13.	Do all unverified assumptions have a tracking and closure mechanism in place?			
EXELO	NREVIEWER: DALE EAMAN Dale Eaman I	DATE: _	8-16	-04

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

NES-G-14.01 Effective Date: 04/14/00

# CALCULATION TABLE OF CONTENTS

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3.	ACCEPTANCE CRITERIA	5	
4.	ASSUMPTIONS/ENGINEERING JUDGEMENTS	5	
5.	INPUT DATA	5	
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7.	CALCULATIONS	9	
8.	SUMMARY AND CONCLUSIONS	15	
Attach	nments		
А	DIT DR-EPED-0685-00	A1-A27	
В	Fluke 45 Dual Display Multimeter User's Manual, Appendix A	B1-B12	
С	S&L Interoffice Memorandum from J. F. White	C1-C2	
D	GE Document 7910 Dated 6-20-77	D1-D3	
Е	Telecon Between S. Hoats (ABB) and A. Runde (S&L)	E1-E2	
F	ABB Instruction Bulletin I.B 7.4.1.7-7, Issue D	F1-F12	
G	Telecon Between C. Downs (ABB) and H. Ashrafi (S&L)	G1-G6	
Н	Calculation MLEA 91-014	H1-H22	
I	DIT DR-EPED-0671-01	11-13	
J	S&L Interoffice Memorandum from B. Desai	J1-J42	
К	RSO's for 2nd LvI UV Relays & E-Mail from J. Kovach	K1-K4	
L	DOC ID 0006191944	L1-L4	
М	Telecon Between J. Kovach (ComEd) and C. Tobias (S&L)	M1-M3	
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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 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 safetyrelated 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  $1\sigma$  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  $2\sigma$  value.

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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  $[2\sigma]$  value of  $\pm 1\%$  of span per refueling cycle for mechanical components and  $\pm 0.5\%$  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 (oin) 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 =  $\pm [0.7^*(Zav ST) + ST]$ , where ST is used at a  $2\sigma$  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.

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### 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)

Setpoint Ranges (pe	er Ref. 6.9)
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).
Operating Ranges (	per Refs. 6.5, 6.9, and 6.14)
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

SIGN A	NALYSIS NO. 8982-1	7-19-2	REVISION	004	PAGE NO. 6 of 15
		Atmospheric, to Gamma 100k r olerances (per Referen	ads over 40 yrs nce 6.9)	rence 6.	11, Section 10.3)
	@ const temp a for volt. range 1 for temp. range		+/-0.1% +/-0.1% +/-0.4% +/-0.75% +/-1.50%		
	The 3 tolerances	are cumulative and a	re taken as 2σ valι	ues per l	Reference 6.7).
		e over temperature rar cated in Reference 6.		ty effect	is linear over the range of 0
5.3.	Calibration Instrument D	ata (per References 6	.2 and 6.14)		
	The Fluke 45 Digital Mult included as Attachment		r the calibration of t	the trip u	nit (see Ref. 6.14
	Reference Accur Full Scale: Minimum Gradat	300 Vac, 5			
5.4.	Calibration Procedure Da	ata			
	The setting tolerance whe which is taken as a 3 va				4, 6.16 and 6.19
5.5.	Station Data				
	The circuits for these two Environment Zone 26 pe will be subject to:				
	Normal Conditions				
	Control Voltage Range: Temperature Range: Humidity Range: Radiation Level:	95-140Vdc (Ref. 6.14 +18.33 - +39.44°C (s 0 - 90% <10k rads over 40 ye	see Ref. 6.12)		
	Accident Conditions				
	Control Voltage Range: Temperature Range: Humidity Range:	95-140Vdc; 89 Vdc f +18.33 - +39 44°C (s 0 - 100% non-conde	see Ref. 6.12)	4)	
	As noted in Reference 6. relays are installed will be the cubicle. The minimur installed will be approxim cubicle. Therefore, the re 42.22°C.	e approximately 2.78°0 n actual temperature i ately 0.39°C higher th	C higher than the a nside the cubicle w an the ambient tem	mbient to here the perature	emperature outside e relays are e outside the
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.					

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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).

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6.11.	Main Line Engineering Associates (MLEA) Calcu Company, entitled, "Environmental Qualification Equipment for RWCU Line break Environmental	of Dresden Seco	nd Leve	Undervoltage System and
6.12.	DIT Number DR-EPED-0671-01, "Reactor Buildi 92 (Attachment I).	ng Ventilation, M	inimum ⁻	Femperature," dated 5-08-
6.13.	DIT Number BB-EPED-0178, "Undervoltage Rela (Attachment N).	ay Accuracy Calo	culation I	nput Data," dated 5-07-92
6.14.	Interoffice Memorandum from Bipin Desai (EPED which contains information required for assumption			
6.15.	NES-EIC-20.04, Revision 3, "Analysis of Instrum Accuracy" (Not Attached)	ent Channel Set	point Erro	or and Instrument Loop
6.16.	Current Relay Setting Orders for the Second Lev G, Kovach to Craig Tobias dated 07/14/00, which undervoltage relay for Bus 33-1 (Attachment K).			
6.17.	DOC ID 0006191944, Rev. 5-DIT transmitting Im Limits (Attachment L).	proved Technica	I Specifi	cation (ITS) Analytical
6.18.	"Improved Technical Specifications and 24-Month Revision 2 dated 04/28/2000	h Technical Spec	cification	Project Technical Plan",
6.19.	Telecon between John Kovach of ComEd and Cr verifying the relay setting orders for the degraded			
6.20.	EC 8229, ITS Disconnect U3 Watt-Hr Meter At 33	3-1 & 34-1, Rev.	0	

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### 7. CALCULATIONS

- 7.1. Per inputs 5.1 and 5.2.1, the PT has a standard published error of  $\pm$  0.3% and the burden of the PT is within the standard test burden of the PT. Therefore, the maximum error of  $\pm$  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 2 $\sigma$  error. Therefore the PT 1 $\sigma$  error value is  $\pm$  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  $\pm$  0.1% of voltage reading [2 $\sigma$ ]. Dividing by 2 to take to a 1 $\sigma$  value:

RA = 0.05% of reading  $[1\sigma]$ .

7.2.2. Calibration Instrument error (CAL):

The reference accuracy at medium sampling rate (Reference 6.14) of a 60 Hz voltage signal is  $\pm$  (0.2% of reading + 10 least significant digits), to a 2 $\sigma$  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 2 $\sigma$  reference accuracy is  $\pm$  (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  $1\sigma$  value:

 $CALv = \pm (0.2\% \times 112 V + 10 \times 0.01 V)/2 = 0.162 V [1\sigma]$ 

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

CAL = CALv/112 V = 0.162 V / 112 V = 0.145% of reading [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  $\pm 0.2 \text{ V}$  [3 $\sigma$ ]. Converting this to terms of % of reading, for a 112V reading, and dividing by 3 to get the 1 $\sigma$  value:

ST =  $\pm (0.2 \text{ V}) / ((112 \text{ V}) * 3) = \pm 0.060\%$  of reading [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  $2\sigma$  value. Per Section 5.2.2,

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					an of 50 V. Converting the /, and taking to a 1ơ value:
	DR = (± 0.5% of	span) * (120 V – 70 V) /	′ (112 V) / 2 = ± 0	.112% o	f reading
7.2.5.	Random Input Er	ror (ơin)			
	The random inpu Section 7.1 is 0.1	t error present at the re 5%. Thus:	lay is the random	error fro	om the PT, which per
	σin = 0.15%	% of reading [1σ]			
7.2.6.	Drift Tolerance In	terval (DTIv)			
	$DTIv = \pm (RA^2 + Q)$	$CAL^{2} + ST^{2} + DR^{2})^{1/2}$			
	Where RA CAL ST DR Thus:	= reference accurac = calibration error = = setting tolerance = = drift = 0.112% per	0.145% per Sect = 0.060% per Sec	ion 7.2.2	2
		6) ² + (0.145%) ² + (0.060	$(0\%)^2 + (0.112\%)^2$	$(1/2)^{1/2}$	
	DTlv = $\pm 0.199\%$ of reading [1 $\sigma$ ]				
7.2.7.	Total Random Er	ror (ơ)			
	The total random error is the SRSS of the random errors from Sections 7.2.1 through 7.2.6. Therefore:				
	$\sigma = \pm (RA^2 + CAL)$	$^{2} + ST^{2} + DR^{2} + \sigma in^{2})^{1/2}$			
	0	•	a a		4/0

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

 $\sigma = \pm 0.249\%$  of reading [1 $\sigma$ ]

- 7.3. Relay Non-Random Errors
  - 7.3.1. Temperature effect (eT):

Per Input 5.2, the temperature effect is  $\pm 0.75\%$ , and the absolute effect is 1.5% over the temperature range of 0 to  $\pm 55^{\circ}$ 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  $55^{\circ}$ C range results in a rate of  $\pm 0.5\%$  / (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.

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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 6.14). 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  $\pm 0.1\%$  over the dc control voltage range of 100-140 Vdc. This is classified as a non-random error.

 $CV = \pm 0.1\%$  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:

$$\Sigma e_{-} = -eT + (-CV) = (-0.579\%) + (-0.1\%) = -0.679\%$$
 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:

$$\Sigma e^+ = +eT + (+CV) = (+ 0.144\%) + (+ 0.1\%) = + 0.244\%$$
 of reading

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### 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

Σe+ = 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,

 $\sigma_{AV} = DTIv = \pm 0.199\%$  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:

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

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7.5.	Setpoint Determination			
	The setpoints for 4160 V Switchgear 33-1 (Div	. I) and 34-1 (Div. 2)	are cal	culated as:
	Nominal Trip Setpoint for Dropout (NTSI	P _{DO} )= Analytical Limi	t (AL) +	TNE
	NTSP _{DO} = AL + TNE (Usir	ng values from Section	ons 5.6	and 7.4)
	= 3820 V + 46 V =	= 3866 V at 4.19 kV l	ous	
	Converting to voltage read at the relay b	y multiplying by the	voltage	ratio:
	NTSP _{DO-R} = NTSP _{DO} * (120 ^v ) = 110.46 V ≈ 110.	V) / (4200 V) = (3866 5 V at relay	6 V) * (1	20 V)/(4200 V)
	NTSP _{PU-R} = NTSP _{DO-R} / 0.99 = 111.06 V ≈ 111.	95 = 110.5 V / 0.995 1 V at relay		
	From the nominal dropout, the maximum	n dropout and pickup	voltag	es can be determined:
	Maximum Dropout = NTSP _{DO} + TPE = 3895 V at 4.16	E = (3866 V) + (0.74% kV bus	% * 386	6)
	Converting to terms of voltage at t	he relay: (3895 V) *	(120 V	)/(4200 V) = 111.3 V
	Maximum Pickup = Maximum Dropout / = 3915 V at 4.16		) = 389	5 V / 0.995
	Converting to terms of voltage at the	he relay: (3915 V) *	(120 V	)/(4200 V) = 111.9 V
	(The Max. Pickup is the relay Ma	ax. Reset Voltage)		
7.6.				
	Per Section 2.6, the Allowable Value is determ	ined.		
	The lower allowable value for the dropout setpo	oint is determined as	5:	
	$AV_{DOL} \ge SPc -  Z_{AV}+ $ [lower limit]			
	$SPc_{DO} = 3866 V at 4.16 kV bus$ (S	Section 7.5)		
	$Z_{AV} + = 0.398\% \text{ of reading} $	Section 7.4)		
	$AV_{DOL} \ge (3866 \text{ V}) - (0.398\% * (3866 \text{ V})) = 3$	3851 V		
	Converting to voltage at the relay, by multiplyin	g by the voltage ration	0:	
	AV _{DOL-R} ≥ (3851 V) * (120 V) / (4200 V) = 1	10.029 V ≈ 110.0 V		
	Applying the applicable uncertainties to determ	ine the upper dropou	ut AV:	
	$AV_{DOU} \le SPc +  Z_{AV}+ $ [lower limit]			
	$AV_{DOU} \le (3866 \text{ V}) + (0.398\% * (3866 \text{ V})) =$	3881 V		
	Converting to voltage at the relay, by multiplyin	g by the voltage ratio	D:	

# DESIGN ANALYSIS NO. 8982-17-19-2 REVISION 004 PAGE NO. 14 of 15 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 $2\sigma$ value $Z_{AV}$ + = 0.398% of reading (Section 7.4) $ST = 0.2 V [3\sigma]$ (Section 5.4) Taking the ET at a reading of 112V at the relay: ET = $\pm [(0.7 * ((0.398\% \text{ of reading}) * (112 \text{ V}) - (0.2 \text{ V} * 2/3)) + (0.2 \text{ V} * 2/3) = \pm 0.352 \text{ V} \text{ at relay})$ $ET \approx \pm 0.35 V$ at relay The ET is now checked to ensure that the applicable limits are maintained: ST? Check 1: ET ≥ $\pm 0.35 V \geq \pm 0.2 V$ PASS Check 2: $SPc - ET \ge AV$ ? [lower limit] $110.5 - 0.35 V \ge 110.0 V$ 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

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#### SUMMARY AND CONCLUSIONS 8.

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	Field Calibration Setpoint	≥ 110.5 V
127-3(4)-B34-1	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

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# MINOR PLANT CHANGE DESIGN PACKAGE

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FOR

COMMONWEALTH EDISON COMPANY

# DRESDEN STATION

# UNIT 3

REPLACEMENT OF SECOND LEVEL

# UNDERVOLTAGE RELAYS MODIFICATION

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#### 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.

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# 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 OA 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.

	<u>Code</u>	<u>Standard</u>
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.

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E)	ANSI N45.2.2-1978 (*1972)	Packaging, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants.
<b>F)</b>	*IEEE-308-1980 (*1971)	Criteria for Class lE Power Systems for Nuclear Power Generating Stations.
G)	*IEEE-323-1983 (*1974)	Standard for Qualifying Class lE Equipment for Nuclear Power Generating Stations.
H)	*IEEE-344-1975	Recommended Practices for Seismic Qualification of Class lE 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).
0)	DC-SE-002-DR, Rev. 2	Dresden Seismic Design Criteria.
P)	Specification 13524-068-N101, Rev. 1	Bechtel Radiation Study

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Q) Nuclear Station Work Procedures (NSWP), Vol. III, Rev. 1

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- 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

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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	Norma]	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:

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<u>Panel No.</u>	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

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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).

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#### 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.

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# 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:

Туре:	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 בהם C37.98
Catalog No.:	411T4375-HF

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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.

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## 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.

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#### 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.

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#### 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.

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#### 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 safity 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

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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 OC 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 <u>System Interaction</u>

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.

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### 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

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.

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Environmental Qualification

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# 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 IE 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.

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# 5.0 SAFETY-RELATED COMPONENT OR MASTER EQUIPMENT LIST

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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 <u>Material Specifications</u>

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.

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## 8.5 <u>Purchase Orders</u>

Purchase orders for the undervoltage relays have been issued by CECo to the appropriate manufacturer.

## 9.0A AC/DC LOADS

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Input load tickets have been completed to reflect the new model number (ITE-27N) and are included as an attachment (see attachments).

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# 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 (OP 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 <u>Technical Reports</u>

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

No Computer I/O Listings were generated for this minor plant change.

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# 12.0 ATTACHMENTS

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	SAFETY RELATED DC LOAD DATA FORM PAGE 2 OF 4							
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<b> </b>			N:	(30			PRUJ. NU. 3	8100-03
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	SAFETY RELATED DC LOAD DATA FORM PAGE 3_ OF 4_						
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UTILITY: CECo S	TATION: Dres	den	UNIT: 3	PROJ.NO	: 8900-03		
ITEN DESCRIPTION			DATA		NOTES		
A LOAD NAME		- 83					
B LOAD STATUS (E.N. OR M)	M						
C INRUSH CURRENT - AMPS							
D INRUSH DURATION - SECONDS							
E CONTINUOUS LOAD CURRENTS -	MPS 0.05 A	NPS					
F TINE LOAD STARTS - HL ss	0.0						
G LOAD DURATION - HE SS	240.0			<del></del>			
H SOURCE BUS OR PANEL	TB RE	SB	VIS 318-11	┵┵└┠			
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Proposal for 1160 Volt Switchgear For 1600 Volt Auxiliaries, Cont. Dresden Chits 2 and 3

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	1	Insert					se	colum
SWITCHGEAR DATA, Cont. 7		1200 A			2000			000 A
H. Percentage of water absorbed in bus s ports per ASTM Test D570 (plastic) of XXXXXXXXXXXXXXXXX		,05 g	ram	s				
I. Minimum clearance between buses:								
a. Phase-to-phase(inc	hes)				4.	5		
b. Phase-ro-ground(inc	hes)				-3.			
J. Bus spacing center-to-center(inc	hes) 🗕				5.	o —	ļ	
K. Tap spacing center-to-center(inc	hes)				6.	0 —		
L. Type and description of bus joints	••••	Bol	ted		sil	ver	pla	ted
M. Size and material of main bus		Alu	mir	um				
N. Size and material of ground bus		2 X	3	8	Cop	per		
O. Watthour meter		anufact	urei	,		T	уре	
P. Circuit breaker control switch							SBM	
Q. Overcurrent relay		A	11				IAC	
R. Overcurrent ground relay		Gene	ral				IAC	
S. Ündervoltage relay		Elect	tric	2			IAV	
T. Elapsed time meter	• • • •					I	КT	
U. Potential transformer					Å	-1.12		
Accuracy					1	<b>F</b> E <b>\$</b> ;		
V. Current transformer	1					JCS	6-0	
Accuracy	•••• AS	SA.6	в-0		4 E	3-0.2 13-2		3-0,5
W. Cubicle Space Heaters:				•			•	
Watts per cubicle	•••							
Voltage rating								
BUS DUCT ASSEMBLIES (Furnish information both indoor and outdoor designs, where different):	for							
A. High potential withstand test at facto on assembled structure:	ry							
60-cycle (1 minute)(					i		19	

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DRESDEN III OPR-25 Amenament No. 103

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	Res	Marks
(2)	Reactor Low Low Water Level	84" (plus 4, minus 0 inches) above top of active fuel (5)	2.	In conjunction with low reactor pressure initiates core spray and LPCI. In conjunction with high dry-well pressure, 120 sec. time delay, and low pressure core cooling interlock initiates auto blowdown. Initiates MPCI and SBGTS. Initiates starting of diesel generators.
2	High Orywell Pressure (2), (3)	Less than or equal to 2 PSIG	1. 2. 3.	In conjunction with low low water level 120 sec. time delay and low pressure core cooling interlock initiates auto blowdown.
1	Reactor Low Pressure	Greater than or equai to 300 PSIG & less than or equal to 350 PSIG		Permissive for opening core spray and LPCI admission valves. 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 con- tainment 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 con- tainment 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 low pressure core cooling system operation
2/8us	4 KV Loss of Voltage Emergency Buses	Trip on 2930 volts plus or ainus 5% decreasing voltage	1. 2. 3. 4.	Initiates starting of diesel generators. Permissive for starting ECCS pumps. Removes nonessential loads from buses. 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% tole ance) after less than o equal to 5 minutes (plu 5% tolerance) with a 7 second (plus or minus 20%) inherent time dela	17- 17 15	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)

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# ATTACHMENT B

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

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# FLUKE.

# **45** Dual Display Multimeter

**Users Manual** 

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# 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 k $\Omega$  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

# RS-232 and IEEE-488 Reading Transfer Rates

	Reading Per Second		
Rate	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.

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DC Voltage	DC	Vo	ltag	e
------------	----	----	------	---

Range		Resolution			iracy	
	Slow	Medium	Fast	(6 Months)	(1 Year)	
300 mV		10 <i>µ</i> V	100 <i>µ</i> V	002 % + 2	0.025 % + 2	
3 V		100 <i>µ</i> V	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 <i>μ</i> V			0.02 % + 6	0.025 % + 6	
1000 mV	10 <i>µ</i> V	_		0.02 % + 6	0.025 % + 6	
10 V	100 <i>µ</i> ∨	_	_	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 M $\Omega$  in parallel with <100 pF

Note

In the dual display mode, when the volts ac and volts dc functions are selected, the 10 M $\Omega$  dc input divider is in parallel with the 1 M $\Omega$  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	Peak Normal Mode Signal		
		Voltage	NMRR* >80 dB†	NMRR >60 dBt	
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	

# **Common Mode Rejection Ratio**

>90 dB at do, 50 or 60 Hz, (1 k $\Omega$  unbalanced, medium and slow rates)

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# Maximum Input

1000V dc or peak ac on any range

# True RMS AC Voltage, AC-Coupled

Pango	Resolution			
Range	Slow	Medium	Fast	
300 mV		10 µV	100 μV	
3 V	_	100 <i>µ</i> V	1 mV	
30 V		1 mV	10 mV	
300 V	_	10 mV	100 mV	
750 V	_	100 mV	1 V	
100 mV	1 <i>µ</i> V	_	_	
1000 mV	10 <i>μ</i> V		_	
10 V	100 <i>µ</i> V			
100 V	1 mV	_		
750 V	10 mV		_	

# Accuracy

	Line	ar Accuracy		dB Accu	uracy		Max
Frequency	Slow	Medium	Fast	Slow/Med	Fast	Power*	Input at Upper Freq
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	r mode will not	exceed twice	the linear acc	uracy specifica	ation	L	

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	

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## **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 <b>*</b>	125 Ω	16 Ω†			
* Default resistance † Reading displayed in watts (POWER)					

#### Input Impedance

1 M $\Omega$  in parallel with <100 pF

## Maximum Crest Factor

3.0

# **Common Mode Rejection Ratio**

>60 dB at 50 Hz or 60 Hz (1 k $\Omega$  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.

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# **DC Current**

Range		Resolution			Burden
	Slow	Medium	Fast	Accuracy	Voltage
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

## 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  $\Omega$ .

# AC Current

		Resolution		
Range	Slow	Medium	Fast	Voltage*
10 mA	100 nA			0.14 V
30 mA		1 <i>µ</i> A	10 µA	0.45 V
100 mA	1 <i>µ</i> A	10 <i>µ</i> A	100 µA	1.4 V
10 A	100 µA	1 mA	10 mA	0.25 V

	<b>.</b>	Accuracy			
Range	Frequency	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 speci	mA accuracy specifications apply within the following limits, based on reading rate:				
Slow Reading Rate: Between 1		5,000 and 99,999 co	unts (full range)		
Medium Reading F	late: Between 1	,500 and 30,000 ∞u	nts (full range)		
Fast Reading Rate	: Between 1	50 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  $.003\Omega$ .

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# Ohms

	Resolution			<b>Typical Full</b>	Max Current	
Range	Slow	Medium	Fast	Accuracy	Scale Voltage	Through the Unknown
300 Ω		10 mΩ	100 MΩ	0.05 % + 2 + 0.02Ω	0.25	1 mA
3 kΩ	_	100 MΩ	1Ω	0.05 % + 2	0.24	120µA
30 kΩ	_	1Ω	10 Ω	0.05 % + 2	0.29	14 µA
300 kΩ		10 Ω	100 Ω	0.05 % + 2	0.29	1.5 µA
3 ΜΩ		100 Ω	1 kΩ	0.06 % + 2	0.3	150 <i>µ</i> A
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	-		$0.05 \% + 8 + 0.02 \Omega$	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	1Ω			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 κΩ	-		2 % + 2	2.75	320 µA

*Because of the method used to measure resistance, the 100 M $\Omega$  (slow) and 300 M $\Omega$  (medium and fast) ranges cannot measure below 3.2 M $\Omega$  and 20 M $\Omega$ , 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  $\Omega,$  300  $\Omega,$  30 M\Omega, 100 M\Omega, and 300 M\Omega 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 <i>µ</i> V
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.

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# **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  $< 2 k\Omega$ , 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

	Res	A	
Range	Slow & Medium	Fast	Accuracy
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

## 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

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## 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  $<2 k\Omega$ , 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	To 90 % at 0 °C to 28 °C (32-82.4 °F),				
(non-condensing)	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 k $\Omega$ , 3 M $\Omega$ , 10 M $\Omega$ , 30 M $\Omega$ , 100 M $\Omega$ ,and 300 M $\Omega$ 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, 11.27 in deep)	28.6 cm deep (3.67 in high,8.5 in wide,			
Weight	Net, 2.4 kg (5.2 lbs) without 3.2 kg (7.0 lbs) with ba Shipping, 4.0 kg (8.7 lbs) w 4.8 (10.5 lbs) with batt	ithout battery;			
Power Standards	90 V to 264 V ac (no switch maximum	ing required), 50 Hz and 60 Hz < 15 VA			
RS-232-C	Complies with: IEC 348, UL EMC: Part 15 subpart J of F	•			
10-202-0	Baud rates: 300, 600,1200,2400,4800 and 9600 Odd, even or no parity One stop bit				
Options					
Battery (Option -01 K)	Туре	8 V, Lead-Acid			
	Operating Time	8 hours (typical). 🖃 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			

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# ATTACHMENT C

# S&L Interoffice Memorandum from J. F. White

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

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#### INTEROFFICE MEMORANDUM

From J. F. White - 22 x-3172	Date August 14, 1991
Dept./Div. <u>Mech./Component Qualification</u>	Project No.         8900-03           Spec. No.
Client Commonwealth Edison Co. Stn. Dr	esden Unit 2&3
Subject	Undervoltage Relay
Model 27N, Series 411T	
	/
<b>To:</b> 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 "Indervoltage 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 + Cohits

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# ATTACHMENT D

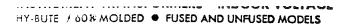
# GE Document 7910 Dated 6-20-77

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2400 to 4800 Volts

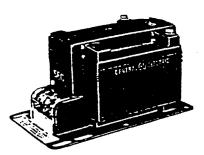
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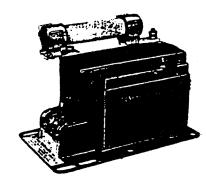
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BIL---60 Kv

June 20, 19

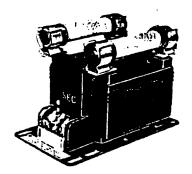


(Photo 1234873) Fig. 1. Type JVM-3 voltage transformer (unfused)



(Ph n 1234874) Type JVM-3 vellage transformer Fig. 2. (one-fuse design)

DIMENSIONS



(Photo 1234875) Type JVM-3 voltage transform (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.

Developed	Olimensions in Inches					
Description	Height	Longth	Width			
Unfused	51%10	10%	6%			
With one primary fuee	74.	10%	6%			
With two primary fuses	74.	10%	61710			

## DATA TABLE (For Pricing Information, see Section 7901)

Transfe Ratins				Rating in i	ANSI Accuracy Classification, 60 Hz Application		Primory Futes			Appro Win L			
				, 	Burden Pi	er ANSI	Burden						
Primary Yoltage	t atio	Cat. No.	55 C Rise above 30 C Ambient	30 C Rise above 55 C Ambient	Operated at Roted Voltage	Operated at 58% Rated Valtage	Impedance as at Rated Valtage, but Operated at 58% Rated Voltage*	Circuit Voit- oge, Line-to- line	Permissible Trans- former Primary Connec- tion	Volt- age Rating	Amp	fuse Cat. Na.	Ship.
INFUS	ED								L				
2400 4200 4800	20-1 35:1 40:1	643X83 643X90 643X95	7 <b>50</b> 750 750	500 500 500	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' 0.3 W', X', M', Y', 1.2 Z' 0.3 W', X', M', Y', 1.2 Z'	4200			 		35 35 35
VITH O	NE PI	RIMARY FUS	E (Neutra	I termina	I insulation to group							•••••	- 35
2400 2400 4200 4800	20:1 20:1 35:1 40:1	763X21G42 643X85 643X91 643X96	750 750 750 750	500 500 500	0.3 W, X, M, Y; 1.2 Z	L 2 W, X, 1.2 M, Y 0.3 W, X, 1.2 M, Y		4160	Y anly Y anly Y anly Y anly Y anly	2400 4800 4800 4800	0.5	9760AAB001 9760BBD001 9760BBD905 9760BBD905	37 37 37 37
יז אזוי	NO PI	RIMARY FUS	ES										
4200	35.1	763X21G40 643X92 643X97	750 750 750	500 500 500	0.3 W, X, M, Y, 1.2 Z 0.3 W, X, M, Y, 1.2 Z 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 T 0.3 W, X, M, Y, 1.2 T 0.3 W, X, M, Y, 1.2 Z	4200	⊼ er ¥1	2400 4800 4800	0.5	9F60AA8001 9F60880905 9F60880905	

correspond to standard ANSI definitions.

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

OFor 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 east 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.

Comple	re revision since Dec	23, 1974 issue. Formerly page 12	5.
SE	700, 701, 702, 7	1-713, 721-723, 731, 733-737	794 Tob 2
CW35,	5W35, CW35IGE,	W35IGE	

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DIMENSIONS

Type JVM-3 50-60 Hz

#### 2400 to 4800 Volts June 20, 1977

RY TERMINALS-The primary terminus 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.

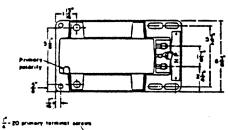
FUSES-Current-limiting fuses, Type EJ-1, are used.

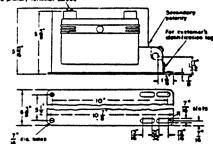
SECONDARY TERMINALS-The secondary terminals are solderless clamp type. The terminal cover is made of transparent plastic. Provision is made for scaling the cover.

POLARITY-See Section 7907, item 6.2.

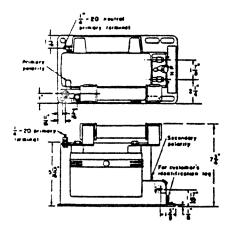
NAMEPLATE-See Section 7907, item 5.3.

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.

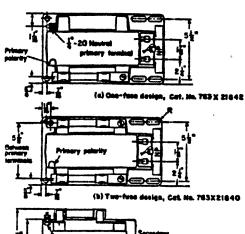




#### Fig. 4. Dimensions of JVM-3 (unfused)



ig. 6. Dimensions of JVM-3 (one-fuse design), Cat. Ne's. 643X85, 643X91, and 643X96. (See Fig. 4 for base)



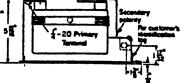


Fig. 5. Dimensions of JVM-3 Cat. No's. 763X21G42 and 763X21G40. (See Fig. 4 for base)

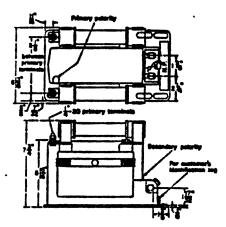


Fig. 7. Dimensions of JVM-3 (two-fuse design), Cat. Nets. 643X92 and 643X97. (See Fig. 4 for base)

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# ATTACHMENT E

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

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

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# ATTACHMENT F

# ABB Instruction Bulletin I.B 7.4.1.7-7, Issue D

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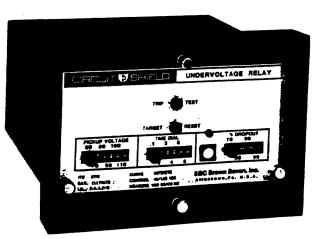
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INSTRUCTIONS

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**

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PrecautionsPage	
Placing Relay into ServicePage	2
Application DataPage	4
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#### 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.

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#### 2. INSTALLATION

#### Mounting:

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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.

#### OROPOUT

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.

operating voltage values other than the specific values provided by the taps Note: 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 charac-teristic 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 :Jay 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.

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#### 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. ۰<u>,</u>۱

		CHARACTERI	STICS OF C	OMMON UNITS		!
-	Distus Deser			Delay	Catalog	
Туре	Pickup Range	Dropout Range	Pickup	Dropout	Std Case	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	1.						7
250	vdc		•	•	•		•	5
2 <b>20</b>	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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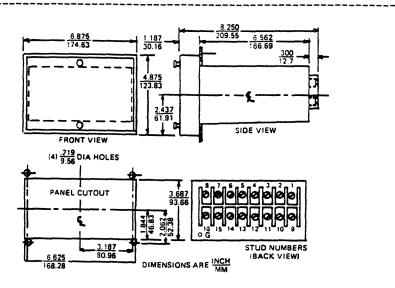
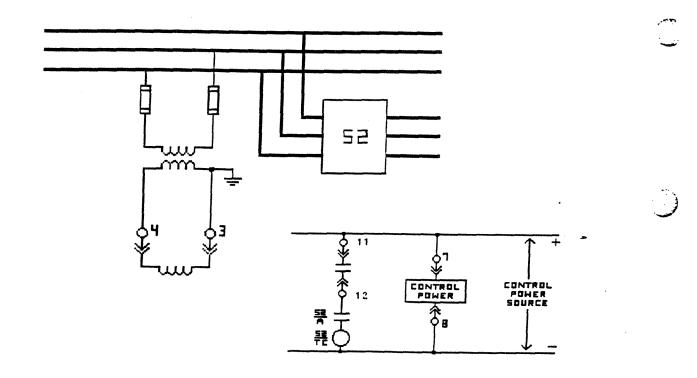


Figure 1: Relay Outline and Panel Drilling





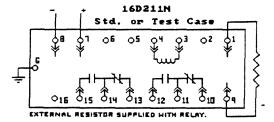
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Figure 3: INTERNAL CONNECTION DIAGRAM AND OUTPUT CONTACT LOGIC

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	



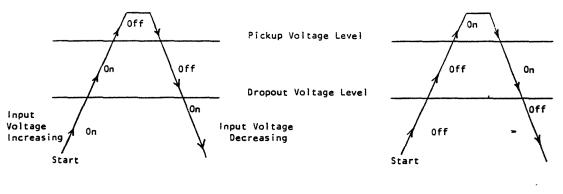


Figure 4a: ITE-27N Operation of Dropout Indicating Light Figure 4b: ITE-59N Operation of Pickup Indicating Light

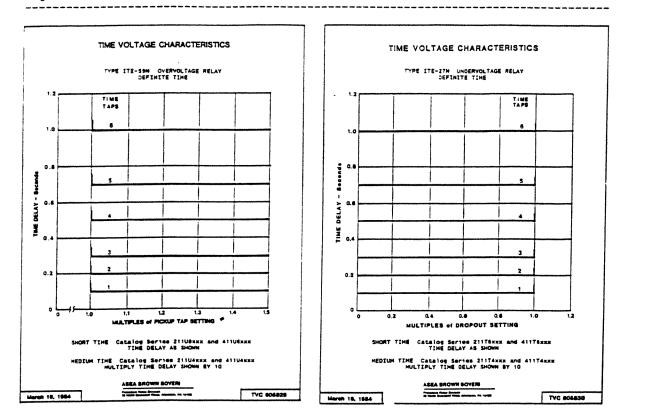
Figure 4: Operation of Pickup/Dropout Light-Emitting-Diode Indicator

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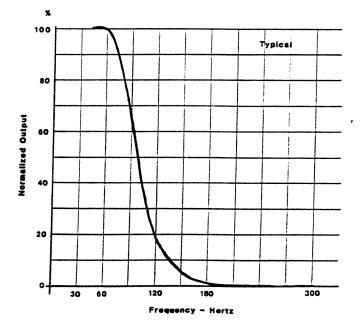


Figure 5: Normalized Frequency Response - Optional Harmonic Filter Module

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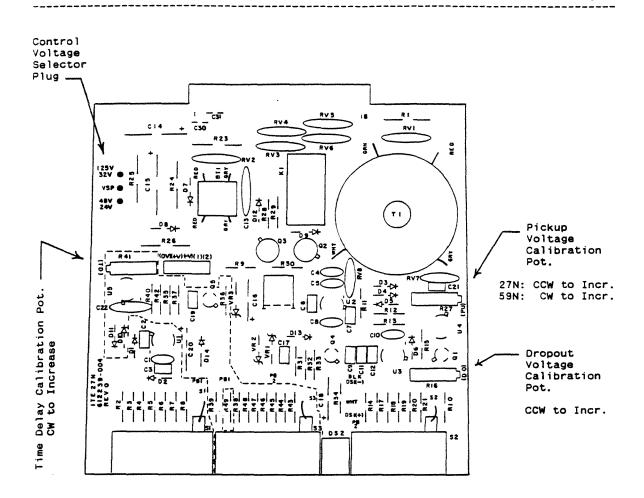


Figure 6: Typical Circuit Board Layouts, types 27N and 59N

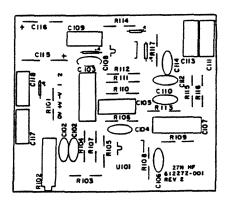


Figure 7: Typical Circuit Board Layout - Harmonic Filter Module

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#### 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.

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#### 4. ACCEPTANCE TESTS

Follow the test procedures under paragraph 5. ... do. ....der 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. 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.

#### 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	oh <b>ms;</b>	( –HF	models	with	harmonic	filter	4000	ohms)
		48/110	vdc:	4000	ohms;	(-HF	models	with	harmonic	filter	3200	oh <b>ms</b> )
		250	vdc:	10000	ohms;	(-HF	models	with	harmonic	filter	9000	oh <b>ms</b> )
		220	vdc:	10000	ohms;	(-HF	models	with	harmonic	filter	9000	ohms)

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Page	F11	of	F12	



 ABB Power Transmission Inc.

 Protective Relay Division

 35 N. Snowdrift Rd.

 Allentown, Pa. 18106
 Issue D (2/89)

 215-395-7333
 Supersedes Issue C

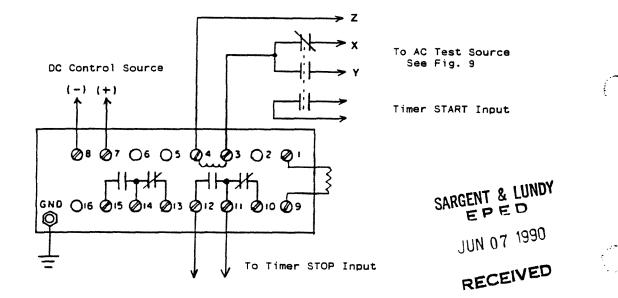


Figure 8: Typical Test Connections

T1, T2	Variable	Autotransformers	(1.5 amp rating)
Т3	Filament	Transformer	(1 amp secondary)
V	Accurate	AC Voltmeter	

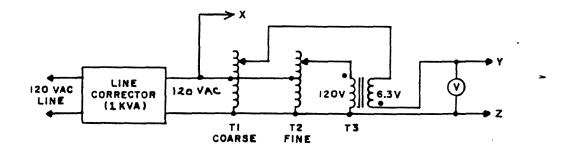


Figure 9: AC Test Source Arrangement

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.

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# ATTACHMENT G

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

Calculation No.		89	82-17-19-2	
Revision		00	4	
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Page	G1	of	G6	

	proverson and only
	3 March 21, 1992)
Xemorandum of Telephone Conversatio	BARGENT & LUNDY
	Date 3/30/92 / Time 11:15 a.m.
Cliff Downs	Company PAX (215) 395-1055 ABE (215) 395-7333
Person Calling H. Ashrafi	Company BEL (312) 269-2041
	Protect No.

Project Subject Discussed: Effect of Temperature on the ITE-27N Relays with Harmonic Filter Units DVPM01

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 37N Relays. He pointed out that the test results for the ITE 37N 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.

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. Notes

CG: C. DOWNS-ABB File: Relays

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TRANSMISSION REPORT

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Page	G2	of	G6	

March 21, 1992

Memorandum of Telephone Conversation

SARGENT & LUNDY

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

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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

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H. Ashrafi

Calculation No.		8982-17-19-2		
Revision		00	4	
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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	192	Total	Pages: 2
TO: Andy R	unde		
Reference:			

cc:____

Andy in the attachment the TYPE TEST Please find certificate for our 27N celay. These are me Hom actual test results labora dur test 04 the results 6. can SEP thèse are in our I. ncally Doubled <u>'</u>2 when published I hope this document will Help satisfy problems your renards

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Page	G4	of	G6	

. جمع ي Temperature Tests:

Temperature	Pickup Voltage	Variation from Room Temperature	Dropout Voltage	Variation from Room Temperature
25°C	100.04v	nas alto das	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%
5 <b>5</b>	100.15	+0.11 %	99.96	+0.01%
70	100.21	+0.17 %	100.10	+0.15%

•

Temperature	Time Delay	Variation from Room Temperatur	
25° C	0.997 sec	ange gas inter and and	
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
22º C	100.12v		100.03v	4000 4000
-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 <b>%</b>

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	Relay Tested:	211T0175-HF	Date of Test: 3/6/84 Tester: C.L. Downs
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		TD	Xarch	21, 199	92	. 1
Memorandum of Tele	phone Conversat	ion		SARGE	t s Li	YON
	/	Date 3/	30/92	Time	11:15	a.m.
Person Called	ITT DOWNS	Company	FAX (2) ABB (2)		-1055 -7333	
Person Calling H.	Ashrafi	Company	<b>SEL (3</b>	12) 269-	-2041	
Project Ou	d Cities	Project No.	8913-7		VPM01	
Subject Discussed:	Effect of Ter Relays with H	araonic Filte	he ITE-27) r Units	7		

Summary of Discussion, Decisions, and Commitments:

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cc: C. Downs-ABB File: Relays

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Page <u>G6</u>	of <u>G6</u>

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# ATTACHMENT H

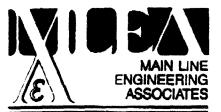
**Calculation MLEA 91-014** 

 Calculation No.
 8982-17-19-2

 Revision
 004

 Attachment:
 H

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 of



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:

bineller Annette M. McHugh

Senior Project Engineer

C.J. Cean

Approved by:

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)
E. 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)

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Calculation Cover Sheet         Calculation No. MEA.81-014           Page 1 of 20         Safety Related II Yes II No           Clent: Commonwealth Edison Company         Disciplins: Environmental Qualification         Disciplins: Environmental Qualification           Project Title: 4KV Second Level Undervoltage Protection         Project No. MO071           Equipment for RWCU Line Break Environmental Conditions         Project No. MO071           Calculation Title: Environmental Qualification of Drescien Second Level Undervoltage System and Equipment for RWCU Line Break Environmental Conditions         Status           Status IPreliminary I Final IVoid         Computer Program:         NA           Computer Program:         NA         Version NA         Vertified I Yes II No           O         Description         Signatures         Date           Original Issue         Present to Monte II P						
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MLEF-103/2 Rev 0

 Calculation No.
 8982-17-19-2

 Revision
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# **Calculation Sheet**

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Attachment 1 - References

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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 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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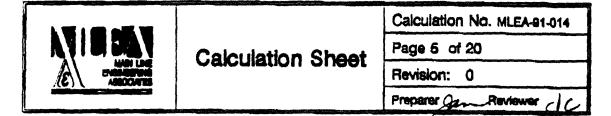
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## 2.0 Statement of Qualification and Summary of the Evaluation

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, Dreeden 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 ETR14D38003 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 Boverl 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

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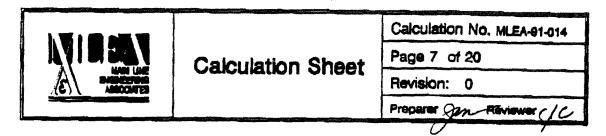
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	Sum	mary Report for Mechanically Equival	ent Device Model 47D, (DIT-71-032)
3.12	Eiec Corr	ASEA Brown Boveri Report RC-5039-A with RC-5139-A, dated 1/10/90, Class IE Electrical Equipment Qualification, 27N undervoltage Relay with Appendix "A", Component Aging Evaluations and Appendix "B", Seismic Summary Report. (DIT-71-032)	
*3.13	and Test	stat Nuclear Environmental Qualification ETR Control Relays by Control Produ Report ES-2000, Rev. A dated 7/11/8 as 1, 2, 3, and 7 are attached.) (DIT 7	0. (Contained in CECo EQ files,
3.14	Sept	Memorandum from C. Collins (CECo/Dreaden) to C. Crane (MLEA) dated September 11, 1991, Subject: Replacement of 2nd Level Undervoltage Relays Dresden Unit 2. (DIT-71-034)	
3.15	CEC Relay	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	Quai	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	018,	Bechtel Specification N102, Rev. 3, dated 10/21/88, Response to IE Bulletin 79- 018, 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. <b>20</b>		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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## 4.0 Qualification Criteria

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

- <u>X</u> 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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#### 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 25 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.

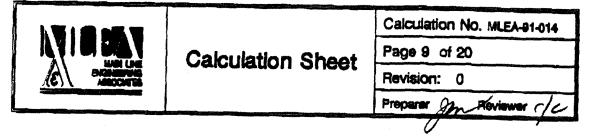
(b) The on-off switch of the Agastat ETR14D3B003 relay was closed to verify that it would change state after approximately 5 seconds.

(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

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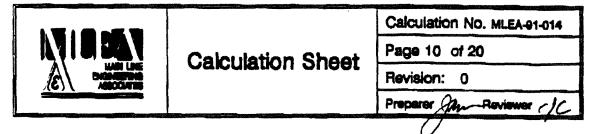


specimens were monitored for any unintended change of state during the HELB test.

- 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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## 6.0 Equipment Description and Similarity to Tested Equipment

The following table lists the equipment installed in Dreeden 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

A88 Type 270 Relay Cat. 211R4175 A88 Type 27N Relay Cat. 411T4375-L-HF-DP Westinghouse FT-1 Switch Style 129A501G01 Agastat Time Delay Relay ETR14D3N002 Agastat Time Delay Relay ETR14D3B002 Agastat Control Relays (2) EGPD002 Marathon 1600 Series Terminal Blocks Hoffman Junction Box Cat. A302420LP Junction Box Back Panel Cat. A30P24 Agastat Relay Socket Base ECR0095001 Agastat Locking Strap ECR0155001 Amer-tite 3' Flex Conduit Top Entry 3' conduit Fitting GE Vulkene 14 AWG SIS Wire Rockbestos 14 AWG Firewall Wire ABB Type 270 Relay Cat. 411R4175 ABB Type 27N Relay Cat. 411R4175 ABB Type 27N Relay Cat. 411T4375-HF-DP Westinghouse FT-1 Switch Style 129A501G01 Agastat Time Delay Relay ETR14D38003 Agastat Control Relays (2) EGPD002 Marathon 1600 Series Terminal Blocks Hoffman Junction Box Cat. A302420LP Junction Box Back Panel Cat. A30P24 Agastat Relay Socket Base ECR0095001 Agastat Locking Strap ECR0155001 Anaconda Sealtite 3" Flex Conduit Top Entry 3" O-Z/Gedney conduit Fitting 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.

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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.

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## 7.0 Salety 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 ourrent 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 dissel generator is started, the incoming breakers are tripped, load shedding is initiated, and the dissel 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).

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## 8.0 Qualified Life

## 8.1 ABB Type 27D and Type 27N solid state undervoltage releva:

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 Amenius 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 data 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 a 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.

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## 9.0 Qualification for Radiation

The second level undervoltage circuitry and equipment for Dreaden Station 4 KVac buses 24-1, 33-1, and 34-1 are located in a mild radiation environment in the event of LOCA. Dreaden 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 fails 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 menner 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 stearn 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 stearn 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 ateam 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

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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:

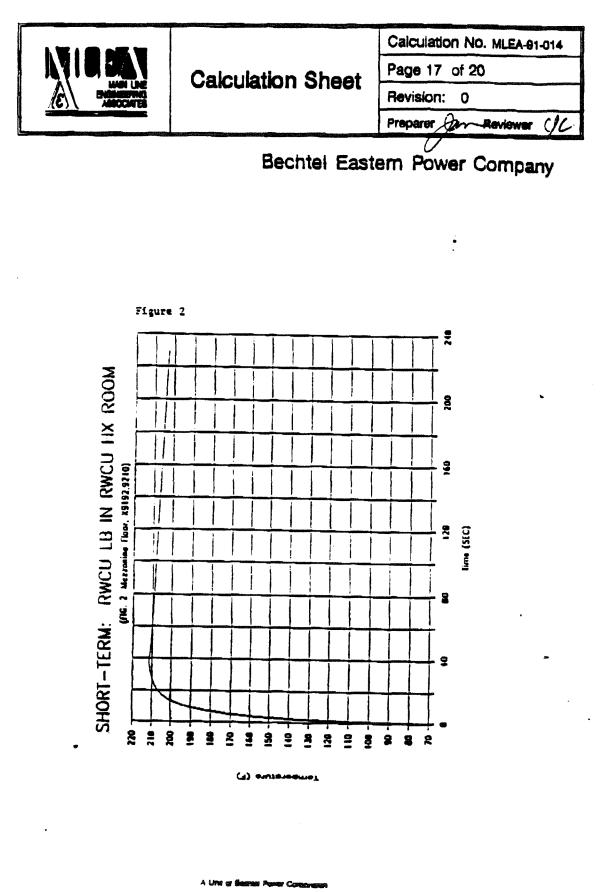
Although Reference 3.8 demonstrates a temperature margin of 4°F to 15°F during the HELB simulation testing, the qualification margin for the Dresden 4KVac Second Level Undervokage Protection Circuitry and Equipment is a Time margin.

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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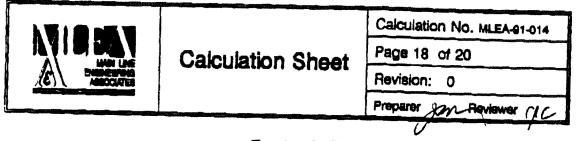
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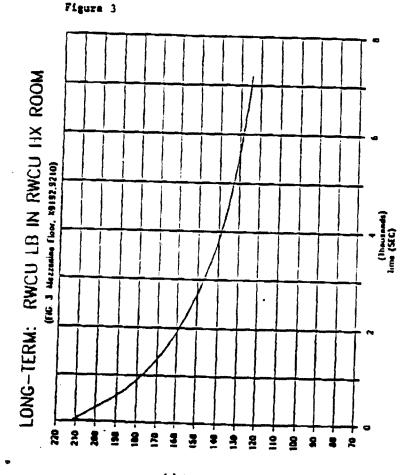


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## 11.0 Synargistic Effects

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 war 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 Meintenance anti Surveilance

## 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 Agentat 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, America 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 Marsthon 1600 Series Terminal Blocks:

Dreaden Station EQ Binder, EQ-48D, Tab E, contains the maintenanc... 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.

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## ATTACHMENT I

## **DIT DR-EPED-0671-01**

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SARGENT & LUNDY		TRANSMITTAL
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9 RESPEN 4 ESPE. 13.11.2-1

## 10.11.2 DESCRIPTION

The plant heating, ventilating and air conditioning system consists of the alements 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

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## ATTACHMENT J

## S&L Interoffice Memorandum from B. Desai

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## DRESDEN STATION

## UNITS 2 AND 3

## DEGRADED VOLTAGE CALCULATIONS ASSUMPTION VERIFICATION

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## 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  $\pm 0.2$  V and setpoints are near 110 V. Therefore, this assumption does not require further verification.

## Follow Up Action

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Incorporate assumption verification in the calculation.

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RELAY SETTING ORDER
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CT. TUEN NA NA NA
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LUE LAG DEG RESET TAP ( 99% RESET TAP D, 99%
IMING FEELS (USE STAP) FSECS (USE STAR)
KESET V. MAY NOT EXCEED 110.12 VOLTS
JAD RECORD KISET V: A-B: 109.58V B-C: 109.60V
SUPERSEDES RSO ISSUED 1-27-973WE 6-2-92 VIC SOM BB W6 4/92
DESIGNATIONS NOT COVERED ACOVE OR DELOW, SUCH AS LINE NO., NEW OR OLD SETTING, ETC.
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
RELAY SETTING ORDER
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SELAY SETTING ORDER PROM STA. ELEC. OR DIV. ENG. STATION /2 - ORESNEL BUS 14-1 KV7.16 TYPEZTE 17N-HE AND B C RESNEL BUS 14-1 KV7.16 TYPEZTE 17N-HE SECOND LEVEL UNDER - VOLTA'S E.
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RELAY SETTING ORDER RELAY SETTING ORDER REATION /2 - RESAEL BUS 14-1 KVR.16 THELTE 17N-HF STATION /2 - RESAEL BUS 14-1 KVR.16 THELTE 17N-HF AND B C C RES = RE BL BUS 14-1 KVR.16 THELTE 17N-HF STATION /2 - RESAEL BUS 14-1 KVR.16 THELTE 17N-HF SECOND LEVEL UNDER - VOLTA'SE TONE OR LICHARACI UV UV SAL ATION 1 NA NA ATION 1 NA NA ATION 1 ANA NA ATION 1 ANA NA ATION 1 ANA 3820 REMARY 1 3784 STATUS 1 ON 1 FO-12 V SAL STATUS 1 ON 1 FO-12 V SAL SAL STATUS 1 ON 1 FO-12 V SAL STATUS 1 ON 1 FO
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## 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

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Caic. For Minimum Control Power Voltage at The Te

of The Second Level Undervoltage Relays

SARGENT & LUNDY

ENGINEERS L

X Safety-Related

Non-Safety-Relat__

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Client	Commonwealth Edison Company		Prepared by	Date
Project	Dresden Station - Units 2 and 3		Reviewed by	Date
Proj. No.	9198-42 Equip. No.		Approved by	Date

- I. The battery chargers are rated at 200A (Reference 16) and are set to currenlimit 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.

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	Calc. For Minimum Control	Power Voltage at The T	
	of The Second Level Under	rvoitage Relavs	
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Client Commonwealth Ediso	n Compeny	Prepared by	Date
Project Dresden Station -	Units 2 and 3	Reviewed by	Date
Proj. No. 9198-42	Equip. No.	Approved by	Date

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 coltages 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. <u>REFERENCES</u>

- 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

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CLUDING COVER SHEET:

DATE: 10/14/93 PAGES INCLUDING COVER SHEET: In KULAGA S+L TO: CLIFF DOWNS - PRODUCT MOR FROM : ZIN **REFERENCE:** MESSAGE: PER YOUR REQUEST THIS TO CONFIRM ALLOWAGLE IS. THAT THE PC CONTROL VOLTAGE RANGE FOR TYPE 27 N WITH HARMONIC FILTER IS 95-140V EXCURSION TO ١ SECOND AND A THAT 89400 OPERATION . AFFECT ITS WILL NOT THE RESISTOR INSTALLED THIS Assumes 9 HAS A BETWEEN TERRINALS | AND 4000 04-15. VALUE OF

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J8</u> of <u>J42</u>

## 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  $70^{\circ}$  and  $75^{\circ}$ 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.

Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J9</u> of <u>J42</u> 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 - Divis		
Primary Trip Setting		
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 - Divis:		
Primary Trip Setting		
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	8 8	7 seconds +/- 20%

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J10</u> of <u>J42</u> 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:

- 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

17.18--

Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J11</u> of <u>J42</u>

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:

Date: Electriz

Approved: - M.

M.F. Pietraszewski E/I&C Design Supervisor

L'unspussion Date: 5-26-52

8-31-92

cc: M.L. Reed T.S. Kriz

D. VanPelt H.S. Mirchandani

MIKE PER YOUR REQUEST-AM ROUNUG 545 ROUNUG X 2760

Page 1 of 1 RSOREQST.DOC

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Calcu	lation N	lo	8982-17	19-2
Revisi	on	004		
Attach	ment:		J	
Page	J12	_ of	J42	

InterOffi	īce 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, we¹ are going to have to determine an alternate course of action.

If you have any questions, please call me on ext. 7648.

ne SI

CC: M.L Reed

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J13</u> of <u>J42</u>

¹The term "we" in this context should be best interpreted to mean "you."

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

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J14</u> of <u>J42</u>

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E.CO. 88-4804	- DRESDE	Ri	3_/ ×	V 4. 16 TYPE []	E-17N-HF	
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RELAY SET	TING ORDER	PROM	STA. ELEC	•	 	DIV. ENG.
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C.T. TURN FATIOS					1,014	ONLY
PANGE (EATING)	70-120%	70-1200				!
SETTING	37841	38704		·		
SEC. SET'G	108.10	110.6v (±	.21)	SET	&TAP +	= 79%
COMPUTED TAPS	1100	llov	110.	6 V S V	RESETS	///./v
TEST A-V CUE LAG DEG	120-201	120V->0V				
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OAD TO	RECEN REM	ET VOLTAGE.	SETT	WES B	ASES ON	I NED "
RFcor.	TE, JARTICA L	ETTER OF	2/10/92	TUCKE	e To	HERWATH .
CHRS	1#180284	ISSUE DATE	2/11/12 11 0	Rs fier	TED 2/13	1920× 117

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J15</u> of <u>J42</u>

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RELAY SET	TING ORDER	FROM -	STA. ELEC.			
C.E.CO. 84-464		_	X STST. PLAN.		}	
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C.T. TURN RATIOS	NA		NA	Wr.C.M.M.		
PANGE L	70-1201		70-110V	1	Uive	
SETTING	3820	হ	3835			
SEC. SET'G	109.15 1	.2V .0	109.57	72V		
COMPUTED TAPS	110 VOLTS	5	110 VOLTS			
TEST A-V CUR. LAG DEG	RESET TAP &	99%	RESETTAT	0,99%		
TIMING	FIECS (U	ESTAP)	7secs (1	SE STAL		
KESET V. MAY NOT EXCEED 110.12 YOLTS						
OAD A	ECORD KES	ET V: A-B	3: 109.58V	B-C : 10	1.60V	
SUPERSE	OFS RSO ISSUE	-27-9 Asue	-2-92-1		5B6 AA-	
"DESIGNATIONS	NOT COVERED AD	OVE OR SELOW, S	UCH AS LINE NO.	NEW OR OLD SET	L.	

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STATION /	- ORESAL			VA. 16 HELAY	= 17N-HF
	8 NS. []	= •	STALL	LEPL. 📋 CHG. 🖞	
· 500	ONO LEVE	2 UNDER	- VOLTA'S	<u>.</u>	
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SEC. SETTO ON	108.1	Ę	109.15 7	1 yours	
COMPUTED	110 VOLTS		110 VOLTS		
TEST A-V CUE LAG DEG	RESETTAR	P.99%	RESET TAR	C99%	
TIMING	FSECSUS	TAP)	7 secs (Vs	ESTAP	
RESET V	MAY NOT	- EYCEER	0 109.7	VOLTS	•
OAD	RECORD	RESET	V: ABrelow=1	H. 22 BC rel	lay = 10919
			-27-92 mm	C COM. 1/20	192 . W. W. M.
DESIGNATIONS	NOT COVERED AU	OVE OR CELOW, S	UCH AS LINE NO	NEW OR OLD SET	TING. ETC.

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J16</u> of <u>J42</u>

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**Commonwealth Edison** Dresden Nuclear Power Station R.R. #1 Morris, illinois 60450 Telephone 815/942-2920

### FACSIMILE TRANSMITTAL SHEET

DATE: 413/92
TO: Mike Tucker
TELECOPIER NUMBER: 7299
FROM: J. Grates
COVER SHEET PLUS PAGE(S)
DO YOU WANT TELECOPY BACK? YES SHOL
IF YOU HAVE ANY PROBLEMS RECEIVING YOUR TELECOPY, Please Call (815) 942-2920 Ext0-
Telecopy # 815-942-2920 Extension 2265

***N O T E S***

Mille, CAM/ACAD procedures and for them

Senti	
Time:	
By 1	

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Calculation No. 8982-17-19-2 Revision __004 Attachment: _____J Page <u>J17</u> of <u>J42</u>

## TESTING OF ECCS UNDERVOLTAGE AND DEGRADED VOLTAGE RELAYS

Requirements:

Technical Specifications Section 4.2, Table 4.2.1

-	ecial Controls/Reviews:	
•	NONE.	, 1
	-	
	ang ta dhin fan de anna an anna an anna an anna an anna an an	
	<u>L. Livers</u> Originator	
	5. Rhee Independent Reviewer/Verifier	r (If Applicable)
	J. Fiedler Department Procedure	e Writer
	H. Korchynsky Department Superv	APPROVED
		NIG 05 '92
ZDOS/1: ZW/198	17 1 of 8	D.O.S.R.

### 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.

#### 8. USER REFERENCES:

1. Technical Specifications:

 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:
  - Relay Calibration Procedure (Supplied by Operational Analysis Department).
- 3. Printe:

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- 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 Z3-1 6 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.
- 122-3335, Relay and Metering Diagram 480 V Switch Groups 35, 36, 37, 38, 39, 4 30 and 4160 V SWGR CUB 15.
- h. 12E-3344, Schematic Control Diagram, 4160 V Buses 33-1 4 34-1 Main Feed BKRS.
- 12E-3345, Schematic Control Disgram, 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.

ZDOS/137 ZW/198

2 of 8

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J19</u> of J42

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#### C. SUPPLEMENTA:

- 1. Checklist A, ICCS Bus Relay Test.
- D. <u>COUIPMENT REQUIRED</u>:
  - 1. Timer (Calibrated per DAP 11-12). Record Serial Number and Calibration Due Date on Checklist A.
  - ●Fluke Model 45 Multimeter. Record Serial Number and Calibration Due Date on Checklist A. ● (W-2, W-3, W-4)
  - Digital Thermometer. Record Serial Number and Calibration Due Date on Checklist A.
- E. PREREOUISITES:

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.
- E. 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.

ZDO5/137 ZW/198

3 of 8

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J20</u> of J42

8.	3.	Acceptance	criteria	is	annotated	by	acceptance	criteria	(AC)
		before the	step.						

I. PROCEDURE:

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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 (TE 33-1 UV) or TS 24-1 UV (TS 34-1 UV) directly below the relay.

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- I. 4. c. Connect the trips by closing Test 5 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.
  - (AC) All operating voltages and trip times are within the tolerances listed on Checklist A.

(Initial or N/A)_____.

a. IE 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)_____

 Notify the Operations Shift Supervisor of test completion and give him the completed checklist.

#### J. DISCUSSION:

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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 IZ Information Notice 84-02, dated June 20, 1984.
- 2. Electrical Distribution System Functional Inspection, July 1991.
- S & L Calculation 8982-13-19-6 Rev. 2, Second-Level Undervoltage Relay Setpoint.
- 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		Voltar	Closure (UV) 87.9 volta	Time to Contact Closure 120 to OV 1.89 to 2.31 sec		
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	
127-1-23-1(33-1)	ļ		L				
127-2-23-1(33-1)							
227-1-28 (38)							
227-2-28 (38)		······································					

# ECCS Bus Degraded Voltage Relay Tests* Ambient Temperature ______*P

Relay	Setti	Lever Setting 5.0 Nominal		Closure (UV) 109.77 V	Time to Contact Closure 120 to 09 5.6 to 8.4 sec		
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	
27-3-23-1							
127-4-23-1			·				
Relay	Setti	Lever Setting 5.0 Nominal		Contact Closure Voltage (UV) 110.77 to 111.17 V		Contact 120 to OV 8.4 sec	
•	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	
27-3-33-1							
27-4-33-1							

	Time to Contact Closure 5 min to 5 min, 15 and
IDR 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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CHECKLIST A (Continued) ECCS BUS RELAY TEST

### Prerequisites Complete: Initial/Date__/___

Unit _____

# ECCS Bus Undervoltage Relay Test (Tap setting is 93)

- ----

Relay	Lever Setting 1.0 Nominal		Voltage		Time to Contact Closure 120 to OV 1.89 to 2.31 sec		
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	
127-1-24-1(34-1)	ļ					L	
127-2-24-1(34-1)							
227-1-29 (39)							
227-1-29 (39)							

# ECCS Bus Degraded Voltage Relay Tests*

Ambient Temperature

Relay	Leve Setti 5.0 Nor	- 1 <b>2</b>	Voltag	Clesure (UV) 109.35 V	Closure	Contact 120 to OV 8.4 sec
	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
127-3-24-1						
127-4-24-1						+.~
Relay	Settin	Lever Setting 5.0 Nominal		Closure e (UV) 110.8 V	Time to Contact Closure 120 to O 5.6 to 8.4 aec	
÷	FOUND	LEFT	FOUND	LEFT	FOLIND	LEFT
127-3-34-1			ļ			<u> </u>
<u>127-3-34-1</u>						{

	Time to Contact Closure 5 min to 5 min, 15 aug
TDR 24-1 (34-1)	
	Time to Contact Closure 1.8 to 2.2 sec
27570 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)	)
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### ECCS BUS RELAY TEST

Abnormal Findings and Comments:	
Timer Serial Number	Voltmeter Serial Number
Calibration Due Date	Calibration Due Date
OAD Representative	Digital Thermometer
	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 evaluatic. 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.

Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J26</u> of <u>J42</u>

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# CHRON # 179957

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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/I4C 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: The Juska

M.S. Tucker Senior Engineer

Date: 2/2/92_

Date: 2/2/92

Approved: 1

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 M.H. Richter D. Taylor B.M. Viehl M.C. Strait G.A. Gates S.A. Lawson NEDCC

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# 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.

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# 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.

Page 1			
CCSW Pump	ESS Division	In Vault?	CCSW Cubicle Cooling Fans
A	Division I	No	None
В	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
	Division II	No	None

Table 1

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  $9.9 \times 10^{-12}$  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.

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J29</u> of <u>J42</u>

## 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 calculation 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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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J30</u> of <u>J42</u> 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

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J31</u> of <u>J42</u> 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  $130V \pm 1\%$  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.

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J32</u> of <u>J42</u>

### 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  $3820 \pm 7$  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.

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J33</u> of <u>J42</u> 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.

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J34</u> of <u>J42</u>

In Reply, Refer to

cmm + 180914

Mr. C.W. Schroeder Station Nanager Dresden

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Subject: Safety Assessment Degraded Voltage Dresden Unit 3

#### Dear Mr. Schroeder:

The Electrical/ISC group of the Nuclear Engineering Department has assessed the affacts 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 enhicle cooling fams, the battery chargers, certain 120V contactors being subjected to a lower voltage than the manufacturer's recommended value and the use of test date 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, plasse call Mike Tucker on extension 7648 at Downers Grove.

Prepared: Zestanten X.S. Tuckez

Senior Engineer ME

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Data: 2/12/92

Date: 2/11/92

Approved: _____

Z/IIC Design Superintendent

E.L. Massin

D.L. Taylor

X.C. Strait

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attachmants

c <b>c :</b>	C.A.	Grier
	R.M.	Radtka
	B.M.	Viehl
	8.λ.	Laveon

N.F. Pietrasrevski M.H. Richter G.A. Gates

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# 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 Cubicia 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 values 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 values. Therefore, these pumps do not require cooling fans. Only one CCSW pump is required per the FSAR.

		Table 1	
CCSW Pump	ESS Division	in Vauit?	CCSW Cubicle Cooling Fans
A	Division I	No	None
8	Division 4	Yes	A Fan 1, A Fan 2, B Fan 1 and B Fan 2
С	Division II	Yes	C Fan 1, C Fan 2, D Fan 1 and D Fan 2
٥	Division II	No	None

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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 O. 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  $9.9 \times 10^{-12}$  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.

Attachment U3SADVA_DOC Page 1 of 6 DRSDN EDSFRU3ATT.DOC 2/18/92 9:16 AM

> Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J36</u> of <u>J42</u>

# 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 terminel voltage of 342.7 Volts under starting conditions. This is 74%% 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 Volte available for starting (76% of rated).

The vendor of the Diesel Generator Cooling Water Pumps (DGCWP), Champump 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 Volta) 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 1/6/82.

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 trin 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

Amenment USSADVA.DOC Page 3 of 6 DRSDN EDS/RUSATT.DOC 2/18/82 9:15 AM

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J38</u> of <u>J42</u> 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 Ampares 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  $130V \pm 1\%$  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 (85.8% 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.

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### 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  $3870 \pm 7$  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 8982-17-18-1 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. Reising the relay setpoint to meet the conservative vandor 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 values 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.

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J40</u> of <u>J42</u> The minimum expected voltage on the 4kV bus is 3924 Volta. (M.L. Reed, Evaluation of Dreadan 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.

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page J41 of J42

#### 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 they W.R. No.: D-97548

Follow Up Action

Incorporate assumption verification in calculation.

Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>J</u> Page <u>J42</u> of <u>J42</u>

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# ATTACHMENT K

# RSO's for 2nd LvI UV Relays & E:Mail from J. Kovach

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RELAY SET	TING ORDER	FROM	STA. ELEC.	10T - OR_	DIV. E
STATION 5	TA. 12 DRESDE	Y Bus 3	4-1 4.16 K	N RELAY T	TE ZTN-R
AD . D	1 PES. []	= 0 • 0		REPL. CHG. [	
• 4.16	KU BUS 34.	-1 Second	Covar UND	GRUOLTAGE	1
ZONE OR EL.(CHARAC)	UV (ITE 27N-	٤) ·.			
P.T. (P.D.) RATIO	35:1		. (SEE 143d	6 T. Malo LAR)	
C.T. TURN RATIOS	N/A			. <i>T</i>	
RANGE (BATING)	70-120 V	,		• • •	
PRIMARY	3871 ±74	シレナリ		· · ·	
SEC. SET G	110.6 ± 0.	2 VOLTS		· · ·	
COMPUTED TAPS	110 VOLTS PICH			•	
TEST A-V CUR. LAG DEG	ADJUST DROP			75	- -
TIMING	17.0 sec = 24				
	D/EFIC CH				
	ISSUED TO C				AND TU
MAKE IT	ICHMANONT.	ISSUE DATE	10-31-96 .T	JM FORTIBILIS	96 or H
*DESIGNATIO	NS NOT COVERED A	OVE OR BELOW,	SUCH AS LINE NO	NEW OR OLD SE	TTING, ETC.

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Calculation No. <u>8982-17-19-2</u> Revision <u>004</u> Attachment: <u>K</u> Page <u>K2</u> of K4

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RELAY SET		FROM	STA. ELEC. SYST. PLAN.		DIV. ENG.		
STATION /2	-DRESDER	u Bus.		VF. 16 TYPE I	TE 1.7N-R		
	M #5.	= 🗋 🔍 🖳 🗋	STALL STALL	REPL. 📋 CHG.			
· 4. 15 KV	1 Bu= 33-	! SECOLO	FEREL UN	DERVOLTAG	¢.		
ZONE OR EL.ICHARACI	UV (ITE	17N)	UVITE	X7N-RJ			
P.T. (P.D.) RATIO	35:1		351				
C.T. TURN L	NIA		NA				
RANGE (RATING)	70-120V	36	70-11= V.				
PRIMARY 11	3887 = 74	nit's	3884V±7	VOLTS			
SEC. SET G A		0.2 Kars K		0.2 YerT=			
COMPUTED I TAPS	110 VOLT=		11.0 Voit=				
TEST A-V CUR. LAG DEG	RESET TAP	29973	RESET TA	AC 99%	1		
TIMING	I. AGAS	TATE FER.		· · · · · · · · · · · · · · · · · · ·	T		
REPLACE ITE 17N RELAT IN ITE 17N-R							
REMOVE	- AGASTA	F TIMER	• • •				
	•	ISSUE DATE	3-16-94	K COM. 4	14-14 or GB		
DESIGNATION	S NOT COVERED A	BOVE OR SELOW.	SUCH AS LINE NO	NEW OR OLD S	TTING. ETC.		

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nor: John.G.Kovach@ucm.com at nxmime e: 7/14/00 10:20 AM ***: Normal Craig tobias at SNLPOBIA Thomas.J.Meno@ucm.com at nxmime oject: 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 copout/pickup ratio will be reflected in the next revision of the RSO that .11 be required to implement the new setpoint changes.

egards,

ohn G. Kovach resden X-3645 //I&C Design Engineering

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# ATTACHMENT L

# DOC ID 0006191944

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# Dresden Station Design Information Transmittal

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[X]Safety-Related		Design Information Transmittal	DOC II	D _0006191944	
[]Non-Safety-Relate	d	Dresden Station	Revisio	n – 05	
[ ]Augmented Qualit	y	Unit(s): 2 and 3	Page_1	of3	
To: <u>Mr</u> . William	A. Bar	158			
Organization:	Sar	gent & Lundy LLC	-		
Address/Location:	¹ 55 1	E. Monroe, Chicago, IL 60603-5780	ï		
Subject: Improved Tech	nical Sp	ecification (ITS) Analytical Limits			
Status of Information	: 🛛 Ve	erified 🗌 Unverified			-1
		lethod and Schedule of Verification in the "Des verification of "Unverified" information:	scription of	Information."	
	_	The attached table identifies the Analytic			
included in the Methodo Undervoltage (Degraded 9198-18-19-3 Rev. 3 & LOCA) Setpoint and To frequency for Condensa calc.#8982-13-19-6 (DC and vendor data. Purpose of Issuance: The	logy se Voltag 9198-11 lerance æ Stora R# 990	current Technical Specification LCO val ection of each calculation prepared. Rev ge) value to 3820 volts per Calc. # 9198- 8-19-4 Rev.3. Rev. 3 of this DIT changes per page 3. Rev. 4 of this DIT changes ge Tank Level. Rev. 5 of this DIT chan (552) and 8982-17-19-2 (DCR# 990560)	v. 2 change -18-19-1 R es 4160V ] device typ ages the cal due to no Revision (	2 4160V ESS Bus Rev.3, 9198-18-19-2 Rev. ESS Time Delay (No pe and calibration libration frequency of thaving valid site specifi 03 dated 7/05/00 in its	
imitations: None		Allowable Values for the ITS calculation	ons submit	ital.	
References (Source of I Current Technical Specif		tion): DCR#990552 & 990560			
	J. Patel		Date:	9/5/00	I^
eviewed by: Dale	R. Eama	n/ Dale Eama Printed Name / Signature	Date:	9-6-00	_
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	v. 1000		Date:	9-6-00	
istribution: Doc ID Fi		Printed Name / Signature Printed Name / Signature	-	<u>9-6-0-</u>	

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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	21	Deleted. See DRE00-0035 for new values.	Time Delay Relay	24M
Dresden	LPCI Rx Vsi 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	30	≤ 15 feet-8 1/4 inches **	Mech. Displacer Switch	24M
	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	41	≤ 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
	HPCI Steam Line Flow Timer	3.3.6.1-1	3b	$\geq$ 3 seconds and $\leq$ 9 seconds	Time Delay Relay	92D
	Low Set RV Reactuation Time Delay	3.3.6.3-1	1b	$\geq$ 8.5 seconds and $\leq$ 11.5 sec.(Note 1)	Time Delay Relay	24M
	4160V ESS Bus Undervoltage (Loss of Voltage)	3.3.8.1-1	1	≥ 2784 volts and ≤ 3076 volts	Protective Relay	24M
	4160V ESS Bus Undervoltage Time Delay	3.3.8.1-1	2a	$\geq$ 5.6 seconds and $\leq$ 8.4 sec.	Time Delay Relay	24M
	4160V ESS Bus Undervoltage (Degraded Voltage)	3.3.8.1-1	2a	≥ 3820 volts (Note 3)	Protective Relay	Note 4
	4160V ESS Time Delay (No LOCA)	3.3.8.1-1	2b	≥ 270 seconds and ≤ 330 sec (See page 3	) Time Delay Relay	24M
	RPS Elec. Power Monitoring - Overvoltage Trip	3.3.8.2	SR 3.3.8.2.2a	≤ 129.6 volts	Protective Relay	24M
	RPS Elec. Power Monitoring - Undervoltage Trip	3.3.8.2	SR 3.3.8.2.2b	≥ 105.3 volts	Protective Relay	24M
	RPS Elec. Power Monitoring - Underfrequency Trip	3.3.8.2	SR 3.3.8.2.2c	≥ 55.4 Hz	Protective Relay	24M
	RPS Elec. Power Monitoring-Overvoltage Time Delay	3.3.8.2	SR 3.3.8.2.28	( A seconds (Note 2)	Time Delay Relay	24M
		1		< 4 seconds (Note 2)	Time Delay Relay	24M
Dresder	RPS Elec. Power Monitoring-Undervoltage Time Delay RPS Elec. Power Monitoring-Underfrequency Time	3.3.8.2	SR 3.3.8.2.2b SR 3.3.8.2.2c	( A company ( ) ( ) ( )	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: Aliowable 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).

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# Doc JD #0006191944 Rev. # 5

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."

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.

40, Koran 713/2000

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TOHN G, KOVACH

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# ATTACHMENT M

Telecon Between J. Kovach (ComEd) and C. Tobias (S&L)

 Calculation No.
 8982-17-19-2

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 004

 Attachment:
 M

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4/20/00 3:13 PM
Date:
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-----
            craig_tobias@mail.sargentlundy.com
> From:
 > [SMTP:craig tobias@mail.sargentlundy.com]
           Thursday, April 20, 2000 9:15 AM
> Sent:
           john.g.kovach@ucm.com
> To:
 > Subject:
               Telecon Documenting RSOs
>
> John,
 5
 > 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
               Issued 2/11/86 Completed 3/1/86
 > 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
 >
 > Degraded Voltage Relay RSOs
               Issued 6/27/96
 > Bus 23-1
               Issued 7/11/96
 > Bus 24-1
> 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
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 Calculation No.
 8982-17-19-2

 Revision
 004

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being > performed. > > Thank you for your time and support. > > Yours truly, > Craig Tobias > Sargent & Lundy, LLC > 312-269-6577 ******* ******* This E-mail and any of its attachments may contain Unicom proprietary information, which is privileged, confidential, or subject to copyright belonging to the Unicom family of Companies. This E-mail is intended solely for the use of the individual or entity to which it is addressed. If you are not the intended recipient of this E-mail, you are hereby notified that any dissemination, distribution, copying, or action taken in relation to the contents of and attachments to this E-mail is strictly prohibited and may be unlawful. If you have received this E-mail in error, please notify the sender immediately and permanently delete the original and any copy of this E-mail and any printout. Thank You. ********* ****** ......

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# **DIT BB-EPED-0178**

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BARGENT & LUNDY	DESIGN INFORMATION	TRAD
SAFETY-RELATED	NON-SAFETY-RELATED	DIT No. BB-EPED-0178
LINNT Commonweal	th Edison Company	Page <u>1</u> of <u>1</u>
BTATION Byron/Brai	<u>dwood(8) 1 &amp; 2</u>	To <u>J.B.Wisniewski-25</u>
PROJECT NO(8) 8915-8	8	
UBJECT Undervolta	ge Relay Accuracy Calculation I	nput Data
ODIFICATION OR DESI	GN CHANGE NUMBER (8) <u>N/A</u>	
J. J. Bojan	EPED Moren	<u>5-7-92</u> Isaut Date
TATUR OF THROPHATTO	(This information is approved for use. Design Information, appro	
sliminary or requires further verification (	review) shall be so identified.)	for use, that contains assumptions or is
his information is a	manual for use and an address of	
als information is a	approved for use and requires no	b further verification.
ISSUE(List any supporting docum	SPECIFIC DESIGN INFORMATION TH ents attached to DIT by its title, revision and/or issue date, and tot tion is for use in the preparat Y calculation:	al number of pages for each supporting document
Switchgear Room	Environmental Conditions	
- Minimum Temp.	= 65° F = 5.3	· ·
- Maximum Temp.	$= 108^{\circ} F = 4^{2}$	
- Relative Humi		
- Radiation exp		
- Internal Swite	chgear Temp. Rise = $\leq 5^{\circ}$ F	
Potential Transfo	Armer Data	
	200 - 120 V; Model 9146D46G02	
- Accuracy = 0.3	BW, X, Y and 1.2 Z	
<u>References</u>		
1. UFSAR Section		
a) 9.4.5.4.2		
b) 3.11 (Tab	le 3.11-2)	
2. Westinghouse	Instruction Book, Volume 3A (Du	/g. 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)
RCE OF INFORMATION		
.c. NoN/2	AReport No	
Rev. and/or date		Rev. and or date
er <u>See above</u>		
TT-JUTION	<b>A</b>	
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-3.17.1, Rev. 2(01-08-87)		

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.

B-IRON WALKDOWN

DATA COLLECTED USING INSTRA BY 444 1 LUKE 8024B MULTI METER W/FLUKE 80T-150 TEMP. PRO:

OUTSIDE AIR TEMP (NEAR UNIT I TRACKWAY) 79.8° AT 1:25

BUS	INSIDE SWGR CUB.	OUTSIDE SUGR 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 TOOR WAS OPENED & TEMPERATURE READ IMMEDIATELY. TEMPERATURE TAKEN INSIDE CUBICLE WHICH CONTAINS ITE DESEADED NOLTAGE RELAY.

NOTE: BOTH UNITS OPERATING AND NENTILATION SYSTEMS IN ALL SWGR BUS ROOMS OPERATING. THE TEMPERATURE OUTSIDE THE CUBICLE WAS MEASURED NEAR THE SUPPLY AIR DUCT TO ENSURE THE COLEST TEMPERATURE (RESULTING IN THE GREATEST TEMPERATURE DIFFERENTIAL) WAS RECORDED.

PREPARED 5-11-92 VERIFIED Dame 5-11-97

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#### **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. <u>Material</u> None
- 2.2. <u>Special Equipment</u>
- 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. <u>Precautions</u>
- 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. <u>Prerequisites</u>
- 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. <u>Control Isolation</u>
- 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 <u>not</u> 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. <u>Functional Testing</u>

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. <u>Commitments</u> 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. <u>References</u>
- 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. <u>Control Isolation</u>
- 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

WV 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. <u>Relay Calibration</u>

3.1. **REMOVE** relays from 4 KV Bus 23-1 Cubicle 13 listed below and Initial/Date.

Relay Number	Service Description	<u>Relay Type</u>	<u>WV/Date</u>
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).

 $\frac{1}{CV}$  /  $\frac{1}{Date}$   $\frac{1}{WV}$  /  $\frac{1}{Date}$ 



#### ATTACHMENT 1 Relay Routine for 4 KV Bus 23-1 Undervoltage Relays Page 3 of 11

3.3. **CALIBRATE** 127-1-B23-1.

WV / 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.

WV / Date

3.3.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

WV / 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.

WV / Date



#### ATTACHMENT 1 Relay Routine for 4 KV Bus 23-1 Undervoltage Relays Page 4 of 11

3.4. **CALIBRATE** 127-2-B23-1.

WV Date

Allowable Value:79.91 VAC < VAC < 87.52 VAC</th>Expanded Tolerance:80.86 VAC < VAC < 86.50 VAC</td>Setting Tolerance:81.00 VAC < VAC < 86.40 VAC</td>Recommended Setpoint:83.7 VAC

3.4.1. IF setting is outside the Allowable Value, THEN NOTIFY the Unit Supervisor.

WV / Date

3.4.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

WV / 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.

WV 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

#### Functional Testing with Bus 23-1 Energized 4.

- 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. WV 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.

WV 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. WV Date

**REMOVE** upper and lower relay connection paddles from IAV69A relay 127-2-B23-1 at 4.4. 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.

_/____ 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.

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.

4.5.3. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X3 actuates.

WV / Date

WV Date

4.5.4. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X4 actuates.

WV / Date

WV / Date

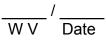
WV Date

4.5.5. Breaker Close Undervoltage Agastat Timer relay 27XTD-23-1 actuates.

- 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.
- 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.

WV[/]Date

4.7.2. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X2 resets.





#### **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.

4.7.4. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X4 resets.

WV Date

WV / Date

4.7.5. Breaker Close Undervoltage Agastat Timer relay 27XTD-23-1 resets.

WV Date

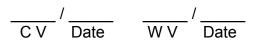
#### 5. Bus 23-1 Undervoltage Relays Functional Testing with Bus De-energized

- 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.
- VERIFY that Bus 23-1 Undervoltage HFA Auxiliary relays 127B23-1X1, 127B23-1X2, 5.1. 127B23-1X3, and 127B23-1X4 are actuated.

WV Date

5.2. **OPEN** test switch TS 23-1UV "E" at Panel 2252-83.

PLACE a jumper between test switches TS 23-1 UV "F" and "G" on Panel 2252-83. 5.3. VERIFY that Agastat relay 459X1-23-1 actuates.





#### **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-WV / Date 1X1, 127B23-1X2, 127B23-1X3, and 127B23-1X4 remain actuated.
- 5.5. **RELEASE** relay disc to its de-energized position.
- 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.

5.6.3. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X3 resets.

WV Date

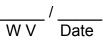
5.6.4. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X4 resets.

5.6.5. Breaker Close Undervoltage Agastat Timer relay 27XTD-23-1 resets.

WV 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.



WV / Date

WV / 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.

5.7.3. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X3 actuates.

WV Date

5.7.4. Bus 23-1 Undervoltage HFA Auxiliary relay 127B23-1X4 actuates.

WV Date

5.7.5. Breaker Close Undervoltage Agastat Timer relay 27XTD-23-1 actuates.

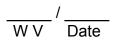
**REMOVE** jumper between test switches TS 23-1 UV "F" and "G" on Panel 2252-84. 5.8. **VERIFY** that Agastat relay 459X1-23-1 resets. CV Date WV Date

5.9 CLOSE test switch TS 23-1UV "E" at Panel 2252-83.

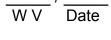
 $\frac{1}{CV}$  /  $\frac{1}{Date}$   $\frac{1}{WV}$  /  $\frac{1}{Date}$ 

Bus 23-1 Undervoltage Relays Trip Restoration 6.

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.



WV Date





#### ATTACHMENT 1 Relay Routine for 4 KV Bus 23-1 Undervoltage Relays Page 10 of 11

6.2. **REPLACE** relay covers.

WV Date

6.3. **REVIEW**, **INITIAL and DATE** appropriate data sheets.

WV / 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. <u>Return to Normal</u>
- 7.1. **VERIFY** all relays are reset (or actuated if Bus 23-1 de-energized).

WV / Date

7.2. **VERIFY** targets reset (or actuated if Bus is 23-1 de-energized).

WV / Date

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

	/
WV	Date



#### ATTACHMENT 2 Relay Routine for 4 KV Bus 24-1 Undervoltage Relays Page 1 of 10

- 1. <u>References</u>
- 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. <u>Control Isolation</u>
- 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



#### 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. <u>Relay Calibration</u>

3.1. **REMOVE** relays from 4 KV Bus 24-1 Cubicle 3 listed below and Initial/Date.

<u>Relay Number</u>	Service Description	Relay Type	<u>WV/Date</u>
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).



#### ATTACHMENT 2 Relay Routine for 4 KV Bus 24-1 Undervoltage Relays Page 3 of 10

3.3. **CALIBRATE** 127-1-B24-1.

WV / Date

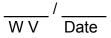
Allowable Value:79.91 VACExpanded Tolerance:80.86 VACSetting Tolerance:81.00 VACRecommended Setpoint:83.7 VAC

80.86 VAC < VAC < 86.50 VAC 81.00 VAC < VAC < 86.40 VAC 83.7 VAC

79.91 VAC < VAC < 87.52 VAC

- 3.3.1. **IF** setting is outside the Allowable Value, **THEN NOTIFY** the Unit Supervisor.
- 3.3.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

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.





#### ATTACHMENT 2 Relay Routine for 4 KV Bus 24-1 Undervoltage Relays Page 4 of 10

3.4. **CALIBRATE** 127-2-B24-1.

WV / Date

Allowable Value:79.91 VAC < VAC < 87.52 VAC</th>Expanded Tolerance:80.86 VAC < VAC < 86.50 VAC</td>Setting Tolerance:81.00 VAC < VAC < 86.40 VAC</td>Recommended Setpoint:83.7 VAC

- 3.4.1. IF setting is outside the Allowable Value, THEN NOTIFY the Unit Supervisor.
  - WV / Date
- 3.4.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

	/
WV	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.

WV / 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	



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#### ATTACHMENT 2 Relay Routine for 4 KV Bus 24-1 Undervoltage Relays Page 5 of 10

- 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.

WV / 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.

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.

WV 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.

WV Date



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#### ATTACHMENT 2 Relay Routine for 4 KV Bus 24-1 Undervoltage Relays Page 6 of 10

4.5.2. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X2 actuates.

WV / Date

4.5.3. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X3 actuates.

WV / Date

WV / Date

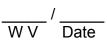
4.5.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-24-1 actuates.

- 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.
- 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.

WV[/]Date

- 4.7.2. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X2 resets.
  - WV / Date
- 4.7.3. Bus 24-1 Undervoltage HFA Auxiliary relay 127B24-1X3 resets.
- WV / Date

4.7.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-24-1 resets.





#### **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. WV Date

WV Date

WV Date

5.2. **OPEN** test switch TS 24-1UV "E" at Panel 2252-84.

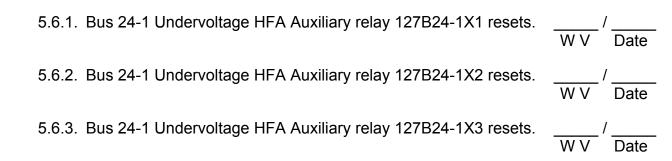
 $\underline{-}$   $\underline{-}$   $\frac{-}{\overline{-}}$   $\frac{$ 

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.

 $-\frac{1}{CV}$  / Date WV / Date

- ACTUATE IAV69A relay 127-1-B24-1 at Bus 24-1, Cubicle 3 by moving relay disc to its 5.4. energized position. VERIFY that Bus 24-1 Undervoltage HFA Auxiliary relays 127B24-1X1, 127B24-1X2, and 127B24-1X3 remain actuated.
- 5.4. **RELEASE** relay disc to its de-energized position.

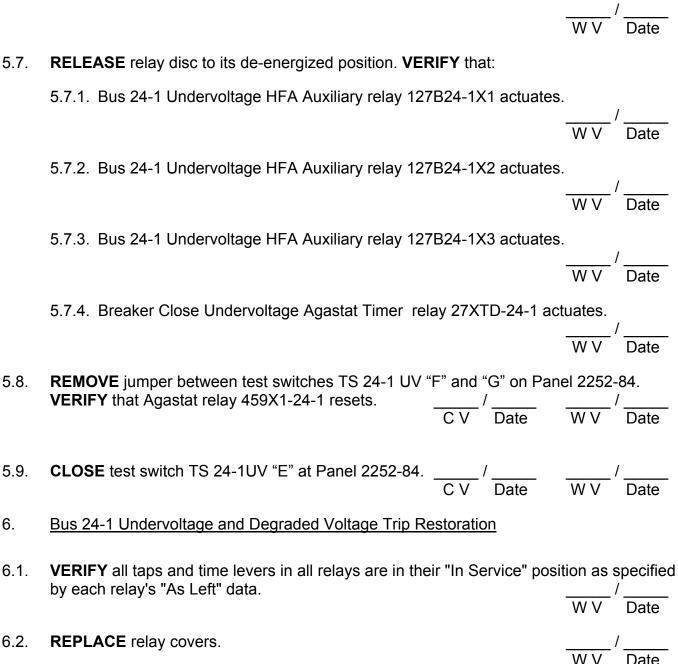
5.6. ACTUATE IAV69A relay 127-2-B24-1 at Bus 24-1, Cubicle 3 by moving relay disc to its energized position. **VERIFY** that:





#### 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.



6.3. **REVIEW**, **INITIAL and DATE** appropriate data sheets.

WV / Date



#### ATTACHMENT 2 Relay Routine for 4 KV Bus 24-1 Undervoltage Relays Page 9 of 10

- **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. <u>Return to Normal</u>
- 7.1. **VERIFY** all relays are reset (or actuated if Bus 24-1 de-energized).

WV Date

WV Date

7.2. **VERIFY** targets reset (or actuated if Bus 24-1 de-energized).



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#### ATTACHMENT 2 Relay Routine for 4 KV Bus 24-1 Undervoltage Relays Page 10 of 10

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

WV / Date



### ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 1 of 11

- 1. <u>References</u>
- 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).

2.2. **INFORM** Operations that the 2/3 DG will be inop to D2 prior to performing the following step.

2.3. **OPEN** test switch TS 23-1UV "E".

2.4. **INSTALL** a jumper between TS 23-1 UV "F" and TS 23-1 UV "G".

Note: After the Jumper is installed on the relay, care shall be taken to ensure that the jumper does not become disconnected.

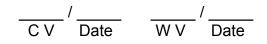


#### ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 2 of 11

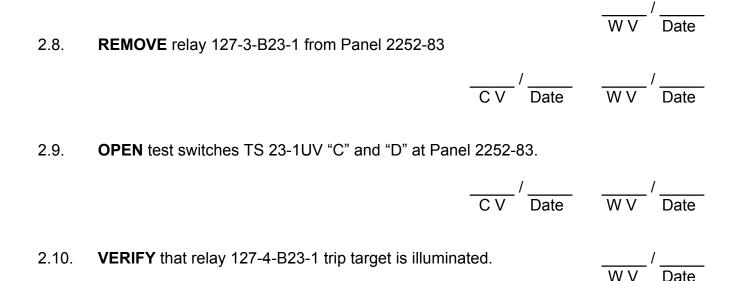
2.5. **REMOVE** TDR-23-1 at Panel 2252-83.

1		/	
CV	Date	WV	Date

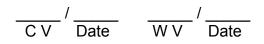
2.6. **OPEN** test switches TS 23-1UV "A" and "B" at Panel 2252-83.



2.7. **VERIFY** that relay 127-3-B23-1 trip target is illuminated.



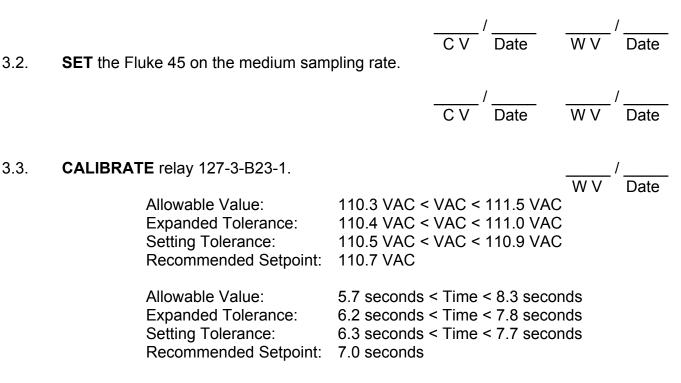
2.11. **REMOVE** relay 127-4-B23-1 from Panel 2252-83





#### ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 3 of 11

- 3. <u>Relay Calibration</u>
- 3.1. **VERIFY** room temperature is between the range of 21 to 24 Deg. C.



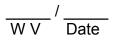
3.3.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

WV / Date

3.3.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

WV / 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.





#### ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 4 of 11

# 3.4. **CALIBRATE** relay 127-4-B23-1.

WV / 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.

WV / Date

3.4.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

WV / 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.

WV / Date



#### ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 5 of 11

3.5. **CALIBRATE** TDR-23-1 relay.

WV / Date

Allowable Value:279.0 secondsExpanded Tolerance:297.8 secondsSetting Tolerance:300.0 secondsRecommended Setpoint:307.5 seconds

279.0 seconds < Time < 321.0 seconds 297.8 seconds < Time < 317.2 seconds 300.0 seconds < Time < 315.0 seconds 307.5 seconds

3.5.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

WV Date

3.5.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

WV / 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.

WV / Date



#### ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 6 of 11

- 4. <u>Relay Installation</u>
- 4.1. **INSTALL** relay 127-3-B23-1 into Panel 2252-83.

		CV Date	WV Date
4.2.	VERIFY that relay 127-3-B23-1 power indicating lig	jht is lit.	WV / Date
4.3.	CLOSE test switches TS 23-1UV "A" and "B" at Pa	nel 2252-83.	
		C V Date	WV Date
4.4.	<b>RESET</b> relay 127-3-B23-1 trip target.	CV / Date	WV Date
4.5.	<b>INSTALL</b> relay 127-4-B23-1 into Panel 2252-83.		
		CV Date	WV / Date
4.6.	VERIFY that relay 127-4-B23-1 power indicating lig	jht is lit.	WV Date
4.7.	CLOSE test switches TS 23-1UV "C" and "D" at Pa	inel 2252-83.	
		/ _ C V / Date	WV / Date
4.8.	<b>RESET</b> relay 127-4-B23-1 trip target.	/ /	WV / Date



## ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 7 of 11

- 5.0 <u>Functional Testing</u>
- 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.

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.

5.3. **REMOVE** jumper previously installed between TS 23-1 UV "F" and TS 23-1 UV "G".

5.4. **CONNECT** VOM #3 between TS 23-1 UV "F" and TS23-1 UV "G", **VERIFYING** no 125VDC. Do not disconnect VOM.

5.5. TRIP Relay 127-3-B23-1 by OPENING test switch TS 23-1 UV "A"

5.6. **VERIFY** that relay 127-3-B23-1 trip target is illuminated.



## ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 8 of 11

5.7. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-23-1 coil.

5.8. VERIFY 125 VDC on VOM #3 connected to TS 23-1 UV "F" and TS 23-1 UV "G".

5.9. **RESET** Relay 127-3-B23-1 by **CLOSING** test switch TS 23-1 UV "A"

5.10. **RESET** target on relay 127-3-B23-1. ____/ ____ / ____ / ____ / ____ / ____ / ____ Date

5.11. VERIFY no 125C VDC on VOM #2 connected across relay TDR-23-1 coil.

5.12. VERIFY no 125 VDC on VOM #3 connected to TS 23-1 UV "F" and TS 23-1 UV "G".

5.13. **TRIP** Relay 127-4-B23-1 by **OPENING** test switch TS 23-1 UV "D".



## ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 9 of 11

- 5.14. **VERIFY** that relay 127-4-B23-1 trip target is illuminated.
- 5.15. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-23-1 coil.

5.16. VERIFY no 125 VDC on VOM #3 connected to TS 23-1 UV "F" and TS 23-1 UV "G".

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.

WV / Date

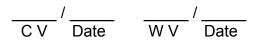
5.18. TRIP Relay 127-3-B23-1 by OPENING test switch TS 23-1 UV "A"

5.19. **VERIFY** that relay 127-3-B23-1 trip target is illuminated.

5.21

5.20. **VERIFY** 125 VDC on VOM #2 connected across relay TDR-23-1 coil.

 $\frac{1}{C V} / \frac{1}{Date} = \frac{1}{W V} / \frac{1}{Date}$  **VERIFY** 125 VDC on VOM #3 connected to TS 23-1 UV "F" and TS 23-1 UV "G".

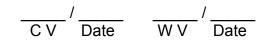




5.27.

## ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 10 of 11

5.22 **VERIFY** continuity (ohms) on VOM #1 across terminal T1 and Terminal M1 of relay TDR-23-1 after 6 minutes.



5.23. **VERIFY** Operations received the "4KV Bus 23-1 Voltage Degraded" alarm on the 902-8 F-07 window.

WV / 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.	<b>RESET</b> target on relay 127-3-B23-1.	$\frac{1}{C_{\rm V}}/\frac{1}{D_{\rm Date}}$	/ WV Date
0.201		C V Date	WVD

5.26. **RESET** Relay 127-4-B23-1 by **CLOSING** test switch TS 23-1 UV "D"

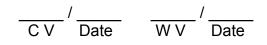
- **RESET** target on relay 127-4-B23-1.
- 5.28. **VERIFY** no continuity (ohms) on VOM #1 connected across terminal T1 and Terminal M1 of relay TDR-23-1 and **REMOVE** VOM.
- 5.29. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-23-1 coil and **REMOVE** VOM.





## ATTACHMENT 3 Relay Routine for 4 KV Bus 23-1 Degraded Voltage Relays Page 11 of 11

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.



Date

WV

- 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".

		CV / Date	WV / Date
6.2.	<b>INFORM</b> Operations that the 2/3 DG to D2 is opera	ble.	WV Date
7.	Return to Normal		
7.1.	VERIFY all relays are reset.	CV / Date	WV / Date
7.2.	VERIFY targets are reset.	CV / Date	WV / Date

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.



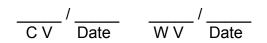
## ATTACHMENT 4 Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays Page 1 of 11

## 1. <u>References</u>

- 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).

2.2. **INFORM** Operations that the 2 DG will be inop to D2 prior to performing the following step.

- 2.3. **OPEN** test switch TS 24-1UV "E". <u>CV</u> / <u>Date</u> / <u>VV</u> / <u>Date</u>
- 2.4. **INSTALL** a jumper between TS 24-1 UV "F" and TS 24-1 UV "G".



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 Page 2 of 11

2.5. <b>REMOVE</b> TDR-24-1 at Panel 2252-	84.
--------------------------------------------	-----

2.6. **OPEN** test switches TS 24-1UV "A" and "B" at Panel 2252-84.

2.7. **VERIFY** that relay 127-3-B24-1 trip target is illuminated.

2.8. **REMOVE** relay 127-3-B24-1 from Panel 2252-84

WV Date

2.9. **OPEN** test switches TS 24-1UV "C" and "D" at Panel 2252-84.

 $\frac{1}{C V} / \frac{1}{Date} = \frac{1}{W V} / \frac{1}{Date}$ 2.10. **VERIFY** that relay 127-4-B24-1 trip target is illuminated.  $\frac{1}{W V} / \frac{1}{Date}$ 

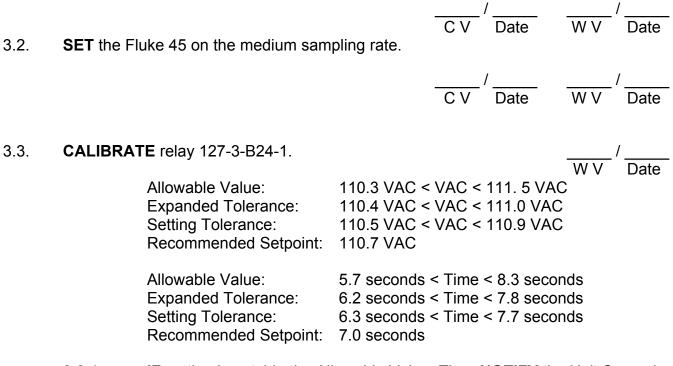
2.11. **REMOVE** relay 127-4-B24-1 from Panel 2252-84

 $\frac{1}{CV}$  /  $\frac{1}{Date}$   $\frac{WV}{V}$  /  $\frac{1}{Date}$ 



## ATTACHMENT 4 Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays Page 3 of 11

- 3. <u>Relay Calibration</u>
- 3.1. **VERIFY** room temperature is between the range of 21 to 24 Deg. C.



3.3.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

WV / Date

3.3.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

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 Page 4 of 11

3.4. **CALIBRATE** relay 127-4-B24-1.

WV[/]Date

Allowable Value:	110.3
Expanded Tolerance:	110.4
Setting Tolerance:	110.5
Recommended Setpoint:	110.7

110.3 VAC < VAC < 111.5 VAC 110.4 VAC < VAC < 111.0 VAC 110.5 VAC < VAC < 110.9 VAC 110.7 VAC

Allowable Value:5.7 secondsExpanded Tolerance:6.2 secondsSetting Tolerance:6.3 secondsRecommended Setpoint:7.0 seconds

- 5.7 seconds < Time < 8.3 seconds 6.2 seconds < Time < 7.8 seconds 6.3 seconds < Time < 7.7 seconds 7.0 seconds
- 3.4.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.
- 3.4.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.
- 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.

WV Date



## ATTACHMENT 4 Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays Page 5 of 11

3.5. CALIBRATE TDR-24-1 relay.

WV / Date

Allowable Value:279.0 secondsExpanded Tolerance:297.8 secondsSetting Tolerance:300.0 secondsRecommended Setpoint:307.5 seconds

279.0 seconds < Time < 321.0 seconds 297.8 seconds < Time < 317.2 seconds 300.0 seconds < Time < 315.0 seconds 307.5 seconds

3.5.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

WV / Date

- 3.5.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.
- 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.

WV Date



## ATTACHMENT 4 Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays Page 6 of 11

- 4. <u>Relay Installation</u>
- 4.1. **INSTALL** relay 127-3-B24-1 into Panel 2252-84.

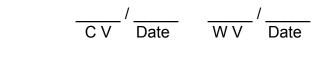
4.2. **VERIFY** that relay 127-3-B24-1 power indicating light is lit. WV' Date

4.3. **CLOSE** test switches TS 24-1UV "A" and "B" at Panel 2252-84.

		CV Date	WV Date
4.4.	<b>RESET</b> relay 127-3-B24-1 trip target.	CV Date	WV Date
4.5.	<b>INSTALL</b> relay 127-4-B24-1 into Panel 2252-84.		
		CV Date	WV Date

4.6. VERIFY that relay 127-4-B24-1 power indicating light is lit. ____ / ___ Date

4.7. **CLOSE** test switches TS 24-1UV "C" and "D" at Panel 2252-84.





#### 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.

/			/
CV	Date	WV	Date

- 5.0 <u>Functional Testing</u>
- 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.

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.

CV / Date WV / Date

5.3. **REMOVE** jumper previously installed between TS 24-1 UV "F" and TS 24-1 UV "G".

5.4. **CONNECT** VOM #3 between TS 24-1 UV "F" and TS 24-1 UV "G", **VERIFYING** no 125VDC. Do not disconnect VOM.

5.5. TRIP Relay 127-3-B24-1 by OPENING test switch TS 24-1 UV "A"

5.6. **VERIFY** that relay 127-3-B24-1 trip target is illuminated.



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## ATTACHMENT 4 Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays Page 8 of 11

5.7. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-24-1 coil.

5.8. VERIFY 125 VDC on VOM #3 connected to TS 24-1 UV "F" and TS 24-1 UV "G".

5.9. **RESET** Relay 127-3-B24-1 by **CLOSING** test switch TS 24-1 UV "A"

5.10. **RESET** target on relay 127-3-B24-1. <u>CV</u> / <u>Date</u> <u>WV</u> / <u>Date</u>

5.11. VERIFY no 125 VDC on VOM #2 connected across relay TDR-24-1 coil.

5.12. VERIFY no 125 VDC on VOM #3 connected to TS 24-1 UV "F" and TS 24-1 UV "G".

5.13. TRIP Relay 127-4-B24-1 by OPENING test switch TS 24-1 UV "D".



## ATTACHMENT 4 Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays Page 9 of 11

- 5.14. **VERIFY** that relay 127-4-B24-1 trip target is illuminated.
- 5.15. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-24-1 coil.

5.16. VERIFY no 125 VDC on VOM #3 connected to TS 24-1 UV "F" and TS 24-1 UV "G".

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.

WV / Date

WV Date

5.18. TRIP Relay 127-3-B24-1 by OPENING test switch TS 24-1 UV "A"

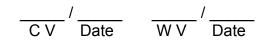
- 5.19. **VERIFY** that relay 127-3-B24-1 trip target is illuminated.
- 5.20. **VERIFY** 125 VDC on VOM #2 connected across relay TDR-24-1 coil.  $\frac{-}{C V} / \frac{-}{Date} = \frac{-}{W V} / \frac{-}{Date}$

5.21. VERIFY 125 VDC on VOM #3 connected to TS 24-1 UV "F" and TS 24-1 UV "G".



## 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.



5.23. **VERIFY** Operations received the "4KV Bus 23-1 Voltage Degraded" alarm on the 902-8 H-10 window.

WV / Date

5.24. **RESET** Relay 127-3-B24-1 by **CLOSING** test switch TS 24-1 UV "A"

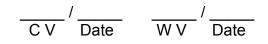
		C V Date	WV Date
5.25.	<b>RESET</b> target on relay 127-3-B24-1.	C V Date	WV Date

- 5.26. **RESET** Relay 127-4-B24-1 by **CLOSING** test switch TS 24-1 UV "D"
- 5.27. **RESET** target on relay 127-4-B24-1.  $\frac{-}{C V} / \frac{-}{Date} = \frac{-}{W V} / \frac{-}{Date}$
- 5.28. **VERIFY** no continuity (ohms) on VOM #1 connected across terminal T1 and Terminal M1 of relay TDR-24-1 and **REMOVE** VOM.
- 5.29. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-24-1 coil and **REMOVE** VOM.



## ATTACHMENT 4 Relay Routine for 4 KV Bus 24-1 Degraded Voltage Relays Page 11 of 11

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.



- 6. <u>Restoration</u>
- 6.1. **VERIFY** no voltage across test switch TS 24-1UV "E" and then **CLOSE** test switch TS 24-1UV "E".

		CV / Date	WV Date
6.2.	<b>INFORM</b> Operations that the 2 DG to D2 is operable	le.	WV Date
7.	Return to Normal		
7.3.	VERIFY all relays are reset.	//	/ /
7.4.	VERIFY targets are reset.	//	WV Date

7.4. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

WV 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. <u>Material</u> None
- 2.2. <u>Special Equipment</u>
- 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. <u>Precautions</u>
- 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. <u>Prerequisites</u>
- 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. <u>Control Isolation</u>
- 4.1.1. **LIST** any additional test switches **<u>not</u>** 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 <u>not</u> 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. <u>Functional Testing</u>

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. <u>Evaluation</u>
- 5.3.1. **INITIAL and DATE** as each attachment is completed.

## 6. **REFERENCES**

- 6.1. <u>Commitments</u> None
- 6.2. <u>Documents</u>
- 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 Page 1 of 10

#### 1. <u>References</u>

- 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. <u>Control Isolation</u>
- 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

_/____ Date

#### ATTACHMENT 1 Relay Routine for 4 KV Bus 33-1 Undervoltage Relays Page 2 of 10

## 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	<u>Relay Type</u>	<u>WV/Date</u>
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).

#### ATTACHMENT 1 Relay Routine for 4 KV Bus 33-1 Undervoltage Relays Page 3 of 10

3.3. **CALIBRATE** 127-1-B33-1.

WV / Date

Allowable Value:79.91 VAC < VAC < 87.52 VAC</th>Expanded Tolerance:80.86 VAC < VAC < 86.50 VAC</td>Setting Tolerance:81.00 VAC < VAC < 86.40 VAC</td>Recommended Setpoint:83.7 VAC

3.3.1. **IF** setting is outside the Allowable Value, **THEN NOTIFY** the Unit Supervisor.

WV / Date

- 3.3.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.
  - WV / 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.

WV Date

#### ATTACHMENT 1 Relay Routine for 4 KV Bus 33-1 Undervoltage Relays Page 4 of 10

## 3.4. **CALIBRATE** 127-2-B33-1.

WV / 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.
- 3.4.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.
- 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.

WV / Date

3.5. **INSTALL** relays into 4 KV Bus 33-1 Cubicle 13 listed below and Initial/Date.

Relay Number	Service Description	<u>Relay Type</u>	<u>WV/Date</u>
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

#### Functional Testing with Bus 33-1 Energized 4.

- 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. WV / 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.

WV 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.

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. V Date

**REMOVE** upper and lower relay connection paddles from IAV69A relay 127-1-B33-1 4.5. 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.

WV 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.

4.5.3. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X3 actuates.

WV / Date

WV / Date

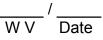
4.5.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-33-1 actuates.

WV / 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.
- 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:

4.7.2. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X2 resets.

4.7.3. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X3 resets.



^{4.7.1.} Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X1 resets.

#### 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.

WV / 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.

5.2. **OPEN** test switch TS 33-1UV "E" at Panel 2253-83.

5.5.

 $\frac{1}{CV}$  /  $\frac{1}{Date}$   $\frac{1}{WV}$  /  $\frac{1}{Date}$ 

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.

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.

**RELEASE** relay disc to its de-energized position.

WV Date

#### ATTACHMENT 1 Relay Routine for 4 KV Bus 33-1 Undervoltage Relays Page 8 of 10

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.

5.6.2. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X2 resets.

WV / Date

5.6.3. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X3 resets.

WV[/]Date

5.6.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-33-1 resets.

WV / 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.

WV / Date

5.7.2. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X2 actuates.

WV[/]Date

5.7.3. Bus 33-1 Undervoltage HFA Auxiliary relay 127B33-1X3 actuates.

WV / Date

WV Date

#### ATTACHMENT 1 Relay Routine for 4 KV Bus 33-1 Undervoltage Relays Page 9 of 10

5.7.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-33-1 actuates.

			WV	Date
5.8.		<b>MOVE</b> jumper between test switches TS 33-1 UV "F" and "G" on <b>RIFY</b> that Agastat relay 459X1-33-1 resets.		
5.9	CLC	<b>DSE</b> test switch TS 33-1UV "E" at Panel 2253-83.		
		CV / Date	WV	/ Date
6.	<u>Bus</u>	33-1 Undervoltage Relays Trip Restoration		
6.1.		<b>RIFY</b> all taps and time levers in all relays are in their "In Service" ition as specified by each relay's "As Left" data.		
			WV	Date
6.2.	REF	PLACE relay covers.		
				/ Date
			VV V	Dale
6.3.	RE\	/IEW, INITIAL and DATE appropriate data sheets.		/
			WV	Date
CAUTIO	SN:	If 4 KV Bus 33-1 is energized, then VERIFY 4 KV Bus 33 Undervoltage HFA Auxiliary relays 127B33-1X1, 127B33-1X and 127B33-1X3 are reset <b>BEFORE</b> restoring Bus 33 Undervoltage relays trip test switches.	X2,	

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		

*<u>Note</u>: 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. <u>Return to Normal</u>

7.1. **VERIFY** all relays are reset (or actuated if Bus 33-1 de-energized).

7.2. **VERIFY** targets reset (or actuated if Bus is 33-1 de-energized).

WV Date

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

WV 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 2TS 159SD3X "A"INTLK LPCI SYS 2TS 159SD3X "H"INTLK LPCI SYS 2

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. <u>Relay Calibration</u>

3.1. **REMOVE** relays from 4 KV Bus 34-1 Cubicle 13 listed below and Initial/Date.

Relay Number	Service Description	<u>Relay Type</u>	<u>WV/Date</u>
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).

CV / Date WV / Date

#### **ATTACHMENT 2** Relay Routine for 4 KV Bus 34-1 Undervoltage Relays Page 3 of 9

3.3. CALIBRATE 127-1-B34-1. WV / 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.

WV / Date

- 3.3.2. IF setting is outside the expanded tolerance, THEN INITIATE a condition report while continuing with this procedure.
- 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. /____ Date

WV / Date

#### ATTACHMENT 2 Relay Routine for 4 KV Bus 34-1 Undervoltage Relays Page 4 of 9

## 3.4. **CALIBRATE** 127-2-B34-1.

WV[/]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.

	/
WV	Date

WV / Date

3.4.2. **IF** setting is outside the expanded tolerance, **THEN INITIATE** a condition report while continuing with this procedure.

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	<u>Relay Type</u>	<u>WV/Date</u>
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 Page 5 of 9

#### 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. WV 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.

WV 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. WV / 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. WV / 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.

/____/ ____/ Date

4.5.2. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X2 actuates.

### **ATTACHMENT 2** Relay Routine for 4 KV Bus 34-1 Undervoltage Relays Page 6 of 9

4.5.3. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X3 actuates.

4.5.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-34-1 actuates.

WV / 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.
- 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.

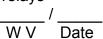
4.7.2. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X2 resets.

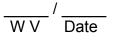
4.7.3. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X3 resets.

WV Date

4.7.4. Breaker Close Undervoltage Agastat Timer relay 27XTD-34-1 resets.

WV Date





# **ATTACHMENT 2** Relay Routine for 4 KV Bus 34-1 Undervoltage Relays Page 7 of 9

#### 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.

5.2. **OPEN** test switch TS 34-1UV "E" at Panel 2253-84.

 $\frac{1}{CV}$  /  $\frac{1}{Date}$   $\frac{WV}{WV}$  /  $\frac{1}{Date}$ 

PLACE a jumper between test switches TS 34-1 UV "F" and "G" on Panel 2253-84. 5.3. **VERIFY** that Agastat relay 459X1-34-1 actuates.

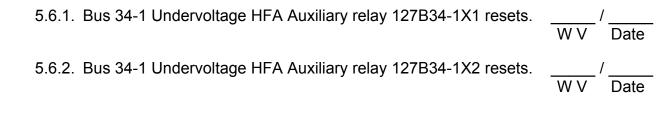
 $-\frac{1}{CV}$  Date WV Date

- 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.
- 5.4. **RELEASE** relay disc to its de-energized position.

WV Date

WV Date

ACTUATE IAV69A relay 127-2-B34-1 at Bus 34-1, Cubicle 13 by moving relay disc to 5.6. its energized position. VERIFY that:

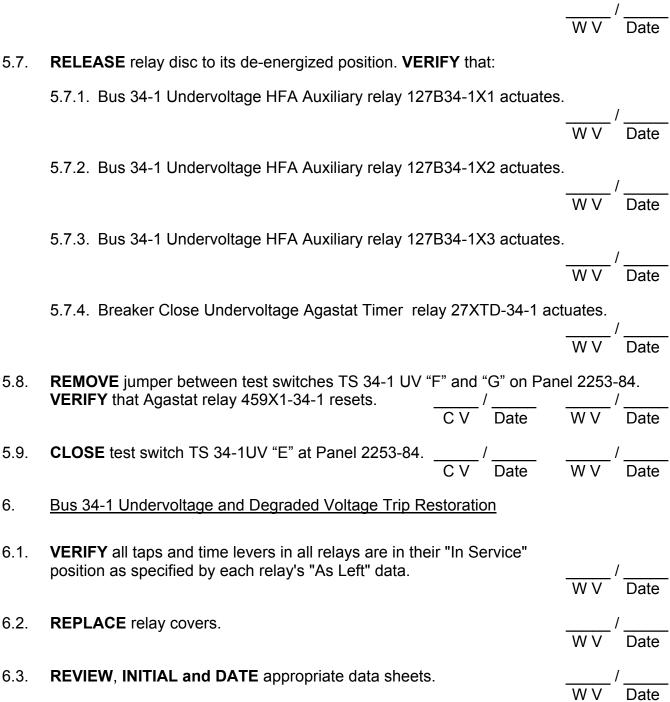


5.6.3. Bus 34-1 Undervoltage HFA Auxiliary relay 127B34-1X3 resets.

WV / 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.



**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 Page 9 of 9

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		

*<u>Note</u>: 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. <u>Return to Normal</u>
- 7.1. **VERIFY** all relays are reset (or actuated if Bus 34-1 de-energized).

7.2. **VERIFY** targets reset (or actuated if Bus 34-1 de-energized).

Date



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7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

WV / Date

## ATTACHMENT 3 Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays Page 1 of 11

# 1. <u>References</u>

- 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. <u>Relay Isolation and Relay Removal</u>
- 2.1. **VERIFY** that the data sheets for this relay agree with the Relay Setting Orders (RSO).

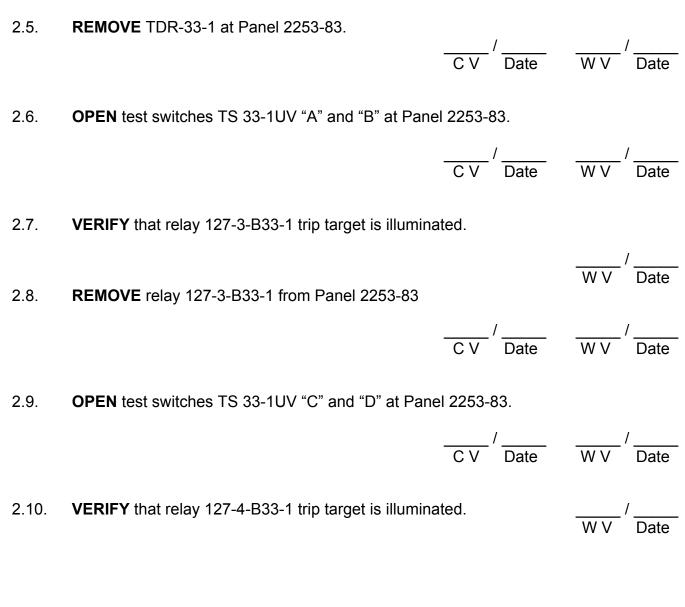
2.2. **INFORM** Operations that the 2/3 DG will be inop to D3 prior to performing the following step.

WV / Date

- 2.3. **OPEN** test switch TS 33-1UV "E". <u>CV</u> Date <u>WV</u> Date
- 2.4. **INSTALL** a jumper between TS 33-1 UV "F" and TS 33-1 UV "G".

**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

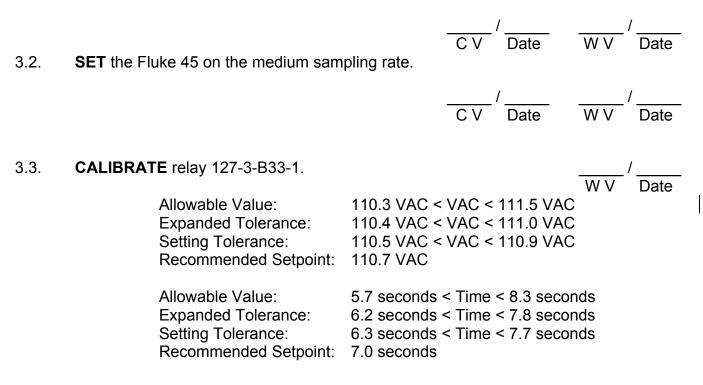


2.11. **REMOVE** relay 127-4-B33-1 from Panel 2253-83

	/		/
CV	Date	WV	Date

#### ATTACHMENT 3 Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays Page 3 of 11

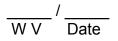
- 3. <u>Relay Calibration</u>
- 3.1. **VERIFY** room temperature is between the range of 21 to 24 Deg. C.



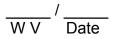
3.3.1. **IF** setting is outside the Allowable Value, Then **NOTIFY** the Unit Supervisor.

WV / Date

3.3.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.



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.



WV / Date

# ATTACHMENT 3 Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays Page 4 of 11

## 3.4. CALIBRATE relay 127-4-B33-1.

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.

WV Date

3.4.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

WV / 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.

WV / 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.

WV[/]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.

WV / Date

3.5.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

WV / 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.

WV / Date

# ATTACHMENT 3 Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays Page 6 of 11

4. Relay Installation

4.1. **INSTALL** relay 127-3-B33-1 into Panel 2253-83.

		CV / Date	WV / Date
4.2.	VERIFY that relay 127-3-B33-1 power indicating lig	ght is lit.	WV Date
4.3.	CLOSE test switches TS 33-1UV "A" and "B" at Pa	anel 2253-83.	
		CV Date	WV Date
4.4.	<b>RESET</b> relay 127-3-B33-1 trip target.	CV Date	WV Date
4.5.	<b>INSTALL</b> relay 127-4-B33-1 into Panel 2253-83.		
		CV Date	WV Date
4.6.	VERIFY that relay 127-4-B33-1 power indicating lig	ght is lit.	WV Date
4.7.	CLOSE test switches TS 33-1UV "C" and "D" at Pa	anel 2253-83.	
		CV Date	WV / Date
4.8.	<b>RESET</b> relay 127-4-B33-1 trip target.	CV Date	WV Date

### **ATTACHMENT 3** Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays Page 7 of 11

- 4.9. **INSTALL** TDR-33-1 relay into Panel 2253-83. CV Date WV Date
- 5.0 **Functional Testing**

5.4

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.

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 disconne

- 5.3. **REMOVE** jumper previously installed between TS 33-1 UV "F" and TS 33-1 UV "G".

  - CONNECT VOM #3 between TS 33-1 UV "F" and TS 33-1 UV "G", VERIFYING no 125VDC. Do not disconnect VOM.

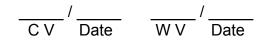
5.5. TRIP Relay 127-3-B33-1 by OPENING test switch TS 33-1 UV "A"

5.6. **VERIFY** that relay 127-3-B33-1 trip target is illuminated.

$$\frac{1}{CV}$$
 /  $\frac{1}{Date}$  WV Date

# ATTACHMENT 3 Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays Page 8 of 11

5.7. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-33-1 coil.



5.8. VERIFY 125 VDC on VOM #3 connected to TS 33-1 UV "F" and TS 33-1 UV "G".

 $\frac{1}{CV}$  / Date  $\frac{WV}{Date}$ 

5.9. **RESET** Relay 127-3-B33-1 by **CLOSING** test switch TS 33-1 UV "A"

5.11. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-33-1 coil.

5.12. VERIFY no 125 VDC on VOM #3 connected to TS 33-1 UV "F" and TS 33-1 UV "G".

5.13. TRIP Relay 127-4-B33-1 by OPENING test switch TS 33-1 UV "D".

# ATTACHMENT 3 Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays Page 9 of 11

5.14. **VERIFY** that relay 127-4-B33-1 trip target is illuminated.

5.15. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-33-1 coil.

5.16. VERIFY no 125 VDC on VOM #3 connected to TS 33-1 UV "F" and TS 33-1 UV "G".

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.

WV / Date

5.18. TRIP Relay 127-3-B33-1 by OPENING test switch TS 33-1 UV "A"

- 5.19. **VERIFY** that relay 127-3-B33-1 trip target is illuminated.
- 5.20. **VERIFY** 125 VDC on VOM #2 connected across relay TDR-33-1 coil.  $\frac{-}{C V} / \frac{-}{Date} = \frac{-}{W V} / \frac{-}{Date}$
- 5.21. VERIFY 125 VDC on VOM #3 connected to TS 33-1 UV "F" and TS 33-1 UV "G".

# **ATTACHMENT 3** Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays Page 10 of 11

5.22 **VERIFY** continuity (ohms) on VOM #1 across terminal T1 and Terminal M1 of relay TDR-33-1 after 6 minutes.

VERIFY Operations received the "4KV Bus 33-1 Voltage Degraded" alarm on the 903-5.23. 8 C-04 window.

5.24. RESET Relay 127-3-B33-1 by CLOSING test switch TS 33-1 UV "A"

		CV Date	WV Date
5.25.	<b>RESET</b> target on relay 127-3-B33-1.	CV / Date	WV / Date

5.26. RESET Relay 127-4-B33-1 by CLOSING test switch TS 33-1 UV "D"

**RESET** target on relay 127-4-B33-1.

5.27.

- VERIFY no continuity (ohms) on VOM #1 connected across terminal T1 and Terminal 5.28. M1 of relay TDR-33-1 and REMOVE VOM.
  - $\underline{-}$   $\underline{-}$   $\frac{-}{\overline{-}}$   $\frac{$
- VERIFY no 125 VDC on VOM #2 connected across relay TDR-33-1 coil and REMOVE 5.29. VOM.

WV / Date

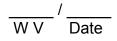
# ATTACHMENT 3 Relay Routine for 4 KV Bus 33-1 Degraded Voltage Relays Page 11 of 11

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.

- 6. <u>Restoration</u>
- 6.1. **VERIFY** no voltage across test switch TS 33-1UV "E" and then **CLOSE** test switch TS 33-1UV "E".

		CV / Date	WV / Date
6.2.	<b>INFORM</b> Operations that the 2/3 DG to D3 is operations that the 2/3 DG to D3 is operations	ble.	WV Date
7.	Return to Normal		
7.1.	VERIFY all relays are reset.	CV Date	WV Date
7.2.	VERIFY targets are reset.	CV / Date	WV Date

7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.



## ATTACHMENT 4 Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays Page 1 of 11

# 1. <u>References</u>

2.3.

- 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. Relay Isolation and Relay Removal

OPEN test switch TS 34-1UV "E".

2.1. **VERIFY** that the data sheets for this relay agree with the Relay Setting Orders (RSO).

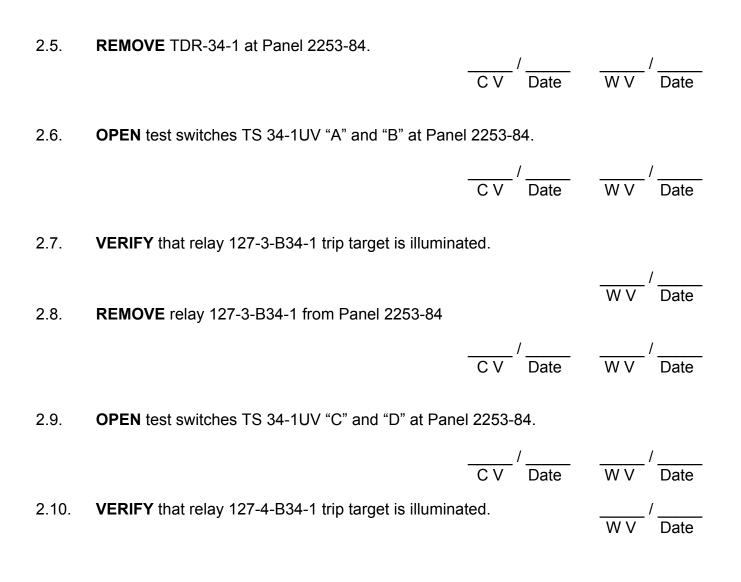
2.2. **INFORM** Operations that the 3 DG will be inop to D3 prior to performing the following step.

WV / Date

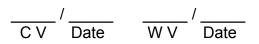
- CV Date WV Date
- 2.4. **INSTALL** a jumper between TS 34-1 UV "F" and TS 34-1 UV "G".

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 34-1 Degraded Voltage Relays Page 2 of 11

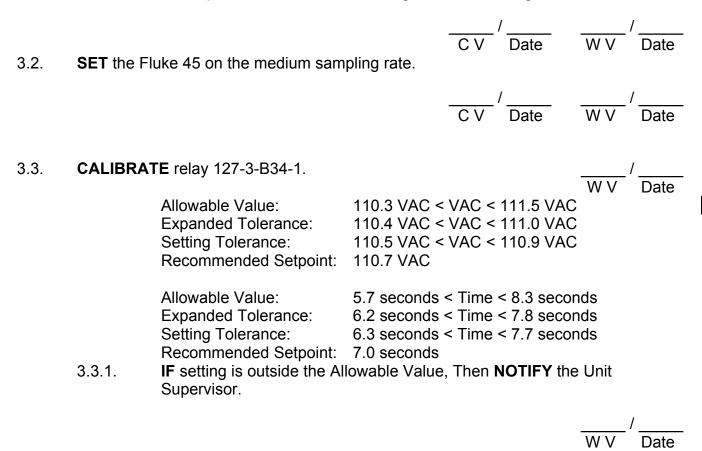


2.11. **REMOVE** relay 127-4-B34-1 from Panel 2253-84



## ATTACHMENT 4 Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays Page 3 of 11

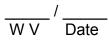
- 3. <u>Relay Calibration</u>
- 3.1. **VERIFY** room temperature is between the range of 21 to 24 Deg. C.



3.3.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

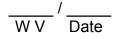
WV Date

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.



#### **ATTACHMENT 4** Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays Page 4 of 11

#### 3.4. CALIBRATE relay 127-4-B34-1.



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:

Setting Tolerance:

Expanded Tolerance:

5.7 seconds < Time < 8.3 seconds 6.2 seconds < Time < 7.8 seconds 6.3 seconds < Time < 7.7 seconds Recommended Setpoint: 7.0 seconds

IF setting is outside the Allowable Value, Then NOTIFY the Unit 3.4.1. Supervisor.

WV / Date 3.4.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

WV / Date

IF the setting is outside the setting tolerance, Then INITIATE a Condition 3.4.3. Report while continuing with this procedure. Re-calibration of the relay will need to be done per the applicable NOAD procedure.

____/ ____ V Date

#### ATTACHMENT 4 Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays Page 5 of 11

# 3.5. **CALIBRATE** TDR-34-1 relay.

WV 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.

WV / Date

3.5.2. **IF** setting is outside the expanded tolerance, Then **INITIATE** a condition report while continuing with this procedure.

WV[/]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.

WV Date

# ATTACHMENT 4 Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays Page 6 of 11

4. <u>Relay Installation</u>

4.1. **INSTALL** relay 127-3-B34-1 into Panel 2253-84.

		C V Date	WV Date
4.2.	VERIFY that relay 127-3-B34-1 power indicating lig	jht is lit.	WV Date
4.3.	CLOSE test switches TS 34-1UV "A" and "B" at Pa	nel 2253-84.	
		CV / Date	WV Date
4.4.	<b>RESET</b> relay 127-3-B34-1 trip target.	CV / Date	WV Date
4.5.	<b>INSTALL</b> relay 127-4-B34-1 into Panel 2253-84.		
		CV Date	WV Date
4.6.	VERIFY that relay 127-4-B34-1 power indicating lig	jht is lit.	/ WV Date
4.7.	CLOSE test switches TS 34-1UV "C" and "D" at Pa	inel 2253-84.	
		// Date	WV Date
4.8.	<b>RESET</b> relay 127-4-B34-1 trip target.	CV / Date	WV Date

#### ATTACHMENT 4 Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays Page 7 of 11

4.9. **INSTALL** TDR-34-1 relay into Panel 2253-84.

- 5.0 <u>Functional Testing</u>
- 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.

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.

5.3. **REMOVE** jumper previously installed between TS 34-1 UV "F" and TS 34-1 UV "G".

5.4. **CONNECT** VOM #3 between TS 34-1 UV "F" and TS 34-1 UV "G", **VERIFYING** no 125VDC. Do not disconnect VOM.

5.5. TRIP Relay 127-3-B34-1 by OPENING test switch TS 34-1 UV "A"

5.6. **VERIFY** that relay 127-3-B34-1 trip target is illuminated.

### ATTACHMENT 4 Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays Page 8 of 11

5.7. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-34-1 coil.

5.8. VERIFY 125 VDC on VOM #3 connected to TS 34-1 UV "F" and TS 34-1 UV "G".

5.9. **RESET** Relay 127-3-B34-1 by **CLOSING** test switch TS 34-1 UV "A"

5.10. **RESET** target on relay 127-3-B34-1. 
$$\frac{-1}{C V} / \frac{-1}{Date} = \frac{-1}{W V} / \frac{-1}{Date}$$
  
5.11. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-34-1 coil.

5.12. VERIFY no 125 VDC on VOM #3 connected to TS 34-1 UV "F" and TS 34-1 UV "G".

5.13. **TRIP** Relay 127-4-B34-1 by **OPENING** test switch TS 34-1 UV "D".

### ATTACHMENT 4 Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays Page 9 of 11

5.14. **VERIFY** that relay 127-4-B34-1 trip target is illuminated.

5.15. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-34-1 coil.

- 5.16. VERIFY no 125 VDC on VOM #3 connected to TS 34-1 UV "F" and TS 34-1 UV "G".
- 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.

WV / Date

5.18. **TRIP** Relay 127-3-B34-1 by **OPENING** test switch TS 34-1 UV "A"

5.19. **VERIFY** that relay 127-3-B34-1 trip target is illuminated.

WV / Date

5.20. **VERIFY** 125 VDC on VOM #2 connected across relay TDR-34-1 coil.

 $\frac{1}{CV}$  /  $\frac{1}{Date}$   $\frac{WV}{WV}$  /  $\frac{1}{Date}$ 

## ATTACHMENT 4 Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays Page 10 of 11

5.21. **VERIFY** 125 VDC on VOM #3 connected to TS 34-1 UV "F" and TS 34-1 UV "G".

5.22 **VERIFY** continuity (ohms) on VOM #1 across terminal T1 and Terminal M1 of relay TDR-34-1 after 6 minutes.

5.23. **VERIFY** Operations received the "4KV Bus 33-1 Voltage Degraded" alarm on the 903-8 D-04 window.

WV / Date

5.24. **RESET** Relay 127-3-B34-1 by **CLOSING** test switch TS 34-1 UV "A"

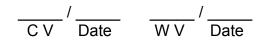
		CV / Date	WV / Date
5.25.	<b>RESET</b> target on relay 127-3-B34-1.	CV / Date	WV / Date

5.26. RESET Relay 127-4-B34-1 by CLOSING test switch TS 34-1 UV "D"

5.27.

	C V Date	WV Date
<b>RESET</b> target on relay 127-4-B34-1.	CV / Date	WV / Date

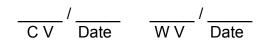
5.28. **VERIFY** no continuity (ohms) on VOM #1 connected across terminal T1 and Terminal M1 of relay TDR-34-1 and **REMOVE** VOM.



5.29. **VERIFY** no 125 VDC on VOM #2 connected across relay TDR-34-1 coil and **REMOVE** VOM.

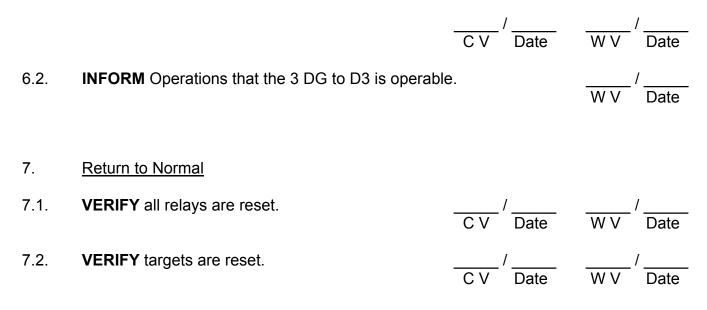
### ATTACHMENT 4 Relay Routine for 4 KV Bus 34-1 Degraded Voltage Relays Page 11 of 11

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.



# 6. <u>Restoration</u>

6.1. **VERIFY** no voltage across test switch TS 34-1UV "E" and then **CLOSE** test switch TS 34-1UV "E".



7.3. **NOTIFY** Operations/Control Room shift personnel that the relay routine is complete.

WV Date