ATTACHMENT 2

DA-EE-93-006-08
"Instrument Performance Evaluation and Setpoint Verification: Undervoltage Relays and Voltmeters on 480V Safeguards Busses"

CALCULATION COVER SHEET

A. INITIATION

Site ☐ CCNPP ☐ NMP ☒ REG

Calculation No.: DA-EE-93-006-08 Revision No.: 5

Vendor Calculation (Check one): ☐ Yes ☒ No

Responsible Group: NEE – I&C/Electrical Systems Engineering

Responsible Engineer: John DiBiase

B. CALCULATION

ENGINEERING DISCIPLINE: ☐ Civil ☐ Instr & Controls ☐ Nuclear ☒ Electrical ☐ Mechanical ☐ Other _____

Title: INSTRUMENT PERFORMANCE EVALUATION AND SETPOINT VERIFICATION: UNDERVOLTAGE RELAYS AND VOLTMETERS ON 480V SAFEGUARDS BUSSES

Unit ☐ 1 ☐ 2 ☒ COMMON

Proprietary or Safeguards Calculation ☐ YES ☒ NO

Comments:

Vendor Calc No.: REVISION NO.:

Vendor Name:

Safety Class (Check one): ☒ SR ☐ AUGMENTED QUALITY ☐ NSR

There are assumptions that require Verification during walkdown: NO TRACKING ID: N/A

This calculation **SUPERSEDES**: DA-EE-93-006-08 REVISION 4

C. REVIEW AND APPROVAL:

Responsible Engineer: John DiBiase (Printed Name and Signature) 8.29.2007 (Date)

Is Design Verification Required? ☒ Yes ☐ No

If yes, Design Verification Form is ☒ Attached ☐ Filed with:

Independent Reviewer: Theodore Miller Theodore H. Miller (Printed Name and Signature) 8/30/07 (Date)

Approval: Jarrod A. Jackson (Printed Name and Signature) 8/30/07 (Date)

List of Effective Pages

This calculation was revised in its entirety for revision 5 and reformatted consistent with CNG-CM-1.01-2001.

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1.0 Objective

The objective of this calculation is to document analytical limits and calculate setpoints for the undervoltage relays and voltmeters on the 480 volt safety related busses at Ginna Station including:

- Documentation of the minimum analytical limits
- Documentation of the maximum analytical limits
- Determination of the minimum calculated setpoints
- Determination of the maximum calculated setpoints
- Determination of the channel calibration acceptance values

The undervoltage protection scheme incorporates redundant relays on each 480 volt Class 1E safety related bus to provide two levels of protection. The first level of protection is from the loss of voltage relays which operate on a definite time delay. The second level of protection is from the degraded voltage relays which operate on an inverse time characteristic.

2.0 Scope of Calculation

The following degraded voltage relays are in scope to this calculation:

- 27/14
- 27B/14
- 27/16
- 27B/16
- 27/17
- 27B/17
- 27/18
- 27B/18

The following loss of voltage relays are in scope to this calculation:

- 27D/14
- 27D/B/14
- 27D/16
- 27D/B/16
- 27D/17
- 27D/B/17
- 27D/18
- 27D/B/18

The following voltmeters are in scope to this calculation:

- EI/PD
- EI/NN
- EI/NI
- EI/ND

The following setpoints are referenced, utilized or derived in this calculation:

- SP-0078
- SP-2241
- SP-2308
- SP-2309
- SP-2311
- SP-2312
- SP-2325
- SP-3524
- SP-3526
- SP-4022
- SP-4023
- SP-4024
- SP-4025
- SP-4026
- SP-4027
- SP-4028
- SP-4029
- SP-4030
- SP-4031
- SP-4032
- SP-4033
- SP-4034
- SP-4035
- SP-4036
- SP-4037
- SP-4038
- SP-4039
- SP-4040
- SP-4041
- SP-4042

3.0 Conclusions

3.1 The following setpoint values have been determined in this calculation:

Degraded Voltage Relay Operate Voltage Setpoints				
setpoint	Description	Value	setpoint as a percentage of bus voltage	setpoint transposed to 120 volt bus voltage
SP-2312	AL_{MIN}	414.0	86.25%	103.5
SP-3524	AL_{MAX}	432.0	90.00%	108.0
SP-4023	CS_{MIN}	420.0	87.50%	105.0
SP-4022	CS_{MAX}	423.6	88.25%	105.9
SP-4024	CCA	1.1	N/A	N/A
SP-3526	NOMINAL	420.8	87.67%	105.2
Degraded Voltage Relay Time Delay Setpoints				
Setpoint	Description	Value	N/A	N/A
SP-4034	$AL_{MIN@420.0}$	56.3	N/A	N/A
SP-4035	$AL_{MIN@423.6}$	60.0	N/A	N/A
SP-4025	AL_{MAX}	136.8	N/A	N/A
SP-4036	$CS_{MIN@420.0}$	68.1	N/A	N/A
SP-4037	$CS_{MIN@423.6}$	71.8	N/A	N/A
SP-4038	CS_{MAX}	125.0	N/A	N/A
SP-4039	CCA	9.8	N/A	N/A
SP-4042	NOMINAL	91.8	N/A	N/A
Loss of Voltage Relay Dropout Voltage Setpoints				
Setpoint	Description	Value	setpoint as a percentage of bus voltage	setpoint transposed to 120 volt bus voltage
SP-2308	AL_{MIN}	368.0	76.67%	92
SP-4026	AL_{MAX}	381.2	79.42%	95.3
SP-4029	CS_{MIN}	372.0	77.50%	93
SP-4028	CS_{MAX}	374.8	78.08	93.7
SP-4030	CCA	0.67	N/A	N/A
SP-2309	NOMINAL	372.8	77.67%	93.2
Loss of Voltage Relay Time Delay Setpoints				
Setpoint	Description	Value	N/A	N/A
SP-4027	AL_{MIN}	2.0	N/A	N/A
SP-2241	AL_{MAX}	2.75	N/A	N/A
SP-4032	CS_{MIN}	2.13	N/A	N/A
SP-4031	CS_{MAX}	2.62	N/A	N/A
SP-4033	CCA	0.06	N/A	N/A
SP-2311	NOMINAL	2.4	N/A	N/A

3.2 Degraded Voltage Relay Calibration

The degraded voltage relays shall be calibrated at nominal setpoints of 105.2 volts (operate voltage) and 91.8 seconds which fall within the Calculated Setpoint Region (as seen on the chart in section 13.2).

3.2.1 The as-found reset voltage, operate voltage and associated timing shall be determined prior to calibrating the relay.

3.2.2 Tolerance for the as-found reset voltage shall be ±1.1 volts of the previous as-left reset voltage. This is based on the channel calibration acceptance value of ±1.1 volts.

3.2.3 Tolerance for the as-found operate voltage shall be ±1.1 volts of the previous as-left operate voltage. This is based on the channel calibration acceptance value of ±1.1 volts.

3.2.4 Tolerance for the as-found operate time for a 120 volt to 92 volt step change shall be ≥30 seconds and ≤50 seconds. These values fall within the minimum analytic limit of 20 seconds and the maximum analytical limit of 136.8 seconds.

3.2.5 Tolerance for the as-found operate time for a 120 volt to 104.1 volt step change shall be ±9.8 seconds of the previous as-left operate time. This is based on the channel calibration acceptance value of ±9.8 seconds.

3.2.6 The relay shall be calibrated for an as-left operate voltage of ≥105.2 volts and ≤105.7 volts (nominal 105.2 volts, +0.5 volts, -0.0 volts). This is based on the decision to create a negative calibration bias.

3.2.7 The relay shall be calibrated for an as-left operate voltage time delay of ≥89.5 seconds and ≤94.1 seconds (91.8 seconds, ±2.3 seconds) for a 120 volt to 105.2 volt step change. This range is based on the decision to limit calibration uncertainty to ±2.5% of the nominal setpoint (91.8 seconds).

3.2.8 The relay shall be post-calibration trip tested for a 120 volt to 92 volt step change for an as-left tolerance of ≥30 seconds and ≤50 seconds. These values fall within the minimum analytic limit of 20 seconds and the maximum analytical limit of 136.8 seconds.

3.2.9 The relay shall be post-calibration trip tested for a 120 volt to 104.1 volt step change for an as-left tolerance of ≥82 seconds and ≤101.6 seconds. These values are based on the nominal setting at 105.2 volts of 91.8 seconds ±9.8 seconds (nominal ± channel calibration acceptance value).

3.2.10 At the completion of post-calibration testing the as-left pickup voltage shall be determined.

3.3 Degraded Voltage Relay Periodic Testing

The degraded voltage relays shall be tested monthly.

3.3.1 The as-found operate voltage shall have acceptance criteria of ≥105.0 volts and ≤105.9 which are the minimum and maximum calculated setpoints.

3.3.2 The as-found reset voltage shall have acceptance criteria of ≥105.0 volts and ≤106.4 volts. The minimum value of 105.0 volts is equivalent to the minimum calculated setpoint for the operate voltage and the value of 106.4 volts is 0.5% higher than the maximum calculated setpoint.

3.3.3 The relay shall be trip tested for a 120 volt to 92 volt step change with acceptance criteria of ≥30 seconds and ≤50 seconds. These values conservatively fall within the minimum analytic limit of 20 seconds and the maximum analytical limit of 136.8 seconds.

3.3.4 The relay shall be trip tested for a 120 volt to 104.1 volt step change with acceptance criteria of ≥68.1 seconds and ≤125 seconds. The test voltage is 1.1 volts below the nominal setpoint of 105.2 (nominal – CCA). This range is conservatively based on the minimum calculated setpoint of 68.1 seconds at 105.0 volts and the maximum calculated setpoint of 125 seconds.

3.4 Loss of Voltage Relay Calibration

The loss of voltage relays shall be calibrated at a nominal setpoint of 93.2 volts (dropout voltage) and 2.4 seconds which fall within the Calculated Setpoint Region (as seen on the chart in section 13.3).

3.4.1 The as-found pickup voltage, dropout voltage and associated timing shall be determined prior to calibrating the relay.

3.4.2 Tolerance for the as-found pickup voltage shall be ±1.0 volts of the previous as-left pickup voltage.

3.4.3 Tolerance for the as-found dropout voltage shall be ±0.67 volts of the previous as-left setting. This is based on the channel calibration acceptance value of ±0.67 volts.

3.4.4 Tolerance for as-found dropout time shall be ±0.06 seconds from the previous as-left tolerance. This is based on the channel calibration acceptance value of 0.06 seconds.

3.4.5 The relay shall be calibrated for an as-left dropout voltage of ≥93.2 volts and ≤93.7 volts (nominal 93.2, +0.5 volts, -0.0 volts). This is based on the decision to create a negative calibration bias.

3.4.6 The relay shall be calibrated for an as-left dropout voltage time delay of ≥2.13 seconds and ≤2.62 seconds (2.4 seconds, +0.22 seconds, -0.27 seconds). The range is based on the minimum calculated setpoint of 2.13 seconds and the maximum calculated setpoint of 2.62 seconds.

3.4.7 The relay shall be calibrated for an as-left pickup voltage of ≥93.7 volts and ≤94.2 volts. These values are 0.5 volts higher than calibration values for the dropout voltage.

3.5 Loss of Voltage Relay Periodic Testing

The loss of voltage relays shall be tested monthly.

3.5.1 The as-found dropout voltage shall have acceptance criteria of ≥93.0 volts and ≤93.7 which are the minimum and maximum calculated setpoints.

3.5.2 The as-found pickup voltage shall have acceptance criteria of ≥93.0 volts and ≤94.6 volts. The minimum value of 93.0 volts is equivalent to the minimum calculated setpoint for dropout voltage and the value of 94.6 volts is based on the stated tolerance of dropout being 99% of pickup.

3.5.3 The relay shall be trip tested for a 120 volt to 0.0 volt step change with acceptance criteria of ≥2.13 seconds and ≤2.62 seconds. This range is based on the minimum calculated setpoint of 2.13 seconds and the maximum calculated setpoint of 2.62 seconds.

3.5.4 The relay shall be trip tested for a 120 volt to 92.5 volt step change with acceptance criteria of ≥2.13 seconds and ≤2.62 seconds. The test voltage is 0.67 volts below the nominal setpoint of 93.2 (nominal – CCA). This range is based on the minimum calculated setpoint of 2.13 seconds and the maximum calculated setpoint of 2.62 seconds.

4.0 Design Inputs

4.1 EP-3-S-0505 revision 2, Instrument Setpoint/Loop Accuracy Calculation Methodology

5.0 Assumptions

5.1 VTD-A0500-4002 provides the time-voltage characteristic curves for the inverse time degraded voltage relays which are Type 27 manufactured by ABB. Per the relay setting schedules (11253-1 sheets 3 and 4) the relays are set at 105.2 volts with a TLS setting of 6. Attachment 12 of design analysis DA-EE-96- 068-03, Offsite Power Load Flow Study derives the equation for the curve matching the vendor manual time-voltage curve for TLS setting 6. The formula for the curve was determined to be matched by the equation $V = (V_{SETTING})(1-e^{(0.08(13.5-T))})$, where T is time and the value to be inserted for $V_{SETTING}$ is the operate or reset coefficient. The derived equation is utilized in this calculation to demonstrate the proper application of the time delay relay for both operate and reset values as well as its coordination for protection of electrical equipment. VTD-A0500-4002 also indicates that the relays are set by adjusting the operate setting. The curves for reset are fixed at a value 0.5% higher than the associated operate value.

5.2 VTD-A0500-4002 indicates there is a 0.5 volt variation in operating voltage over the temperature range 20°C to 40°C for the degraded voltage relays. The relays are installed in

locations where ambient temperature varies between 10°C and 40°C. It is assumed that the variation is linear and can be interpolated over the expanded range to account for the actual environmental conditions.

5.3 VTD-A0500-4002 indicates there is a 0.2 volt variation in operating voltage for a 10 volt variation in control voltage. The relays are subjected to a larger variation in control voltage, between 128 volts and 140 volts. It is assumed that the variation is linear and can be interpolated over the expanded range to account for the actual control voltage applied to the relays.

5.4 Gilbert Associates Specification SP-5201 revision 3 indicates motors specified for safeguards equipment were required to be designed and satisfactory for full voltage starting at 80% rated voltage. It assumed that the motors are capable of running continuously at 90% rated voltage (per NEMA Standard MG-1 Motors and Generators – induction motor variation from rated voltage).

5.5 Thermal capability curves for all equipment connected to the 480 volt safeguards busses is not contained in Ginna's design basis document collection. The guidance of ANSI Standard C50.41, which provides criteria for the momentary operation of motors, is assumed to be applicable for utilization in the coordination curves being created in this calculation. The exceptions identified in the standard for which it can not be applied have been reviewed and are not applicable to the equipment connected to Ginna's 480 volt safeguards busses. In addition, due to the large amount of margin which the curve indicates is available, it is assumed that any additional voltage drop from the bus to the terminals of driven equipment will have a negligible effect on the results of this calculation. The thermal capability curves for 440, 460 and 480 volt motors have been added to the coordination curve in section 13. The actual slope of the thermal capability curves follow an exponential function, however they have been depicted as straight lines for the small voltage range at which they are plotted. This approximation will have a negligible impact on the ability to demonstrate coordination for equipment protection.

5.6 VTD-A0500-4201 states in the "Specifications" section under "Tolerances" that repeatability over the allowable DC control power range is ± 0.1%. The VTD also identifies in the "Specifications" section under "Control Power" that the allowable variation for the 125 VDC relays is 100 to 140 volts. It is assumed that variarion is linear and can be interpolated over the actual range of 128 to 140 volts for the Ginna installation.

5.7 DA-EE-92-131-06 calculates the degraded voltages for AC motor operated valves (MOV's). The analysis demonstrates the operability of MOV's at bus voltages of 368 volts and 414 volts. It is assumed that these loads do not require discussion in this calculation (DA-EE-93-006-08) since DA-EE-92-131-06 provides the basis for their operability. The analyses are cross referenced in the configuration management system to ensure reviews are performed when revisions are made.

5.8 DA-EE-92-008-07 analyzed the effect of degraded voltages on safety related motor control center (MCC) loads. The analysis demonstrates the operability of loads fed from the MCC's at a bus voltage of 414 volts. It is assumed that these loads do not require discussion in this

calculation (DA-EE-93-006-08) since DA-EE-92-008-07 provides the basis for their operability. The analyses are cross referenced in the configuration management system to ensure reviews are performed when revisions are made.

5.9 Attachment 12 of the Offsite Power Load Flow Study (DA-EE-96-068) calculates the response of the circuit 767 tap changer for the limiting load flow case 116L_2007_AB. The most limiting response is identified as the target profile in attachment 12 of DA-EE-96-068 and is recreated in the coordination curve in this calculation for comparison of coordination with the degraded voltage relays.

5.10 The loss of voltage relays are set by adjusting the pickup setting. The dropout setting is a fixed percentage of pickup based on tap settings available on the relays. Ginna utilizes the 99% tap and calibrates the relays at the desired dropout voltage.

5.11 The meter drift for the KA-241 voltmeters is assumed to be 1.0% for a 72 month frequency. There is no vendor data available for drift. Indicator drift over a 72 month calibration cycle is assumed to be equal to the reference accuracy of the voltmeter, which is specified in VTD-W0120-4470 to be 1.0% full scale.

5.12 There is no vendor data available for Parallax for calculating voltmeter uncertainty. Parallax is assumed to be negligible because of the Westinghouse "full view" voltmeter design. The voltmeter dial scale is beveled so that there is no dial shadow, making it possible to read the voltmeter at angles up to 60 degrees.

5.13 The effects of repeatability, hysteresis and linearity are assumed negligible in the total loop uncertainty calculation for the voltmeters. There is no vendor data available for repeatability, hysteresis and linearity. The calibration of the voltmeter is currently performed in both directions, as seen on calibration procedures CP-501.3, CP-501.4, CP-501.5 and CP-501.6. This ensures that the attributes of reference accuracy (repeatability, hysteresis and linearity) are accounted for. In addition, generic data about taut band suspensions from another vender (Weschler Instruments) indicates that the taut-band suspension in type K-241 instruments eliminates friction, giving better accuracy [than the conventional pivot and jewel types] and almost perfect repeatability.

6.0 References

6.1 Gilbert Associates Specification SP-5201 revision 3, Motors

6.2 DA-EE-92-008-07 revision 1, Effect of Degraded Voltage on Motor Control Center Safety Related Loads

6.3 DA-EE-92-111-01 revision 1; EDG A Dynamic Analysis

6.4 DA-EE-92-112-01 revision 1, EDG B Dynamic Analysis

6.5 DA-EE-92-131-06 revision 16, AC Motor Operated Valve Degraded Voltages

6.6 DA-EE-96-068-03 revision 4, Offsite Power Loadflow Study

6.7 NFPA 70, National Electrical Code 2005 Handbook

6.8 UFSAR revision 20

6.9 Technical Specifications, Amendment 102, Revision 47

6.10 VTD-A0500-4002 revision 0, Instructions Single-Phase Voltage Relays (Undervoltage Type 27)

6.11 VTD-A0500-4201 revision 0, Instructions Single-Phase Voltage Relays (Undervoltage Type 27N)

6.12 VTD-I005-4001 revision 0, Instructions Single-Phase Voltage Relays (Undervoltage Type 27)

6.13 VTD-I005-4004 revision 1, Instructions Single-Phase Voltage Relays (Undervoltage Type 27N)

6.14 VTD-W0120-4470 revision 1, Installation, Operation, Maintenance Instruction, K-241 Line Switchboard Instruments

6.15 ANSI Standard C39.1-1981, Requirements for Electrical Analog Indicating Instruments

6.16 ANSI Standard C50.41-2000, Polyphase Induction Motors for Power Generating Stations

6.17 NEMA Standard MG-1, Motors and Generators

6.18 Procedures

6.18.1 AP-ELEC.2 revision 01300, Safeguards Busses Low Voltage or System Abnormal Frequency

6.18.2 CP-501-3 revision 20, Voltmeter (PD) and Ammeter (PC) Calibration for 480V Circuit Bus 14

6.18.3 CP-501-4 revision 18, Voltmeter (NI) and Ammeter (NH) Calibration for 480V Circuit Bus 17

6.18.4 CP-501-5 revision 20, Voltmeter (NN) and Ammeter (NM) Calibration for 480V Circuit Bus 16

6.18.5 CP-501-6 revision 17, Voltmeter (ND) and Ammeter (NC) Calibration for 480V Circuit Bus 18

6.18.6 PR-1.1 revision 32, Protective Relay Calibration

6.18.7 PT-9.1.14, revision 02001, Undervoltage Protection – 480 Volt Safeguards Bus 14

6.18.8 PT-9.1.16, revision 02201, Undervoltage Protection – 480 Volt Safeguards Bus 16

6.18.9 PT-9.1.17, revision 02001, Undervoltage Protection – 480 Volt Safeguards Bus 17

6.18.10 PT-9.1.18, revision 02101, Undervoltage Protection– 480 Volt Safeguards Bus 18

6.19 Circuit Schedules

6.19.1 L181 revision 6
6.19.2 L312 revision 6
6.19.3 L425 revision 7
6.19.4 L502 revision 6
6.19.5 L665 revision 3
6.19.6 L666 revision 3
6.19.7 L683 revision 5
6.19.8 L684 revision 5

6.20 Drawings

6.20.1 11253-1 sheet 3, revision 5, 480 Volt Bus 14 & Bus 16 Relay Setting Schedule
6.20.2 11253-1 sheet 4, revision 4, 480 Volt Bus 17 & Bus 18 Relay Setting Schedule
6.20.3 10905-0054, sheet 3, revision 13, PT and UV Relays Elementary Wiring Diagram
6.20.4 10905-0055, sheet 3, revision 11, PT and UV Relays Elementary Wiring Diagram
6.20.5 10905-0056, sheet 3, revision 11, PT and UV Relays Elementary Wiring Diagram
6.20.6 10905-0057, sheet 3, revision 11, PT and UV Relays Elementary Wiring Diagram
6.20.7 21946-0054, revision 5, PT and UV Relays Control Schematic
6.20.8 21946-0055, revision 6, PT and UV Relays Control Schematic
6.20.9 21946-0056, revision 5, PT and UV Relays Control Schematic
6.20.10 21946-0057, revision 5, PT and UV Relays Control Schematic
6.20.11 33013-1736, sheet 8, revision 3, Diesel Generator A and B Sync Switch Control Schematic

7.0 Documentation of Computer Codes

Not applicable.

8.0 Method of Analysis

Instrument uncertainties will be determined and relay setpoints will be evaluated using the methodology of procedure EP-3-S-0505 except where indicated otherwise. This procedure utilizes guidance from ANSI/ISA-S67.04-1994 which is endorsed by ISA-S67.04-1994. EP-3-S-0505 states that it does not apply to time delay relays and protective devices, however NRC IN 91-29 states that the guidance in ANSI/ISA-S67.04-1982 was endorsed by regulatory Guide 1.105 revision 2 and applies both to process instrumentation and in part to certain relays that perform a safety function.

9.0 Acceptance Criteria

Requirement	Acceptance Criteria
UFSAR Section 7.3.3.2 states "The loss of voltage and degraded voltage trips ensure operability of engineered safety features equipment during a postulated design-basis event concurrent with a degraded bus voltage condition. The undervoltage setpoints are selected so that engineered safety features motors will start and accelerate the driven loads (pumps) within the required time and will be able to perform for long periods of time at degraded conditions above the trip setpoints without significant loss of design life."	Acceptance Criteria #1 Engineered safety features motors will start and accelerate the driven loads within the required time without the undervoltage voltage relays actuating. Acceptance Criteria #2 Degraded voltage relays shall be set to allow operation of connected loads at degraded voltages (above the equipment ratings) and actuate at a degraded voltage (below equipment ratings) to ensure equipment thermal damage does not occur due to the degraded voltage condition.
UFSAR Section 8.3.1.1.4.2 states "Each safeguards bus has two undervoltage channels. Each channel has a type 27N relay to detect a complete loss of voltage and a type 27 relay to detect abnormally low voltage. One out of two relays is required to activate the channel. Activation of either channel will give an undervoltage protection system alarm. Activation of both channels will result in bus load shedding and an associated diesel generator start and bus connection."	Acceptance Cirteria #3 The loss of voltage relays shall be set to detect a complete loss of voltage. Acceptance Criteria #4 The degraded voltage relays shall be set to provide protection from abnormally low voltage.
UFSAR Section 8.3.1.2.7.1.c states "In order to protect Class 1E equipment from unsatisfactory bus voltages, the undervoltage setpoints and time-delay values have been chosen to allow retention of the load-shedding feature even after emergency busses are being supplied from onsite sources. The load-shedding setpoints are chosen such that relay operating drift will not cause spurious trips of the onsite sources while Class 1E loads are being sequenced onto the busses."	Acceptance Criteria #5 The degraded voltage relays shall not actuate during the engineered safeguards sequence with the busses supplied by the emergency diesel generators. Acceptance Criteria #6 The time delay on the loss of voltage relays shall be set to prevent inadvertent actuation during actuation of the safeguards sequence loads when the emergency busses are supplied from onsite sources.
For effective operator decision making the minimum calculated setpoint for the bus voltmeters is required to be greater than the minimum analytical limit.	Acceptance Criteria #7 The minimum calculated setpoint for the bus voltmeters should be greater than the operator decision setpoint.

10.0 Calculations/Computations – Degraded Voltage Relays (Type 27)

10.1 Degraded Voltage Relay Operate Voltage Setpoints

10.1.1 Minimum Analytical Limit (AL_{MIN})

Engineered safeguards sequence motors on Ginna's 480 volt Class 1E busses are rated 440 and 460 volts. They are designed for 80% degraded voltage starting and 90% degraded voltage continuous operation [see assumption 5.4]. Utilizing the 90% rating for continuous operation, the 440 volt motors can operate continuously at 396 volts and the 460 volt motors can operate continuously at 414 volts.

The minimum analytical limit for the 480 volt Class 1E bus degraded voltage protection is 414 volts. This value is based on the NRC Safety Evaluation Report dated 3/26/1981 for Amendment No. 38 to Provisional Operating License which approved the degraded voltage relay setpoint of greater than or equal to 414 volts. Transposing this value through the 480/120 volt bus PT produces a voltage of 103.5 volts. This is the minimum voltage at which the degraded voltage relay is expected to begin timing during a degraded voltage condition. The degraded voltage relays will begin timing for all voltages below the minimum analytical limit.

A bus voltage of 414 volts would result in a slightly lower voltage at the terminals of the motors due to the voltage drop in the motor feeder cables. Since motors are constant power devices, operation at voltages below the continuous rating will result in an increased current requirement to the motor resulting in additional thermal heating. Long term operation at elevated current levels will result in accelerated aging of the insulation system of the motor windings. For the purpose of operating the emergency safeguards sequence loads, including smaller loads fed from motor control centers, this loss of life is considered negligible since the operating time at this voltage is minor in comparison to the overall lifespan of the equipment.

If the degraded voltage relays failed to actuate at 414 volts on the bus, there are procedural actions which will ensure equipment is protected from extended operation at low voltage. Procedure AP-ELEC.2 provides guidance for Operators to responding to low voltages on the 480 volt safeguards busses. Operations is required to start both emergency diesel generators if any 480 volt safeguards bus voltage lowers to less than 420 volts. If bus voltage drops below 414 volts, Operations is required to transfer the safeguards busses to the emergency diesel generators. [NOTE: see recommendation section 14.3]

10.1.2 Maximum Analytical Limit (AL_{MAX})

In order to ensure the degraded voltage relays do not inadvertently operate, a maximum analytical limit is required. The maximum analytical limit for the 480 volt Class 1E bus degraded voltage protection has been chosen to be 432 volts, which is 90% of the 480 volt rating of the busses. Transposing this value through the 480/120 volt bus PT produces a voltage of 108.0 volts. This is the maximum voltage at which the degraded

voltage relay is expected to begin timing during a degraded voltage condition. The relay will not begin timing for all voltages above this value.

10.2 Uncertainty Calculation

The degraded voltage relays are affected by the following sources of uncertainty and bias:

Ru - relay uncertainty
Tu – temperature uncertainty
CVu – control voltage uncertainty
Du – drift uncertainty
MTEu – measurement and test equipment uncertainty
Cb – calibration bias
PTb – potential transformer bias
VDb – voltage drop bias

Total Loop Uncertainty (TLU) will be calculated with the following equations:

$$- TLU = -(Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2} - Cb - PTb - VDb$$

$$+ TLU = (Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2} + PTb$$

10.2.1 Relay uncertainty (Ru)

VTD-A0500-4002 states in the "Specifications" section under "Tolerances" that the operating voltage tolerance of ± 5% is applicable based on use of the printed dial markings. It indicates that the relay may be set precisely using the calibration procedure provided in the vendor document to obtain desired values of operating voltage and delay with excellent repeatability which is defined as variation in control voltage and temperature.

Ginna performs relay calibration utilizing the procedure provided in VTD-A0500-4002, therefore the ± 5% tolerance does not apply and the relay uncertainty is defined entirely in terms of its temperature uncertainty and control voltage uncertainty. Therefore the relay uncertainty is ± 0.0% of a 120 volt span.

10.2.2 Temperature uncertainty (Tu)
VTD-A0500-4002 states in the "Specifications" section under "Tolerances" that there is a 0.5 volt variation in operating voltage over the temperature range 20°C to 40°C.

The degraded voltage relays are located in the Relay Room and Screenhouse. UFSAR Table 3.11-1 indicates that normal temperature in these locations varies between 50°F and 104°F (10°C to 40°C). Assuming that the temperature uncertainty can be adjusted linearly over this larger temperature range, the corrected variation is 0.75 volts over the temperature range 10°C to 40°C. [refer to assumption 5.2]

This is (0.75 volts)/(120 volts) or 0.625% of a 120 volt span. The relay temperature uncertainty is therefore ± 0.625% of a 120 volt span.

10.2.3 Control Voltage Uncertainty (CVu)

VTD-A0500-4002 states in the "Specifications" section under "Control Power" that the allowable variation in control voltage is 100 to 140 volts and in the "Tolerances" section that there is a 0.2 volt variation in operating voltage for a 10 volt variation in control voltage.

The highest voltage on the DC distribution system occurs during equalization of the vital batteries. Technical Specifications bases section B3.8.4 indicates that the normal equalize voltage of the battery chargers is limited to less than or equal to 140 volts when tied to the DC electrical power distribution system, due to the voltage rating of various components and fuses. Therefore the upper voltage limit is 140 volts.

Technical Specifications Bases section B3.8.4 indicates that the minimum voltage limit for the batteries is 2.13 volts per cell, which corresponds to a total minimum voltage output of 128 volts per battery.

Actual voltage at the degraded voltage relays will be slightly below these values due to cable impedance. Voltage drop is not required to be factored into this evaluation since the actual parameter being evaluated is the range between highest and lowest voltages.

Calibration procedure PR-1.1 requires the control voltage to be adjusted to 134 volts when performing calibration, therefore control voltage will vary by (140 volts – 128 volts) = 12 volts which can be represented as ± 6 volts variation from the calibration voltage. Assuming that the variation in operating voltage is proportional to the variation in control voltage, the variation in operating voltage is calculated as ± (6 volts / 10 volts)(0.2 volts) = ± 0.12 volts. This is ± 0.10% of a 120 volt span. [refer to assumptions 5.3]

10.2.4 Drift uncertainty (Du)

Attachment 1 contains an IHPA computer run which calculated a 900 day drift of ± 0.5997% of a 120 volt span and a maximum expected value of 0.6265% of a 120 volt span for the degraded voltage relays. For conservatism, the maximum expected value will be used, therefore the drift uncertainty is ± 0.63% of a 120 volt span.

10.2.5 M&TE uncertainty (MTEu)

A review of work orders determined that the Doble F2200 test set was used to calibrate the degraded voltage relays. The typical uncertainty for the Doble test set is ± 0.25%. The typical value will be used, therefore M&TE uncertainty is ± 0.25% of a 120 volt span.

10.2.6 Calibration bias (Cb)

The nominal setting for the degraded voltage relay is 105.2 volts (setpoint SP-3526). In order to create a negative bias at the nominal setting, procedure PR-1.1 requires calibration between 105.2 and 105.7 volts (105.2, +0.5, -0.0 volts). The + 0.5 volts is 0.417% of 120 volts. The calibration bias is therefore -0.42% of a 120 volt span.

NOTE: The bias is equivalent to reducing the voltage to the relay and is therefore a negative bias which will be added to the negative TLU.

10.2.7 Potential Transformer bias (PTb)

Potential transformer accuracy depends on its accuracy class and the total connected burden. Nameplate information for the PT is documented in CMIS:

> Westinghouse 480/120 volt potential transformers, style 254A481G04, type EMPL 0.6, ACC CL IL-44-060-2 line 7, FW impulse test 10KV. Thermal ratings at ambient temperatures are 750 VA at 30 degrees C, 500 VA at 55 degrees C.

Attachment 3 contains Westinghouse bulletin 44-204 which shows that the type EMPL potential transformer has an accuracy rating of ± 0.3% for burdens up to 75 VA and 85% power factor (for W, X and Y burdens).

Based on drawings 10905-0054 sheet 3, 10905-0055 sheet 3, 10905-0056 sheet 3 and 10905-0057 sheet 3, the total burden on a PT consists of a type 27 and a type 27N relay. VTD-A0500-4002 identifies the burden of the 27 relay as 1.2 VA and VTD-A0500-4201 identifies the burden of the 27N relay as less than 0.5 VA. The total burden is therefore 1.7 VA.

The total burden of 1.7 VA is less that 75 VA, therefore the potential transformer bias is ± 0.3% of a 120 volt span.

10.2.8 Voltage Drop bias (VDb)

A review of drawings 21946-0054, 21946-0055, 21946-0056 and 29146-0057 and circuit schedules L665, L666, L683 and L684 shows that maximum cable length is 520 feet for circuit L683. The cable is #14 AWG and per Chapter 9, Table 9 of the NEC Handbook, impedance is 3.1 + j0.073 ohms/1000 ft.

Total burden on the PT is 1.7 VA (refer to section on potential transformer bias).
I = (1.7 VA)/120V = 0.014 A
R = 2(520 ft)(3.1 + j0.073 ohms/1000 ft) = 3.224 + j 0.0759 ohms = 3.22 ohms
Voltage drop = IR = (0.014A)(3.22 ohms) = 0.045 volts which is -0.038% of a 120 volt span.

Therefore the voltage drop uncertainty is a bias of -0.038% of a 120 volt span.

NOTE: The bias is equivalent to reducing the voltage to the relay and is therefore a negative bias which will be added to the negative TLU.

Summary of Uncertainties and Biases	
Ru	± 0.0%
Tu	± 0.625%
CVu	± 0.10%
Du	± 0.63%
MTEu	± 0.25%
Cb	-0.42%
PTb	± 0.3%
VDb	-0.038%

10.2.9 Determination of –TLU

$$-TLU = -(Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2} - Cb - PTb - VDb$$

$$-TLU = -(0.0^2 + 0.625^2 + 0.10^2 + 0.63^2 + 0.25^2)^{1/2} - 0.42 - 0.3 - 0.038$$

$$-TLU = -(0.86)^{1/2} - 0.42 - 0.3 - 0.038$$

$$-TLU = -0.9274 - 0.42 - 0.3 - 0.038$$

$$-TLU = -1.6854\%$$

$$-TLU = -(120 \text{ volts})(0.016854)$$

$$-TLU = -2.02 \text{ volts}$$

10.2.10 Determination of +TLU

$$+TLU = (Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2} + PTb$$

$$+TLU = (0.0^2 + 0.625^2 + 0.10^2 + 0.63^2 + 0.25^2)^{1/2} + 0.3$$

$$+TLU = (0.86^2)^{1/2} + 0.3$$

$$+TLU = 0.9274 + 0.3$$

$$+TLU = 1.2274\%$$

$$+TLU = (120 \text{ volts})(0.012274)$$

$$+TLU = 1.47 \text{ volts}$$

10.2.11 Minimum Calculated Setpoint (CS_{MIN})

$CS_{MIN} = AL_{MIN} + (+ TLU)$

$CS_{MIN} = 103.5 + (1.47)$

$CS_{MIN} = 105.0$ volts

10.2.12 Maximum Calculated Setpoint (CS_{MAX})

$CS_{MAX} = AL_{MAX} + (- TLU)$

$CS_{MAX} = 108.0 + (- 2.02)$

$CS_{MAX} = 105.9$ volts

10.2.13 Channel Calibration Acceptance Value

$CCA = \pm (Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2}$

$CCA = \pm (0.0^2 + 0.625^2 + 0.10^2 + 0.63^2 + 0.25^2)^{1/2}$

$CCA = \pm (0.86^2)^{1/2}$

$CCA = \pm 0.9274\%$

$CCA = \pm (120 \text{ volts})(0.009274)$

$CCA = \pm 1.1$ volts

10.3 Degraded Voltage Relay Time Delay Setpoints

10.3.1 Minimum Analytical Limit for Degraded Voltage Relay Time Delay

Minimum analytical limits will be established for the degraded voltage relays for 480 volt bus voltages above 368 volts. This represents 92 volts at the low side of the 480/120 volt bus PT's. Voltage will be divided into three ranges:

- 92 volts to 96 volts (368 volts to 384 volts)
- 96 volts to 108.54 volts (384 volts to 434.16 volts)
- 108.54 volts and higher (434.16 volts and higher)

92 Volts to 96 Volts

For voltages between 92 volts and 96 volts, the minimum analytical limit for degraded voltage relay time delay will be 20 seconds. This value provides adequate time for the motors to accelerate, without bus voltage remaining in a degraded voltage condition for an extended period of time. The value of 20 seconds will be compared against the time-voltage curve of the degraded voltage relays and the 480

volt bus recovery voltage later in this calculation for the most limiting condition when the busses are being supplied by offsite power. For the scenario when the emergency diesel generators are providing power to the 480 volt busses, the dynamic analyses for the emergency diesel generators (DA-EE-92-111-01 and DA-EE-92-112-01) have been reviewed and determined not to be the limiting condition for evaluation. These analyses provide voltage profiles for the 480 volt busses while starting the safeguards sequence loads and demonstrate that the responsiveness of the exciter on the diesel generators causes bus voltage to rise significantly faster than scenarios when the 480 volt busses are powered from the offsite circuits. There are pending changes to these analyses, however the changes have been reviewed and are not expected to significantly alter the acceleration time of the motors.

96 Volts to 108.54 Volts

The least amount of margin between actuation of the degraded voltage relays and the responsiveness of bus voltage occurs during the safeguards sequence with circuit 767 as the single source of offsite power. The coordination curve in the results section of this calculation contains the time-voltage curve for bus voltage recovery. The minimum analytical limit for time must be a point selected above the time-voltage curve for bus voltage recovery. Any point above this line, which appears as step changes in voltages due to voltage regulator tap changes is acceptable. The analytical limit must also be chosen to ensure it is below the curve which represents the reset voltage of the degraded voltage relays which is fixed at a value 0.5% higher than the operate setting. For the purpose of this analysis, the minimum analytical limit for time will be represented by the equation for the degraded voltage relay reset associated with the maximum analytical limit for voltage at which the relay will actuate. This curve will provide the minimum analytical limit for time for all 480 volt bus voltages above 384 volts (80% of 480 volts) and is defined by the equation:

$$V = (108.54)(1-e^{(0.08(13.5-T))}) \text{ @ 120 volt base voltage}$$

Solving the equation for time at the minimum calculated setpoint for voltage (105.0):

$105.0 = (108.54)(1-e^{(0.08(13.5-T))})$
$(105.0/108.54) = (1-e^{(0.08(13.5-T))})$
$(105.0/108.54) - 1 = -e^{(0.08(13.5-T))}$
$-(105.0/108.54) + 1 = e^{(0.08(13.5-T))}$
$Ln[-(105.0/108.54) + 1] = 0.08(13.5 - T)$
$(1/0.08)(Ln[-(105.0/108.54) + 1]) = 13.5 - T$
$T = 13.5 - (1/0.08)(Ln[-(105.0/108.54) + 1])$
$T = 56.3$ seconds
$AL_{MIN@105.0} = 56.3$ seconds

Solving the equation for time at the maximum calculated setpoint for voltage (105.9):

$105.9 = (108.54)(1-e^{(0.08(13.5-T))})$
$(105.9/108.54) = (1-e^{(0.08(13.5-T))})$
$(105.9/108.54) - 1 = -e^{(0.08(13.5-T))}$
$-(105.9/108.54) + 1 = e^{(0.08(13.5-T))}$

$Ln[-(105.9/108.54) + 1] = 0.08(13.5 - T)$
$(1/0.08)(Ln[-(105.9/108.54) + 1]) = 13.5 - T$
$T = 13.5 - (1/0.08)(Ln[-(105.9/108.54) + 1])$
$T = 60.0$ seconds
$AL_{MIN@105.9} = 60.0$ seconds

The coordination curve in the results section of this calculation indicates the minimum margin between the degraded voltage reset and the bus voltage occurs between 106.0 and 107.0 volts.

108.54 Volts and Higher

NEMA standard design requires equipment to be designed for normal operation at nominal rating ± 10%. Therefore equipment rated 480 volts is capable of continuous operation at (480 volts)(0.90) = 432 volts or 108 volts on a 120 volt base. Therefore for proper coordination with the degraded voltage relay reset, there is no requirement for a minimum analytical limit for degraded voltage relay time delay for all voltages above 108.54 volts.

10.3.2 Maximum Analytical Limit for Degraded Voltage Relay Time Delay

The degraded voltage relays have an inverse time trip characteristic curve. The formula for the curve was determined to be matched by the equation $V = (V_{SETTING})(1-e^{(0.08(13.5-T))})$, where T is time and the value to be inserted for $V_{SETTING}$ is the operate or reset coefficient [see assumption 5.1]. The exponential function of the degraded voltage relays results in the time-voltage curve becoming vertical as time increases.

In theory, an upper bound is required for the vertical portion of the degraded voltage relay characteristic curve, to ensure equipment protection is adequate. As time increases when equipment operates in a degraded voltage condition, equipment is susceptible to damage from thermal heating.

The minimum analytical limit for the operate voltage of the degraded voltage relays was selected to be 414 volts in a previous section of this calculation. This value is based on the 90% start rating of the motors with a terminal voltage rating of 460 volts. The equipment is capable of continuous operation at this voltage. No thermal damage is expected to occur on 440 and 460 volt rated equipment at voltages of 414 volts and higher. For any equipment rated 480 volts, this would be an area of concern for very long term operation.

Since the minimum analytical limit of the degraded voltage relays has been set at 414 volts, the setpoints calculated should provide a 95% confidence level that the degraded voltage relays will actuate prior to bus voltage falling below 414 volts. In order to provide protection for equipment a maximum analytical limit for time will be established.

Ginna utilizes 125 seconds as the maximum calculated setpoint for relay actuation. This was chosen as a conservative value to minimize the potential for thermal degradation for operation below 414 volts. This value will be retained and the maximum analytical limit will be calculated from the maximum calculated setpoint using the equation below:

$CS_{MAX} = AL_{MAX} + (- TLU)$
$AL_{MAX} = CS_{MAX} - (- TLU)$

The value for – TLU will be determined later in this calculation to be – 11.8 seconds. Therefore:

$AL_{MAX} = 125 \text{ seconds} - (- 11.8 \text{ seconds})$
$AL_{MAX} = 125 \text{ seconds} + 11.8 \text{ seconds}$
$AL_{MAX} = 136.8 \text{ seconds}$

Utilizing an analytical limit of 136.8 seconds is considered a conservative time delay. The loads connected to the bus are rated for terminal voltages of 440, 460 and 480 volts and are rated for continuous operation at 90% of the terminal voltage rating. ANSI Standard C50.41 provides criteria for the momentary operation of motors, which requires motors to be capable of operating at rated load for a minimum of 60 seconds when 75 percent of rated voltage at rated frequency is applied to the motor terminals. The thermal capability curves for 440, 460 and 480 volt motors have been added to the coordination curve in section 11. The actual slope of the thermal capability curves follow an exponential function, however they have been depicted as straight lines for the small voltage range at which they are plotted. The distance between the motor thermal capability curves and the degraded voltage relay characteristic curve represents the margin in time before thermal degradation would be expected to occur. Due to voltage drop in the motor feeder cables, actual voltage at the terminals would be slightly lower than the value as indicated by the thermal capability curves. Based on engineering judgement, this is considered negligible in comparison to the margin (in time) available. [See assumption 5.5]

10.4 Uncertainty Calculation

The time delay for the degraded voltage relays is affected by the following sources of uncertainty and bias:

Rut - relay uncertainty
Tut – temperature uncertainty
CVut – control voltage uncertainty
Dut – drift uncertainty
MTEut – measurement and test equipment uncertainty
Cut – calibration uncertainty
PTbt – potential transformer bias

Total Loop Uncertainty (TLU) is calculated with the following equations:

$$- TLU = -(Rut^2 + Tut^2 + CVut^2 + Dut^2 + MTEut^2 + Cut^2)^{1/2} - PTbt$$

$$+ TLU = (Rut^2 + Tut^2 + CVut^2 + Dut^2 + MTEut^2 + Cut^2)^{1/2} + PTbt$$

10.4.1 Relay uncertainty (Rut)

VTD-A0500-4002 states in the "Specifications" section under "Tolerances" that the operating time tolerance of ± 10% is applicable based on use of the printed dial markings. It indicates that the relay may be set precisely using the calibration procedure provided in the vendor document to obtain desired values of operating voltage and delay with excellent repeatability. Repeatability is defined as variation in control voltage and temperature.

Ginna performs relay calibration utilizing the procedure provided in VTD-A0500-4002, therefore the ± 10% tolerance does not apply and the relay uncertainty is defined entirely in terms of its temperature uncertainty and control voltage uncertainty. Therefore the relay uncertainty is ± 0.0%.

10.4.2 Temperature uncertainty (Tut)

VTD-A0500-4002 does not specify time delay accuracy for variations in temperature. For the purposes of this calculation an uncertainty will be added for calculation of the time delay temperature uncertainty. A value of ± 0.625% will be used, which is equivalent to the value used for the temperature uncertainty associated with voltage.

10.4.3 Control Voltage Uncertainty (CVut)

VTD-A0500-4002 does not specify time delay accuracy for variations in control voltage. For the purposes of this calculation an uncertainty will be added for calculation of the time delay control voltage uncertainty. A value of ± 0.10% will be used, which is equivalent to the value used for the control voltage uncertainty associated with the relay.

10.4.4 Drift uncertainty (Dut)

Attachment 4 contains a summary of as found relay drift during testing. The worst case results for a relay were 9.73 seconds between maximum and minimum values. For conservatism this calculation will use ± 9.73 seconds for drift. Utilizing the maximum analytical limit for time (136.8 seconds) as the span results in a value of ± 7.11% of span.

10.4.5 M&TE uncertainty (MTEut)

Attachment 5 contains Dranitz manufacturer data. The Dranitz model 325 polymeter's time measurements accuracy is ± 0.003% of reading (± least significant digit). Test timing is performed on the 0 to 999.99 or 0 to 99.999 second range. Utilizing the maximum analytical limit for time (136.8 seconds) as the span, measurement accuracy is

therefore ± (0.003%)(136.8 seconds) + 0.01 seconds = ± 0.014 seconds. Therefore the time delay MTEut is equal to ± 0.014% of a 136.8 second span.

10.4.6 Calibration uncertainty (Cut)

Past revisions of procedure PR-1.1 calibrated the degraded voltage relays at 92 volts with a time delay of 40 seconds and an as-left tolerance of ± 1.0 second. Since the relay was calibrated at the single point, an uncertainty of 1.0/40 = ± 2.5% was applied. The procedure is being revised to set the relay at 105.2 volts and perform testing at 105.0 volts, therefore using the equation from section 5.1 (assumptions) the new calibration value for time will be:

$105.0 = (105.2)(1-e^{(0.08(13.5 - T))})$
$(105.0/105.2) = (1-e^{(0.08(13.5 - T))})$
$(105.0/105.2) - 1 = -e^{(0.08(13.5 - T))}$
$-(105.0/105.2) + 1 = e^{(0.08(13.5 - T))}$
$Ln[-(105.0/105.2) + 1] = 0.08(13.5 - T)$
$(1/0.08)(Ln[-(105.0/105.2) + 1]) = 13.5 - T$
$T = 13.5 - (1/0.08)(Ln[-(105.0/105.2) + 1])$
$T = 91.8$ seconds (setpoint SP-4042)

Since the relay is only calibrated at the single point, a calibration uncertainty of ± 2.5% will continue to be utilized which is ±2.3 seconds.

10.4.7 Potential Transformer bias (PTbt)

The potential transformers have an accuracy of ± 0.3% of span. The change in time delay for a given change in voltage will vary non-linearly according to the time-voltage equation which is an exponential function. The minimum calculated setpoint for voltage was calculated as 105.0 volts and the maximum calculated setpoint for voltage was calculated as 105.9 volts. In order to add a potential transformer bias a slope will be utilized for the straight line between the minimum and maximum calculated voltage setpoints. The minimum analytical limit for time at 105.0 volts has been calculated to be 56.3 seconds and the minimum analytical limit for time at 105.9 volts has been calculated to be 60 seconds. A straight line between these points would have a slope of (60-56.3)/(105.9-105.0) or 4.1 seconds per volt. Combining these terms, ± 0.3%(120 volts)(4.1 seconds/volt) = 1.48 seconds. Utilizing the maximum analytical limit for time (136.8 seconds) as the span, measurement bias is ±(1.48 seconds)/(136.8 seconds) = ± 0.0108 or ± 1.08%.

Summary of Uncertainties and Biases	
Rut	± 0.0%
Tut	± 0.625%
CVut	± 0.10%
Dut	± 7.11%
MTEut	± 0.014%
Cut	± 2.5%
PTbt	± 1.08%

10.4.8 Determination of –TLU

$$-TLU = -(Rut^2 + Tut^2 + CVut^2 + Dut^2 + MTEut^2 + Cut^2)^{1/2} - PTut$$

$$-TLU = -(0.0^2 + 0.625^2 + 0.10^2 + 7.11^2 + 0.014^2 + 2.5^2)^{1/2} - 1.08$$

$$-TLU = -(57.2029)^{1/2} - 1.08$$

$$-TLU = -7.5633 - 1.08$$

$$-TLU = -8.6433\%$$

$$-TLU = -(136.8 \text{ seconds})(0.086433)$$

$$-TLU = -11.8 \text{ seconds}$$

10.4.9 Determination of +TLU

$$+TLU = (Rut^2 + Tut^2 + CVut^2 + Dut^2 + MTEut^2 + Cut^2)^{1/2} + PTut$$

$$+TLU = (0.0^2 + 0.625^2 + 0.10^2 + 7.11^2 + 0.014^2 + 2.5^2)^{1/2} + 1.08$$

$$+TLU = (57.2029)^{1/2} + 1.08$$

$$+TLU = 7.5633 + 1.08$$

$$+TLU = 8.6433\%$$

$$+TLU = (136.8 \text{ seconds})(0.086433)$$

$$+TLU = 11.8 \text{ seconds}$$

10.4.10 Minimum Calculated Setpoint at 105.0 volts (CS_{MIN})

$$CS_{MIN} = AL_{MIN} + (+TLU)$$

$$CS_{MIN} = 56.3 \text{ seconds} + (11.8 \text{ seconds})$$

$$CS_{MIN} = 68.1 \text{ seconds}$$

10.4.11 Minimum Calculated Setpoint at 105.9 volts (CS_{MIN})

$$CS_{MIN} = AL_{MIN} + (+TLU)$$

$$CS_{MIN} = 60.0 \text{ seconds} + (11.8 \text{ seconds})$$

CS_{MIN} = 71.8 seconds

10.4.12 Maximum Calculated Setpoint (CS_{MAX})

$CS_{MAX} = AL_{MAX} + (- TLU)$

CS_{MAX} = 136.8 seconds + (– 11.8 seconds)

CS_{MAX} = 125.0 seconds

10.4.13 Channel Calibration Acceptance Value

$CCA = \pm (Rut^2 + Tut^2 + CVut^2 + Dut^2 + MTEut^2)^{1/2}$

$CCA = \pm (0.0^2 + 0.625^2 + 0.10^2 + 7.11^2 + 0.014^2)^{1/2}$

$CCA = \pm (50.9529)^{1/2}$

CCA = ± 7.1381%

CCA = ± (136.8 seconds)(0.071381)

CCA = ± 9.8 seconds

11.0 Calculations/Computations – Loss of Voltage Relays (Type 27N)

11.1 Loss of Voltage Relay Dropout Voltage Setpoints

11.1.1 Minimum Analytical Limit (AL_{MIN})

Engineered safeguards sequence motors on Ginna's 480 volt Class 1E busses are rated 440 and 460 volts. They are designed for 80% degraded voltage starting and 90% degraded voltage continuous operation [see assumption 5.4]. Utilizing the 80% rating for starting, the 440 volt motors can start at 352 volts and the 460 volt motors can start at 368 volts.

The minimum analytical limit for the 480 volt Class 1E bus loss of voltage protection is 368 volts. This value is based on the NRC Safety Evaluation Report dated 3/26/1981 for Amendment No. 38 to Provisional Operating License which approved the loss of voltage relay setpoint of greater than or equal to 368 volts. Transposing this value through the 480/120 volt bus PT produces a voltage of 92.0 volts. This is the minimum voltage at which the loss of voltage relay is expected to begin timing during an undervoltage condition. The loss of voltage relays will begin timing for all voltages below the minimum analytical limit.

A bus voltage of 368 volts would result in a slightly lower voltage at the terminals of the motors due to the voltage drop in the motor feeder cables. Running motors are constant

power devices. Therefore as terminal voltage decreases current requirement increases. Starting motors are modeled differently than running motors. Starting motors are constant impedance devices resulting in decreasing locked rotor current as bus voltage decreases. The motors will therefore not draw maximum locked rotor current for this short period of time when the bus voltage drops and subsequently recovers. The short time delay associated with the loss of voltage relays will ensure the busses are tripped in a true loss of voltage scenario.

11.1.2 Maximum Analytical Limit (AL_{MAX})

In order to ensure the loss of voltage relays do not inadvertently operate, a maximum analytical limit is required. The maximum analytical limit for the 480 volt Class 1E bus loss of voltage protection has been chosen to be 381.2 volts which is 79.42% of the 480 volt bus rated voltage. This value was chosen to allow a conservative margin above the wost case value which is found in case 116L_2007_AB from DA-EE-96-068-03 (Offsite Power Load Flow Study) to ensure the time delay coordinates with the most limiting (recoverable) grid voltage conditions. The actual worst case voltage from case 116L_2007_AB is 79.64% of bus voltage. Therefore, using the conservative value of 381.2 volts and transposing this value through the 480/120 volt bus PT produces a voltage of 95.3 volts. This is the maximum voltage at which the loss of voltage relay is expected to begin timing during an undervoltage condition. The relay will not begin timing for all voltages above this value.

11.2 Uncertainty Calculation

The loss of voltage relays are affected by the following sources of uncertainty and bias:

Ru - relay uncertainty
Tu – temperature uncertainty
CVu – control voltage uncertainty
Du – drift uncertainty
MTEu – measurement and test equipment uncertainty
Cb – calibration bias
PTb – potential transformer bias
VDb – voltage drop bias

Total Loop Uncertainty (TLU) will be calculated with the following equations:

$$- TLU = -(Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2} - Cb - PTb - VDb$$

$$+ TLU = (Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2} + PTb$$

VTD-A0500-4201 states in the "Specifications" section under "Tolerances" that the operating voltage tolerance of ± 2% is applicable based on use of the printed dial markings. It indicates that more precise settings may be determined with three tolerances which should be considered independent and may be cumulative. The three tolerances are (1) constant

temperature and constant control voltage, (2) variation over allowable DC control voltage range and (3) variation over temperature range.

Constant temperature and constant control voltage will be calculated in the relay uncertainty section (Ru). Variation over allowable DC control voltage range will be calculated in the control voltage uncertainty section (CVu). Variation over temperature range will be calculated in the temperature uncertainty section (Tu).

11.2.1 Relay uncertainty (Ru)

VTD-A0500-4201 states in the "Specifications" section under "Tolerances" that repeatability at constant temperature and constant control voltage is ± 0.1%. Therefore relay uncertainty is ± 0.1% of a 120 volt span.

11.2.2 Temperature uncertainty (Tu)

The 27N relays contain the harmonic filter option. VTD-A0500-4002 states in the "Specifications" section under "Harmonic Filter" that the relay tolerance is ± 0.4% between 10°C and 40°C.

The loss of voltage relays are located in the Relay Room and Screenhouse. UFSAR Table 3.11-1 indicates that normal temperature in these locations varies between 50°F and 104°F (10°C to 40°C).

Therefore the temperature uncertainty is ± 0.4% of a 120 volt span.

11.2.3 Control Voltage Uncertainty (CVu)

VTD-A0500-4201 states in the "Specifications" section under "Tolerances" that repeatability over the allowable DC control power range is ± 0.1%. The VTD also identifies in the "Specifications" section under "Control Power" that the allowable variation for the 125 VDC relays is 100 to 140 volts.

The highest voltage on the DC distribution system occurs during equalization of the vital batteries. Technical Specifications bases section B3.8.4 indicates that the normal equalize voltage of the battery chargers is limited to less than or equal to 140 volts when tied to the DC electrical power distribution system, due to the voltage rating of various components and fuses. Therefore the upper voltage limit is 140 volts.

Technical Specifications Bases section B3.8.4 indicates that the minimum voltage limit for the batteries is 2.13 volts per cell, which corresponds to a total minimum voltage output of 128 volts per battery.

Actual voltage at the degraded voltage relays will be slightly below these values due to cable impedance. Voltage drop is not required to be factored into this evaluation since the actual parameter being evaluated is the range between highest and lowest voltages.

Assuming that the variation in control voltage is linear over the 100 to 140 volt range (40 volt span), then the value can be adjusted for the actual control voltage range between 128 and 140 volts (12 volts span). [Refer to assumption 5.6] The uncertainty is therefore (±0.1%)(12/40) = 0.03% of a 120 volt span.

11.2.4 Drift uncertainty (Du)

Attachment 7 contains an IHPA computer run which calculated a 900 day drift of ± 0.2411% of a 120 volt span and a maximum expected value of -0.279% of a 120 volt span for the loss of voltage. For conservatism, the maximum expected value will be used, therefore the drift uncertainty is ± 0.28% of a 120 volt span.

11.2.5 M&TE uncertainty (MTEu)

A review of work orders determined that the Doble F2200 test set was used to calibrate the degraded voltage relays. The typical uncertainty for the Doble test set is ± 0.25%. The typical value will be used, therefore M&TE uncertainty is ± 0.25% of a 120 volt span.

11.2.6 Calibration bias (Cb)

The nominal setting for the loss of voltage relay is 93.2 volts (setpoint SP-2309). In order to create a negative bias at the nominal setting, procedure PR-1.1 requires calibration between 93.2 and 93.7 volts (93.2, +0.5, -0.0 volts). The + 0.5 volts is 0.417% of 120 volts. The calibration bias is therefore -0.42% of a 120 volt span.

NOTE: The bias is equivalent to reducing the voltage to the relay and is therefore a negative bias which will be added to the negative TLU.

11.2.7 Potential Transformer bias (PTb)

Potential transformer accuracy depends on its accuracy class and the total connected burden. Nameplate information for the PT is documented in CMIS:

> Westinghouse 480/120 volt potential transformers, style 254A481G04, type EMPL 0.6, ACC CL IL-44-060-2 line 7, FW impulse test 10KV. Thermal ratings at ambient temperatures are 750 VA at 30 degrees C, 500 VA at 55 degrees C.

Attachment 3 contains Westinghouse bulletin 44-204 which shows that the type EMPL potential transformer has an accuracy rating of ± 0.3% for burdens up to 75 VA and 85% power factor (for W, X and Y burdens).

Based on drawings 10905-0054 sheet 3, 10905-0055 sheet 3, 10905-0056 sheet 3 and 10905-0057 sheet 3, the total burden on a PT consists of a type 27 and a type 27N relay. VTD-A0500-4002 identifies the burden of the 27 relay as 1.2 VA and VTD-A0500-4201 identifies the burden of the 27N relay as less than 0.5 VA. The total burden is therefore 1.7 VA.

The total burden of 1.7 VA is less that 75 VA, therefore the potential transformer bias is ± 0.3% of a 120 volt span.

11.2.8 Voltage Drop bias (VDb)

A review of drawings 21946-0054, 21946-0055, 21946-0056 and 29146-0057 and circuit schedules L665, L666, L683 and L684 shows that maximum cable length is 520 feet for circuit L683. The cable is #14 AWG and per Chapter 9, Table 9 of the NEC Handbook, impedance is 3.1 + j0.073 ohms/1000 ft.

Total burden on the PT is 1.7 VA (refer to section on potential transformer bias).
I = (1.7 VA)/120V = 0.014 A
R = 2(520 ft)(3.1 + j0.073 ohms/1000 ft) = 3.224 + j 0.0759 ohms = 3.22 ohms
Voltage drop = IR = (0.014A)(3.22 ohms) = 0.045 volts which is -0.038% of a 120 volt span.

Therefore the voltage drop uncertainty is a bias of -0.038% of a 120 volt span.

NOTE: The bias is equivalent to reducing the voltage to the relay and is therefore a negative bias which will be added to the negative TLU.

Summary of Uncertainties and Biases	
Ru	± 0.1%
Tu	± 0.4%
CVu	± 0.03%
Du	± 0.28%
MTEu	± 0.25%
Cb	-0.42%
PTb	± 0.3%
VDb	-0.038%

11.2.9 Determination of –TLU

$$-TLU = -(Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2} - Cb - PTb - VDb$$

$$-TLU = -(0.1^2 + 0.4^2 + 0.03^2 + 0.28^2 + 0.25^2)^{1/2} - 0.42 - 0.3 - 0.038$$

$$-TLU = -(0.3188)^{1/2} - 0.42 - 0.3 - 0.038$$

$$-TLU = -0.5584 - 0.42 - 0.3 - 0.038$$

$$-TLU = -1.3164\%$$

$$-TLU = -(120 \text{ volts})(0.013164)$$

$$-TLU = -1.58 \text{ volts}$$

11.2.10 Determination of +TLU

$+ TLU = (Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2} + PTb$

$+ TLU = (0.1^2 + 0.4^2 + 0.03^2 + 0.28^2 + 0.25^2)^{1/2} + 0.3$

$+ TLU = (0.3188^2)^{1/2} + 0.3$

$+ TLU = 0.5584 + 0.3$

$+ TLU = 0.8584\%$

$+ TLU = (120 \text{ volts})(0.008584)$

$+ TLU = 1.03 \text{ volts}$

11.2.11 Minimum Calculated Setpoint (CS_{MIN})

$CS_{MIN} = AL_{MIN} + (+ TLU)$

$CS_{MIN} = 92.0 + (1.03)$

$CS_{MIN} = 93.0 \text{ volts}$

11.2.12 Maximum Calculated Setpoint (CS_{MAX})

$CS_{MAX} = AL_{MAX} + (- TLU)$

$CS_{MAX} = 95.3 + (- 1.58)$

$CS_{MAX} = 93.7 \text{ volts}$

11.2.13 Channel Calibration Acceptance Value

$CCA = \pm (Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2}$

$CCA = \pm (0.1^2 + 0.4^2 + 0.03^2 + 0.28^2 + 0.25^2)^{1/2}$

$CCA = \pm (0.3118^2)^{1/2}$

$CCA = \pm 0.5584\%$

$CCA = \pm (120 \text{ volts})(0.005584)$

$CCA = \pm 0.67 \text{ volts}$

11.3 Loss of Voltage Relay Time Delay Setpoints

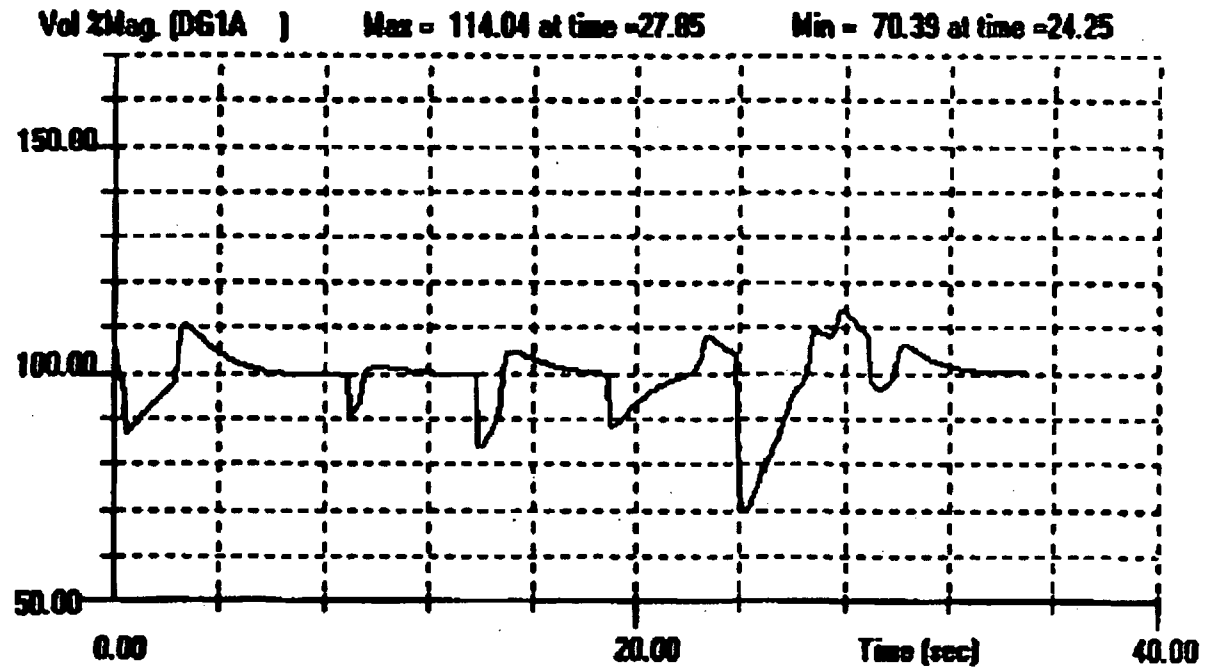
The following design analyses have evaluated bus voltages during various loading scenarios:

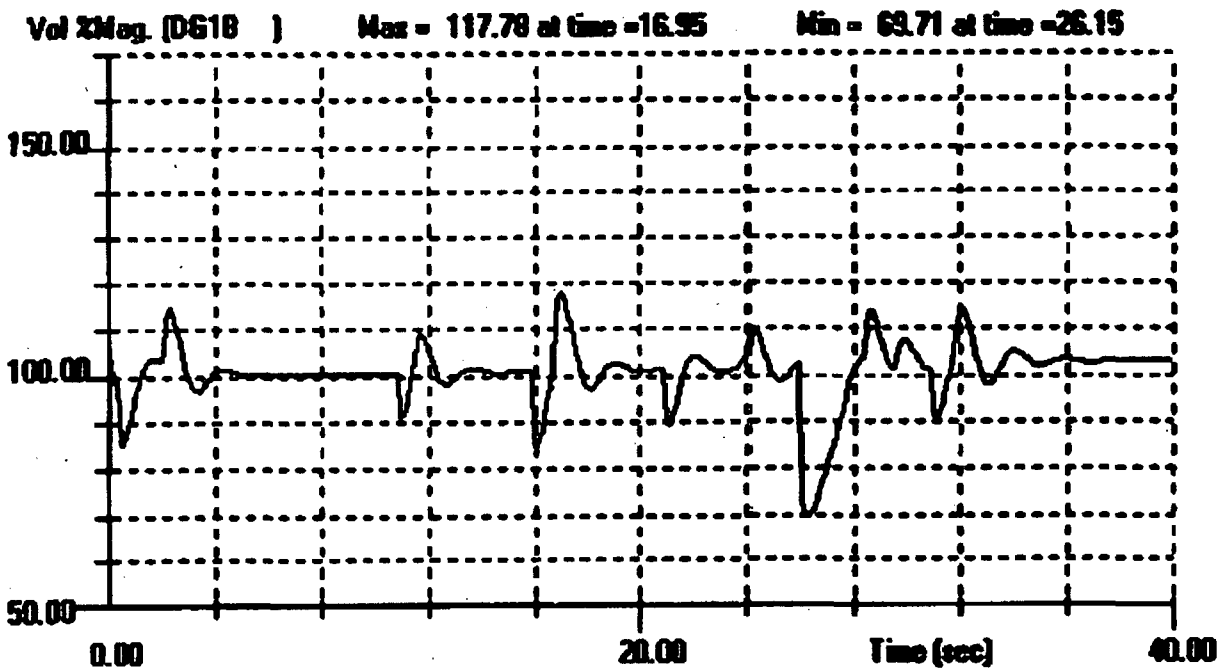
DA-EE-96-068-03, Offsite Power Load Flow Study
DA-EE-92-111-01, EDG A Dynamic Analysis
DA-EE-92-112-01, EDG B Dynamic Analysis

The time delay associated with the loss of voltage relays is required to actuate fast enough to avoid prolonged stalling of motors in the event of a loss of voltage and also be sensitive enough to permit momentary recoverable voltage dips when large motors are started.

11.3.1 Minimum Analytical Limit for Loss of Voltage Relay Time Delay

The difference in source strength between the diesel generators and the offsite circuits has a significant impact on the 480 volt bus voltages during dynamic conditions. When the 480 volt safeguards busses are supplied from the grid, the voltage drop during the safeguards sequence will not be the limiting condition for evaluation of the loss of voltage relays. The largest magnitude voltage drop occurs when the emergency diesel generators are supplying power. Analysis of the variations in bus voltage during the safeguards sequence contained in the EDG A Dynamic Analysis and EDG B Dynamic Analysis indicates that the loss of voltage relays will operate for certain scenarios. These are recoverable scenarios, as shown in the analyses. Although highly improbable, the worst case scenarios analyzed for bounding conditions are the cases in which the containment spray motors and containment fans are started concurrently (attachment J9 in each analysis). The resulting plots of bus voltage versus time are below. The difference between dropout and pickup on the loss of voltage relays is 1% (refer to assumption 5.10). By inspection of the graphs, when voltage drops below 80% (which is higher than the loss of voltage relay maximum analytical limit previously calculated) a minimum time delay of 2 seconds will provide sufficient time for the diesel generator exciter to respond and raise bus voltage above 81% (which is higher than the actual reset value associated with an 80% dropout) of the loss of voltage relays. Therefore selecting a minimum analytical limit of 2 seconds bounds by the cases evaluated.





There are pending changes to the EDG dynamic analyses, however the changes have been reviewed and are not expected to significantly alter the acceleration time of the motors or the minimum analytical limit established as 2.0 seconds.

11.3.2 Maximum Analytical Limit for Loss of Voltage Relay Time Delay

The loss of voltage relays have a maximum analytical limit established in order to assure the time delays associated with actuation of the undervoltage protection scheme and subsequent starting of the emergency diesel generators and initiation of safeguards sequence loads are adequate. A maximum time delay for the loss of voltage relays has been established as 2.75 seconds. The time delay for undervoltage system actuation is 12.75 seconds (setpoint SP-2325) which includes 2.75 seconds for undervoltage actuation and 10 seconds for diesel starting. This value is utilized in the COLR and Technical Specifications.

11.4 Uncertainty Calculation

The time delay for the loss of voltage relays is affected by the following sources of uncertainty and bias:

Rut - relay uncertainty
Tut – temperature uncertainty
CVut – control voltage uncertainty
Dut – drift uncertainty
MTEut – measurement and test equipment uncertainty
Cut – calibration uncertainty

Total Loop Uncertainty (TLU) is calculated with the following equations:

$$- TLU = -(Rut^2 + Tut^2 + CVut^2 + Dut^2 + MTEut^2 + Cut^2)^{1/2}$$

$$+ TLU = (Rut^2 + Tut^2 + CVut^2 + Dut^2 + MTEut^2 + Cut^2)^{1/2}$$

11.4.1 Relay uncertainty (Rut)

VTD-A0500-4201 does not specify a time delay accuracy. This accuracy will be conservatively based on how accurate the field calibration is performed. Since the relay is field calibrated to the nearest 0.1 second, the relay time delay accuracy is ±0.05 seconds which is ±2.5% of a 2.0 second span, utilizing the minimum analytical limit for time as the span.

11.4.2 Temperature uncertainty (Tut)

VTD-A0500-4002 does not specify time delay accuracy for variations in temperature. For the purposes of this calculation an uncertainty will be added for calculation of the time delay temperature uncertainty. A value of ± 0.4% will be used, which is equivalent to the value used for the temperature uncertainty associated with voltage.

11.4.3 Control Voltage Uncertainty (CVut)

VTD-A0500-4002 does not specify time delay accuracy for variations in control voltage. For the purposes of this calculation an uncertainty will be added for calculation of the

time delay control voltage uncertainty. A value of ± 0.10% will be used, which is equivalent to the stated tolerance of ± 0.10% repeatability over the allowable control power range, found in the VTD "Specifications" section under "Tolerances".

11.4.4 Drift uncertainty (Dut)

Attachment 6 contains a summary of as found relay drift during testing. The worst case results for a relay were 0.03 seconds between maximum and minimum values. For conservatism this calculation will use ±0.03 seconds for drift. Utilizing the minimum analytical limit for time as the span (2.0 seconds), drift uncertainty becomes ±1.5% of span.

11.4.5 M&TE uncertainty (MTEut)

Attachment 5 contains Dranitz manufacturer data. The Dranitz model 325 polymeter's time measurements accuracy is ± 0.003% of reading (± least significant digit). Test timing is performed on the 0 to 999.99 or 0 to 99.999 second range. Utilizing the minimum analytical limit for time (2.0 seconds) as the span, measurement accuracy is therefore ± (0.003%)(2.0 seconds) + 0.01 seconds = ± 0.016 seconds. Therefore the time delay MTEut is equal 0.016/2.0 = ±0.8% of a 2.0 second span.

11.4.6 Calibration uncertainty (Cut)

Procedure PR-1.1 indicates that the time delay relays are calibrated at 2.4 seconds (setpoint SP-2311) with an as left tolerance of ±0.12 seconds. An as-left tolerance of ±0.12 seconds represents an uncertainty of ±6.0% of a 2.0 second span.

Summary of Uncertainties and Biases	
Rut	± 2.5%
Tut	± 0.40%
CVut	± 0.10%
Dut	± 1.5%
MTEut	± 0.8%
Cut	± 6.0%

11.4.7 Determination of –TLU

$$-TLU = -(Rut^2 + Tut^2 + CVut^2 + Dut^2 + MTEut^2 + Cut^2)^{1/2}$$

$$-TLU = -(2.5^2 + 0.40^2 + 0.10^2 + 1.5^2 + 0.8^2 + 6.0^2)^{1/2}$$

$$-TLU = -(45.3100)^{1/2}$$

$$-TLU = -6.7313\%$$

$$-TLU = -(2.0 \text{ seconds})(0.067313)$$

$-TLU = -0.13$ seconds

11.4.8 Determination of +TLU

$+TLU = (Rut^2 + Tut^2 + CVut^2 + Dut^2 + MTEut^2 + Cut^2)^{1/2}$

$+TLU = (2.5^2 + 0.40^2 + 0.10^2 + 1.5^2 + 0.8^2 + 6.0^2)^{1/2}$

$+TLU = (45.3100)^{1/2}$

$+TLU = 6.7313\%$

$+TLU = (2.0 \text{ seconds})(0.067313)$

$+TLU = 0.13$ seconds

11.4.9 Minimum Calculated Setpoint (CS_{MIN})

$CS_{MIN} = AL_{MIN} + (+TLU)$

$CS_{MIN} = 2.0 \text{ seconds} + (0.13 \text{ seconds})$

$CS_{MIN} = 2.13$ seconds

11.4.10 Maximum Calculated Setpoint (CS_{MAX})

$CS_{MAX} = AL_{MAX} + (-TLU)$

$CS_{MAX} = 2.75 \text{ seconds} + (0.13 \text{ seconds})$

$CS_{MAX} = 2.62$ seconds

11.4.11 Channel Calibration Acceptance Value

$CCA = \pm (Ru^2 + Tu^2 + CVu^2 + Du^2 + MTEu^2)^{1/2}$

$CCA = \pm (2.5^2 + 0.40^2 + 0.10^2 + 1.5^2 + 0.8^2)^{1/2}$

$CCA = \pm (9.31)^{1/2}$

$CCA = \pm 3.0512\%$

$CCA = \pm (2.0 \text{ seconds})(0.030512)$

$CCA = \pm 0.06$ seconds

12.0 Calculations/Computations for Bus Voltmeters (Type KA-241)

There are four analog voltmeters for the 480 volt safeguards busses located on the Main Control Board.

12.1 Contributions to Uncertainty

The voltmeters are affected by the following sources of uncertainty and bias:

RAu – Reference Accuracy uncertainty
Ru - Readability uncertainty
Tu – Temperature uncertainty
Du – Drift uncertainty
MTEu – Measurement and Test Equipment uncertainty
CTu – Calibration Tolerance uncertainty
PTb – Potential Transformer bias
VDb – Voltage Drop bias

Total Loop Uncertainty (TLU) will be calculated with the following equations:

$$- TLU = -(RAu^2 + Ru^2 + Tu^2 + Du^2 + MTEu^2 + CTu^2)^{1/2} - PTb - VDb$$

$$+ TLU = (RAu^2 + Ru^2 + Tu^2 + Du^2 + MTEu^2 + CTu^2)^{1/2} + PTb$$

12.1.1 PT bias (PTb):

There are two potential transformers which step down the bus voltage for input to the voltmeters as shown on DWG 33013-1736 sheet 8. A selector switch determines the phase voltage to be measured. The PTs are Westinghouse style 7526A02G04, 480/120V, 0.6% accuracy class at W burden and 1.2% accuracy class at X burden according to Attachment 11, Westinghouse Product Bulletin 44-200A.

The total burden on the PT is from the KA-241 Voltmeter. Other connected equipment includes the Basler Sync-check relay type BE1-25, and the KI-241 Synchro-scope with the associated voltmeter which can be neglected because these instruments will only be introduced into the circuit momentarily during monthly testing of the diesel generators. These instruments will not be used during all other operating conditions.

Attachment # 8 contains the Westinghouse Application Data publication 43-200 which indicates the AC burden on the PT from the KA-241 Voltmeter is 1.92Watts at 120V. At 150V, this will be 2.4Watts based on the following:

$$(1.92 Watts \text{ @ } 120 Volts) \cdot \frac{150 Volts}{120 Volts} = 2.4 Watts \text{ @ } 150 Volts$$

The ASA Standard 'W Burden' is 12.5VA with a power factor as low as .1; The burden on this PT falls into this category. Therefore, the accuracy class of .6% will apply.

12.1.2 Voltage Drop bias (VDb):

A review of drawings 21946-0054, 21946-0055, 21946-0056, and 21946-0057 and circuit schedules L181, L312, L425 and L582 shows that maximum calbe length is 350 feet (each) for circuits L425 and L502. The cable is #10 AWG, run in conduit for 120 feet. For conservatism, the entire run will be considered to be run in steel conduit. Each run will total 700 feet. The impedance of the conductor is 1.2+j0.063 ohms/1000ft according to the NEC handbook Chapter 9 Table 9. The total burden on a PT consists of a type KA-241 voltmeter with a burden of 2.4Watts at 150Volts (refer to section on PT bias).

Total burden on the PT is 2.4 watts (refer to section on potential transformer bias).
$I = (2.4\ VA)/150V = 0.016\ A$
$R \doteq 2(350\ ft)(1.2 + j0.063\ ohms/1000\ ft) = 0.84 + j\ 0.0441\ ohms = 0.84\ ohms$
Voltage drop = IR = (0.016A)(0.084 ohms) = 0.0134 volts which is 0.009% of a 150 volt span.

This voltage drop is therefore .009% of a 150V span.

12.1.3 Measurement and Test Equipment Uncertainty (MTEu):

Attachment # 10 contains a copy of vendor data sheets for the Arbiter Model 1040C which is used for calibration. It indicates that accuracy is 0.25%

12.1.4 Reference Accuracy (RAu):

According to VTD-W0120-4470, the rated accuracy class of the KA-241 is 1%.

12.1.5 Drift (Du):

The drift associated with the voltmeters will be assumed to be equal to the reference accuracy of 1%. (See assumption 5.11)

12.1.6 Readability uncertainty (Ru):

There is no vendor data available for the readability of the meter. Readability will be based on half of the smallest demarcation on the scale. The voltmeter is divided in demarcations of 10 Volts so the readability uncertainty will be 5 volts or .83% of the 600 volt scale.

12.1.7 Calibration Tolerance (CTu):

From Calibration Procedures CP-501.3, CP-501.4, CP-501.5, and CP-501.6 the allowed tolerance in calibrations is 6.0Volts or 1% of the 600V span.

12.1.8 Temperature uncertainty (Tu):

No vendor data is available for the temperature uncertainty associated with these voltmeters. Using ANSI C39.1 for guidance a 1% temperature uncertainty will be applied.

Summary of Uncertainties and Biases	
RAu	1%
Ru	.83%
Tu	1%
CTu	1%
Du	1%
MTEu	.25%
VDb	.009%
PTb	.6%

12.1.9 Determination of -TLU

$$- TLU = -(RAu^2 + Ru^2 + CTu^2 + Tu^2 + Du^2 + MTEu^2)^{1/2} - PTb - VDb$$

$$- TLU = -(1^2 + .83^2 + 1^2 + 1^2 + 1^2 + .25^2)^{1/2} - .6 - .009$$

$$- TLU = -(4.7514)^{1/2} - .6 - .009$$

$$- TLU = -2.179 - .6 - .009$$

$$- TLU = -2.7888\%$$

$$- TLU = -(600volts)(-0.027888)$$

$$- TLU = -16.7 \text{ Volts}$$

12.1.10 Determination of +TLU

$$+ TLU = (RAu^2 + Ru^2 + CTu^2 + Tu^2 + Du^2 + MTEu^2)^{1/2} + PTb$$

$$+ TLU = (1^2 + .83^2 + 1^2 + 1^2 + 1^2 + .25^2)^{1/2} + .6$$

$$+ TLU = (4.7514)^{1/2} + .6$$

$$+ TLU = 2.1798 + .6$$

$$+ TLU = 2.7798\%$$

+ TLU = (600volts)(0.027798)

+ TLU = 16.7 Volts

12.1.11 Minimum Calculated Setpoint (CS_{MIN}):

The Minimum Analytical Limit is EOP setpoint **R.11 (SP-2312)**. The minimum calculated setpoint is required to be greater than the minimum analytical limit by the Total Loop Uncertainty (TLU):

$CS_{MIN} = AL_{MIN} + TLU$

CS_{MIN} = 414 volts + 17 volts = 431 volts

12.1.12 The existing Operator Decision Setpoint (OD) is **420** volts (EOP Setpoint **R.1, SP-0078)**.

The existing setpoint of 420 volts is less than the calculated minimum setpoint of 431 volts. See Recommendations in section 14.3.

13.0 Results

13.1 The following setpoint values have been determined in this calculation:

Degraded Voltage Relay Operate Voltage Setpoints				
setpoint	Description	Value	setpoint as a percentage of bus voltage	setpoint transposed to 120 volt bus voltage
SP-2312	AL_{MIN}	414.0	86.25%	103.5
SP-3524	AL_{MAX}	432.0	90.00%	108.0
SP-4023	CS_{MIN}	420.0	87.50%	105.0
SP-4022	CS_{MAX}	423.6	88.25%	105.9
SP-4024	CCA	1.1	N/A	N/A
SP-3526	NOMINAL	420.8	87.67%	105.2
Degraded Voltage Relay Time Delay Setpoints				
Setpoint	Description	Value	N/A	N/A
SP-4034	$AL_{MIN@420.0}$	56.3	N/A	N/A
SP-4035	$AL_{MIN@423.6}$	60.0	N/A	N/A
SP-4025	AL_{MAX}	136.8	N/A	N/A
SP-4036	$CS_{MIN@420.0}$	68.1	N/A	N/A
SP-4037	$CS_{MIN@423.6}$	71.8	N/A	N/A
SP-4038	CS_{MAX}	125.0	N/A	N/A
SP-4039	CCA	9.8	N/A	N/A
SP-4042	NOMINAL	91.8	N/A	N/A
Loss of Voltage Relay Dropout Voltage Setpoints				
Setpoint	Description	Value	setpoint as a percentage of bus voltage	setpoint transposed to 120 volt bus voltage
SP-2308	AL_{MIN}	368.0	76.67%	92
SP-4026	AL_{MAX}	381.2	79.42%	95.3
SP-4029	CS_{MIN}	372.0	77.50%	93
SP-4028	CS_{MAX}	374.8	78.08	93.7
SP-4030	CCA	0.67	N/A	N/A
SP-2309	NOMINAL	372.8	77.67%	93.2
Loss of Voltage Relay Time Delay Setpoints				
Setpoint	Description	Value	N/A	N/A
SP-4027	AL_{MIN}	2.0	N/A	N/A
SP-2241	AL_{MAX}	2.75	N/A	N/A
SP-4032	CS_{MIN}	2.13	N/A	N/A
SP-4031	CS_{MAX}	2.62	N/A	N/A
SP-4033	CCA	0.06	N/A	N/A
SP-2311	NOMINAL	2.4	N/A	N/A

13.2 The chart on the following page depicts the characteristic curves for the degraded voltage relays with the new calculated setpoints. The most limiting 480 volt bus voltage is also shown (which appears as a step function) as well as the thermal capability curves for equipment connected to the bus (see assumption 5.5). The chart demonstrate the proper application of the degraded voltage relays to ensure equipment protection and provide proper coordination with the bus voltage recovery during the most limiting degraded voltage condition.

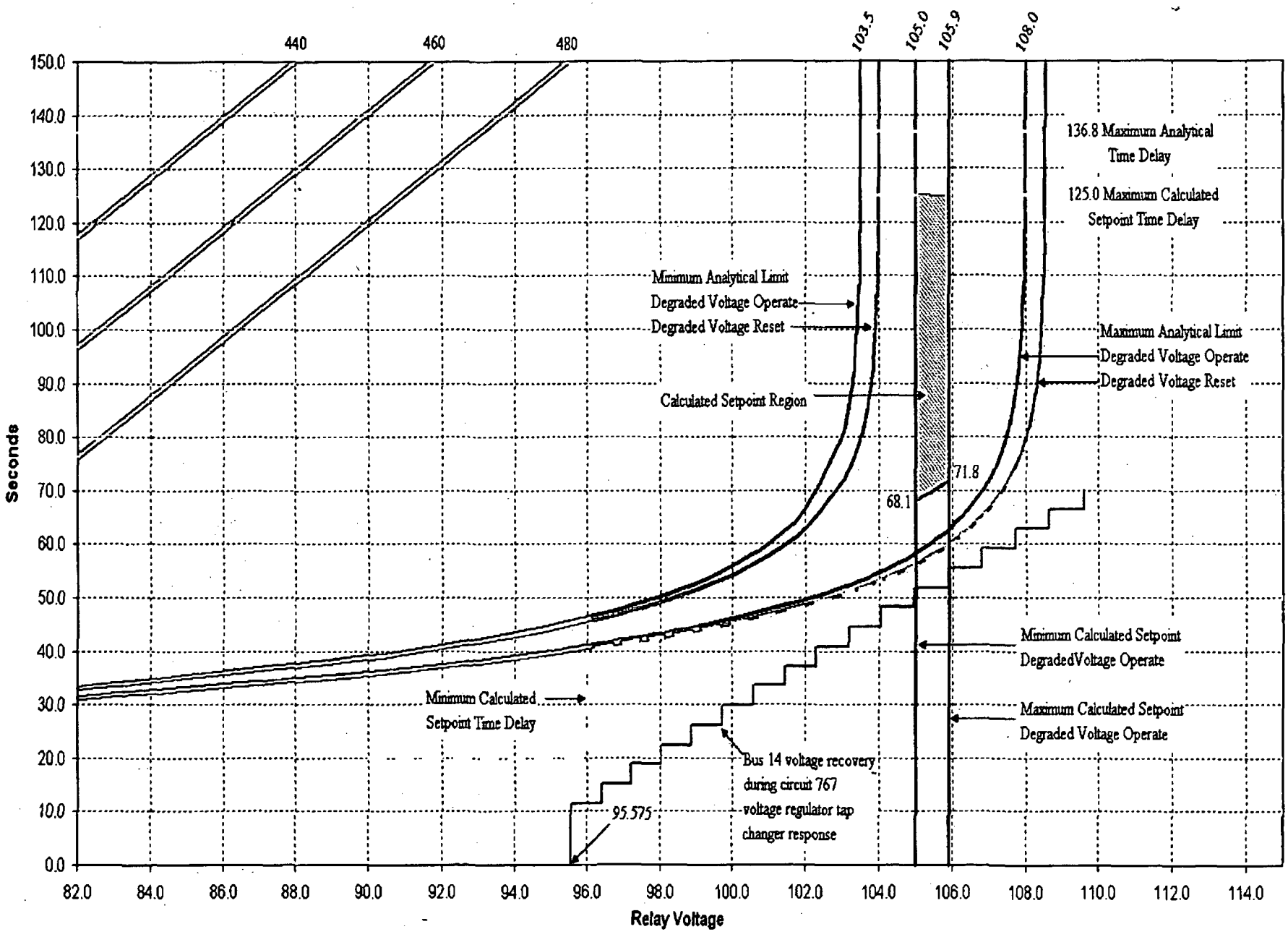
The Class 1E 480 volt safeguards busses 14, 16 17 and 18 are normally fed from the offsite sources (circuit 7T and circuit 767). The safeguards busses are backed by the emergency diesel generators in order to provide AC power in the event that offsite power is not available. The worst case voltages occur on the 480 volt safeguards busses during the sequential starting of emergency safeguards sequence loads.

The following design analysis have evaluated bus voltages during various loading scenarios:

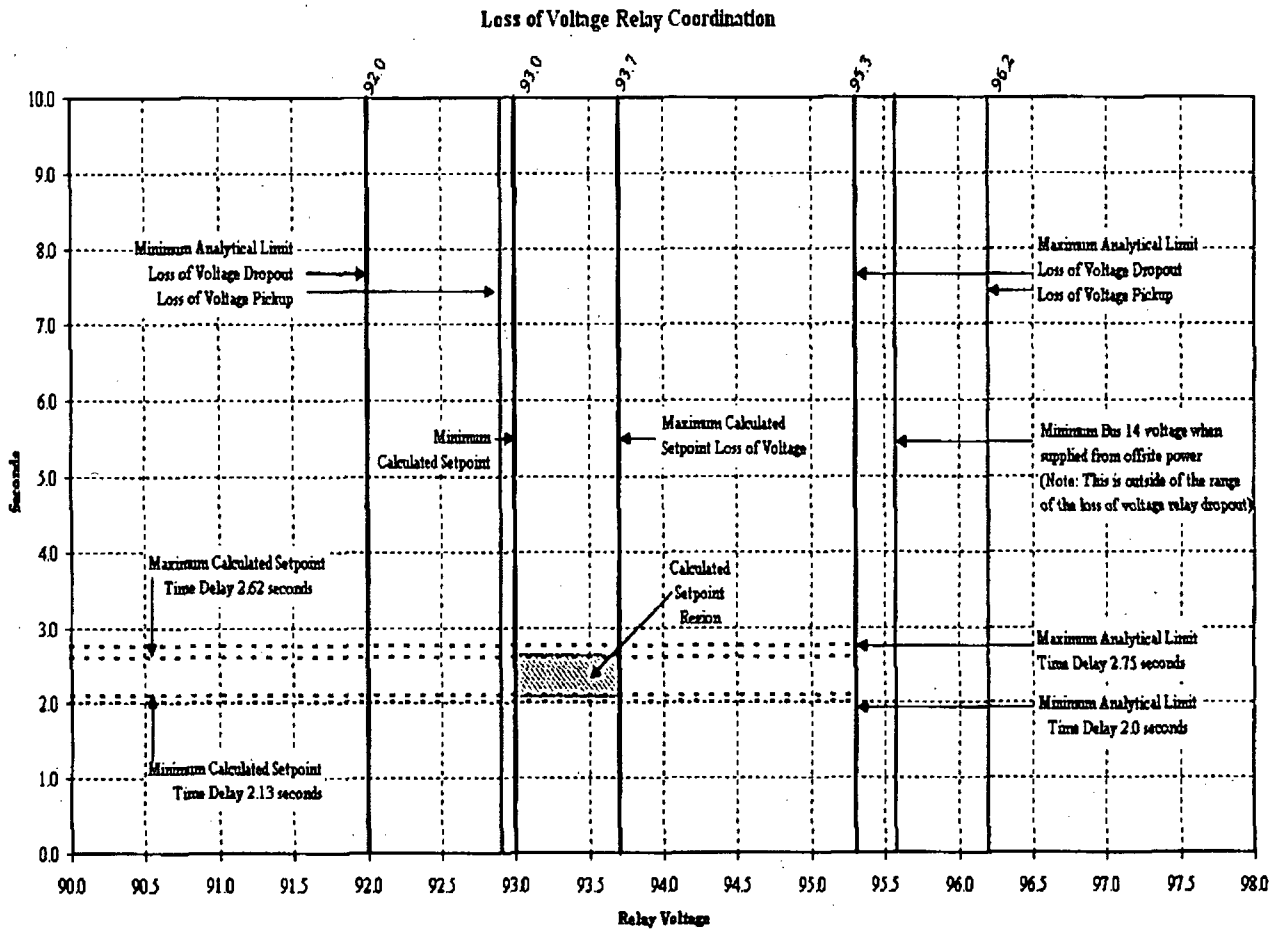
DA-EE-96-068-03, Offsite Power Load Flow Study
DA-EE-92-111-01, EDG A Dynamic Analysis
DA-EE-92-112-01, EDG B Dynamic Analysis

The differences in source strength between the diesel generators and the offsite circuits have a significant impact on the 480 volt bus voltages during dynamic conditions. During the most limiting voltage conditions on the grid, voltage will drop at the start of the safeguards sequence and the voltage recovery will be determined by the automatic tap changer responding and stepping up voltages in time periods equal to the maximum delay associated with the operation of the tap changer. This time delay will be the most limiting condition for analysis of degraded voltage relay response since the recover of voltage will be competing against the timing of the degraded voltage relay.

A summary of the calculated worst case bus voltages is contained in section 2.1 of the Offsite Power Load Flow Study. This indicates the worst case voltage occurs on bus 14 during an accident scenario with circuit 767 providing offsite power, analyzed in load flow case 116L_2007_AB. The minimum voltage is calculated as 79.64% of the 480 volt bus rating, or 382.3 volts.


Degraded Voltage Relay CoordinationCurve
440
460
480
103.5
105.0
105.9
108.0
136.8 Maximum Analytical Time Delay
125.0 Maximum Calculated Setpoint Time Delay
Minimum Analytical Limit
Degraded Voltage Operate
Degraded Voltage Reset
Maximum Analytical Limit
Degraded Voltage Operate
Degraded Voltage Reset
Calculated Setpoint Region
71.8
68.1
Minimum Calculated Setpoint DegradedVoltage Operate
Maximum Calculated Setpoint Degraded Voltage Operate
Minimum Calculated Setpoint Time Delay
95.575
Bus 14 voltage recovery during circuit 767 voltage regulator tap changer response
Seconds
Relay Voltage
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
82.0
84.0
86.0
88.0
90.0
92.0
94.0
96.0
98.0
100.0
102.0
104.0
106.0
108.0
110.0
112.0
114.0

13.3 The chart below the characteristic curves for the loss of voltage relays with the new calculated setpoints. The most limiting 480 volt bus voltage is also shown (which is outside the range of the loss of voltage relays). The chart demonstrate the proper application of the loss of voltage to ensure equipment protection and provide proper coordination with the bus voltage recovery during the most limiting degraded voltage condition.



13.4 Evaluation of Acceptance Criteria

Acceptance Criteria #1

Engineered safety features motors will start and accelerate the driven loads within the required time without the undervoltage voltage relays actuating.

Assessment of Calculations vs. Acceptance Criteria #1

The chart for the degraded voltage relays in section 13.2 and the chart for the loss of voltage relays in section 13.3 demonstrate that the setpoints have been properly applied to coordinate with the range of potential bus voltages and the limiting conditions for protection of loads. The degraded voltage relays have been shown to provide enough time delay for the loads to energize for the most limiting condition with offsite power supplying power to the safeguards busses. The loss of voltage relays have been set at a value which will permit the

relay to reset when bus voltage recovers during the most limiting condition when three motors start concurrently during the safeguards sequence (highly improbable scenario).

Acceptance Criteria #2
Degraded voltage relays shall be set to allow operation of connected loads at degraded voltages (above the equipment ratings) and actuate at a degraded voltage (below equipment ratings) to ensure equipment thermal damage does not occur due to the degraded voltage condition.

Assessment of Calculations vs. Acceptance Criteria #2
The minimum calculated setpoint for the degraded voltage relays has been determined to be 105.0 (420 volts on the 480 volt bus) volts and the maximum calculated setpoint determined to be 105.9 volts (423.6 volts on the 480 volt bus). As shown on the chart in section 13.2, the degraded voltage relays will actuate as low as 103.5 volts (414 volts on the 480 volt bus) when accounting for the uncertainty and bias terms associated with the degraded voltage relays. Actuation of the degraded voltage relays above 414 volts will ensure that equipment is protected from thermal damage due to a degraded voltage condition. The curve also shows the margin available between equipment thermal capability curves and degraded voltage relay actuation.

Acceptance Criteria #3
The loss of voltage relays shall be set to detect a complete loss of voltage.

Assessment of Calculations vs. Acceptance Criteria #3
The minimum analytical limit for the loss of voltage relays is 92 volts (368 volts on the 480 volt bus). This voltage has been established based on the starting capability of the loads fed from the 480 volt bus. Any voltage below this value is considered a complete loss of voltage and the loss of voltage relays are expected to actuate.

Acceptance Criteria #4
The degraded voltage relays shall be set to provide protection from abnormally low voltage.

Assessment of Calculations vs. Acceptance Criteria #4
The chart in section 13.2 contains the coordination curve for the degraded voltage relays and includes curves for the thermal capability of equipment fed from the busses. This chart demonstrates that the degraded voltage relays will actuate before equipment experiences thermal damage from operation at degraded voltages. Including the uncertainty and bias terms, the degraded voltage relays will actuate between 103.5 volts (414 volts on the 480 volt bus) and 105 volts (432 volts on the 480 volt bus). The most limiting value of 414 volts has been selected since it represents the lowest acceptable voltage for long term operation of equipment fed from the 480 volt busses.

Acceptance Criteria #5
The degraded voltage relays shall not actuate during the engineered safeguards sequence with the busses supplied by the emergency diesel generators.

Assessment of Calculations vs. Acceptance Criteria #5

The setpoints for the degraded voltage relays have been chosen to ensure the relays do not inadvertently actuate during the safeguards sequence. When the 480 volt busses are supplied from the emergency diesel generators bus voltage will drop to a lower value than when the 480 volt busses are supplied from offsite power, however the duration of the voltage dip will be shorter when the busses are supplied by the diesel generators. Therefore the most limiting condition for the actuation of the undervoltage relays is when the 480 volt busses are supplied by offsite power. The chart in section 13.2 shows the voltage profile for the most limiting condition on the 480 volt busses. This chart demonstrates that the voltage will recover before the degraded voltage relays time out and actuate. Since the relays do not actuate for this most limiting condition, they will not actuate for conditions when the 480 volt busses are supplied by the diesel generators.

Acceptance Criteria #6
The time delay on the loss of voltage relays shall be set to prevent inadvertent actuation during actuation of the safeguards sequence loads when the emergency busses are supplied from onsite sources.

Assessment of Calculations vs. Acceptance Criteria #6
The time delay for the loss of voltage relays, including uncertainty and bias terms ranges from 2.0 seconds to 2.75 seconds. These values have been chosen to ensure the loss of voltage relays do not inadvertently actuate. The most limiting condition evaluated (highly improbable) is for a concurrent start of the containment spray pump and two containment fans during actuation of the safeguards sequence. The bus voltage during this scenario will drop below the setpoint of the loss of voltage relays and remain there for approximately 1.5 seconds. The minimum analytical limit selected at 2.0 seconds provides time for the diesel generator to recover bus voltage before the loss of voltage relays actuate.

Acceptance Criteria #7
The minimum calculated setpoint for the bus voltmeters should be greater than the operator decision setpoint.

Assessment of Calculations vs. Acceptance Criteria #7
The existing setpoint of 420 volts is less than the calculated minimum setpoint of 431 volts. See Recommendations in section 14.3.

14.0 Recommendations

14.1 Additional margin between the recovery of bus voltage and the setpoint of the degraded voltage relays can be obtained by blocking the lowest tap setting on the offsite power voltage regulator for circuit 767. TSR 2007-0160 has been initiated to evaluate this recommendation.

14.2 Revise the TRM to include new undervoltage relay setpoints. CA-2007-002776 is tracking this item.

14.3 Procedure AP-ELEC.2 requires Operations to start both emergency diesel generators if any 480 volt safeguards bus voltage lowers to less than 420 volts. If bus voltage drops below 414

volts, Operations is required to transfer the safeguards busses to the emergency diesel generators. It is recommended that these values are revised to start the diesel generator at a voltage of 440 volts and transfer safeguards busses to the diesel generators at a voltage of 430 volts. Based on a review of AutoLog values from January of 2005 until August of 2007, the minimum bus voltage recorded is 462 volts with average values of 480 volts. Therefore a value of 440 volts is indicative of a problem. This procedure change would provide additional assurance that electrical loads would not be operated for a significant amount of time at minimum acceptable voltage. CA-2007-001371 is currently tracking a revision to AP-ELEC.2 for this issue.

14.4 Calibration procedure PR-1.1 and test procedures PT-9.1.14, PT-9.1.16, PT-9.1.17 and PT-9.1.18 should be revised to incorporate the new setpoints contained in this calculation. Required changes are identified in the "Conclusions" sections of this calculation (3.2, 3.3, 3.4 and 3.5).

No. Calib. Sets= 74

Test Calibration Points: 2 **Function: ITE-27**

Calib. Set No.	TAG	MODEL	FUNCTION	A/L Date	A/F Date	Days	A/L Value	A/F Value	DELTA Vac	DELTA %Span
1	27B-18	ABB-ITE-27	480V-UVD	4/10/1992	3/19/1994	708	104.600	105.000	0.400	0.3333
				4/10/1992	3/19/1994	708	104.800	0.000	-104.800	-87.3333
2	27B-18	ABB-ITE-27	480V-UVD	3/19/1994	4/11/1995	388	104.800	104.800	0.000	0.0000
				3/19/1994	4/11/1995	388	104.900	0.000	-104.900	-87.4167
3	27B-18	ABB-ITE-27	480V-UVD	4/11/1995	4/12/1996	367	105.000	104.700	-0.300	-0.2500
				4/11/1995	4/12/1996	367	105.200	0.000	-105.200	-87.6667
4	27B-18	ABB-ITE-27	480V-UVD	4/12/1996	10/28/1997	564	104.800	105.700	0.900	0.7500
				4/12/1996	10/28/1997	564	105.000	0.000	-105.000	-87.5000
5	27B-18	ABB-ITE-27	480V-UVD	3/9/1999	9/26/2000	567	105.600	105.300	-0.300	-0.2500
				3/9/1999	9/26/2000	567	106.100	0.000	-106.100	-88.4167
6	27B-18	ABB-ITE-27	480V-UVD	9/26/2000	3/26/2002	546	105.300	105.500	0.200	0.1667
				9/26/2000	3/26/2002	546	105.500	0.000	-105.500	-87.9167
7	27B-18	ABB-ITE-27	480V-UVD	3/26/2002	9/30/2003	553	105.500	105.600	0.100	0.0833
				3/26/2002	9/30/2003	553	105.700	0.000	-105.700	-88.0833
8	27B-18	ABB-ITE-27	480V-UVD	9/30/2003	3/31/2005	548	105.300	104.800	-0.500	-0.4167
				9/30/2003	3/31/2005	548	105.500	0.000	-105.500	-87.9167
9	27B-18	ABB-ITE-27	480V-UVD	3/31/2005	10/6/2006	554	105.200	105.300	0.100	0.0833
				3/31/2005	10/6/2006	554	105.400	105.500	0.100	0.0833
10	27-18	ABB-ITE-27	480V-UVD	4/10/1992	3/16/1994	705	104.600	104.400	-0.200	-0.1667
				4/10/1992	3/16/1994	705	104.700	0.000	-104.700	-87.2500
11	27-18	ABB-ITE-27	480V-UVD	3/16/1994	4/11/1995	391	104.900	104.600	-0.300	-0.2500
				3/16/1994	4/11/1995	391	104.910	0.000	-104.910	-87.4250
12	27-18	ABB-ITE-27	480V-UVD	4/11/1996	10/27/1997	564	105.000	105.600	0.600	0.5000
				4/11/1996	10/27/1997	564	105.500	0.000	-105.500	-87.9167
13	27-18	ABB-ITE-27	480V-UVD	10/27/1997	3/9/1999	498	105.300	105.700	0.400	0.3333
				10/27/1997	3/9/1999	498	105.500	0.000	-105.500	-87.9167
14	27-18	ABB-ITE-27	480V-UVD	3/9/1999	9/26/2000	567	105.400	105.000	-0.400	-0.3333
				3/9/1999	9/26/2000	567	105.600	0.000	-105.600	-88.0000
15	27-18	ABB-ITE-27	480V-UVD	9/26/2000	3/26/2002	546	105.300	105.400	0.100	0.0833
				9/26/2000	3/26/2002	546	105.400	0.000	-105.400	-87.8333
16	27-18	ABB-ITE-27	480V-UVD	3/26/2002	9/30/2003	553	105.400	105.200	-0.200	-0.1667
				3/26/2002	9/30/2003	553	105.600	0.000	-105.600	-88.0000
17	27-18	ABB-ITE-27	480V-UVD	9/30/2003	3/31/2005	548	105.200	104.900	-0.300	-0.2500
				9/30/2003	3/31/2005	548	105.500	0.000	-105.500	-87.9167
18	27-18	ABB-ITE-27	480V-UVD	3/31/2005	10/14/2006	562	105.200	105.300	0.100	0.0833
				3/31/2005	10/14/2006	562	105.500	105.500	0.000	0.0000
19	27B-17	ABB-ITE-27	480V-UVD	4/21/1992	3/23/1994	701	104.500	105.100	0.600	0.5000
				4/21/1992	3/23/1994	701	104.800	0.000	-104.800	-87.3333
20	27B-17	ABB-ITE-27	480V-UVD	3/23/1994	4/10/1995	383	104.900	104.800	-0.100	-0.0833
				3/23/1994	4/10/1995	383	105.000	0.000	-105.000	-87.5000
21	27B-17	ABB-ITE-27	480V-UVD	4/10/1995	4/23/1996	379	104.800	104.900	0.100	0.0833

Test Calibration Points: 2 **Function: ITE-27**

Calib. Set No.	TAG	MODEL	FUNCTION	A/L Date	A/F Date	Days	A/L Value	A/F Value	DELTA Vac	DELTA %Span
				4/10/1995	4/23/1996	379	105.000	0.000	-105.000	-87.5000
22	27B-17	ABB-ITE-27	480V-UVD	4/23/1996	11/1/1997	557	104.800	104.600	-0.200	-0.1667
				4/23/1996	11/1/1997	557	104.800	0.000	-104.800	-87.3333
23	27B-17	ABB-ITE-27	480V-UVD	11/1/1997	3/8/1999	492	105.300	105.700	0.400	0.3333
				11/1/1997	3/8/1999	492	106.000	0.000	-106.000	-88.3333
24	27B-17	ABB-ITE-27	480V-UVD	3/8/1999	9/30/2000	572	105.200	104.400	-0.800	-0.6667
				3/8/1999	9/30/2000	572	105.500	0.000	-105.500	-87.9167
25	27B-17	ABB-ITE-27	480V-UVD	9/30/2000	4/3/2002	550	105.100	105.500	0.400	0.3333
				9/30/2000	4/3/2002	550	105.800	0.000	-105.800	-88.1667
26	27B-17	ABB-ITE-27	480V-UVD	4/3/2002	9/23/2003	538	105.200	105.200	0.000	0.0000
				4/3/2002	9/23/2003	538	105.500	0.000	-105.500	-87.9167
27	27B-17	ABB-ITE-27	480V-UVD	9/23/2003	3/30/2005	554	105.200	105.000	-0.200	-0.1667
				9/23/2003	3/30/2005	554	105.400	0.000	-105.400	-87.8333
28	27B-17	ABB-ITE-27	480V-UVD	3/30/2005	10/18/2006	567	105.500	105.500	0.000	0.0000
				3/30/2005	10/18/2006	567	105.800	105.700	-0.100	-0.0833
29	27-17	ABB-ITE-27	480V-UVD	3/29/1991	4/21/1992	389	104.710	104.400	-0.310	-0.2583
				3/29/1991	4/21/1992	389	105.240	0.000	-105.240	-87.7000
30	27-17	ABB-ITE-27	480V-UVD	4/10/1995	4/23/1996	379	104.800	105.400	0.600	0.5000
				4/10/1995	4/23/1996	379	105.300	0.000	-105.300	-87.7500
31	27-17	ABB-ITE-27	480V-UVD	4/23/1996	11/1/1997	557	104.800	104.600	-0.200	-0.1667
				4/23/1996	11/1/1997	557	105.100	0.000	-105.100	-87.5833
32	27-17	ABB-ITE-27	480V-UVD	11/1/1997	3/8/1999	492	105.200	105.300	0.100	0.0833
				11/1/1997	3/8/1999	492	105.400	0.000	-105.400	-87.8333
33	27-17	ABB-ITE-27	480V-UVD	3/8/1999	9/30/2000	572	105.300	104.900	-0.400	-0.3333
				3/8/1999	9/30/2000	572	105.400	0.000	-105.400	-87.8333
34	27-17	ABB-ITE-27	480V-UVD	9/30/2000	4/2/2002	549	105.400	105.300	-0.100	-0.0833
				9/30/2000	4/2/2002	549	105.700	0.000	-105.700	-88.0833
35	27-17	ABB-ITE-27	480V-UVD	4/2/2002	9/23/2003	539	105.300	105.400	0.100	0.0833
				4/2/2002	9/23/2003	539	105.500	0.000	-105.500	-87.9167
36	27-17	ABB-ITE-27	480V-UVD	9/23/2003	3/27/2005	551	105.300	105.200	-0.100	-0.0833
				9/23/2003	3/27/2005	551	105.700	0.000	-105.700	-88.0833
37	27-17	ABB-ITE-27	480V-UVD	3/27/2005	10/18/2006	570	105.200	105.000	-0.200	-0.1667
				3/27/2005	10/18/2006	570	105.600	105.800	0.200	0.1667
38	27B-16	ABB-ITE-27	480V-UVD	3/18/1994	4/9/1995	387	104.800	104.300	-0.500	-0.4167
				3/18/1994	4/9/1995	387	105.000	0.000	-105.000	-87.5000
39	27B-16	ABB-ITE-27	480V-UVD	4/9/1995	4/22/1996	379	104.900	104.900	0.000	0.0000
				4/9/1995	4/22/1996	379	105.000	0.000	-105.000	-87.5000
40	27B-16	ABB-ITE-27	480V-UVD	4/22/1996	11/1/1997	558	104.900	105.300	0.400	0.3333
				4/22/1996	11/1/1997	558	104.900	0.000	-104.900	-87.4167
41	27B-16	ABB-ITE-27	480V-UVD	11/1/1997	3/6/1999	490	105.200	105.400	0.200	0.1667
				11/1/1997	3/6/1999	490	105.300	0.000	-105.300	-87.7500
42	27B-16	ABB-ITE-27	480V-UVD	3/6/1999	10/2/2000	576	105.300	105.100	-0.200	-0.1667
				3/6/1999	10/2/2000	576	105.400	0.000	-105.400	-87.8333

Test Calibration Points: 2 **Function: ITE-27**

Calib. Set No.	TAG	MODEL	FUNCTION	A/L Date	A/F Date	Days	A/L Value	A/F Value	DELTA Vac	DELTA %Span
43	27B-16	ABB-ITE-27	480V-UVD	10/2/2000	4/3/2002	548	105.100	105.400	0.300	0.2500
				10/2/2000	4/3/2002	548	105.200	0.000	-105.200	-87.6667
44	27B-16	ABB-ITE-27	480V-UVD	4/3/2002	9/24/2003	539	105.400	105.100	-0.300	-0.2500
				4/3/2002	9/24/2003	539	105.600	0.000	-105.600	-88.0000
45	27B-16	ABB-ITE-27	480V-UVD	9/24/2003	3/31/2005	554	105.300	105.000	-0.300	-0.2500
				9/24/2003	3/31/2005	554	105.400	0.000	-105.400	-87.8333
46	27B-16	ABB-ITE-27	480V-UVD	3/31/2005	10/18/2006	566	105.200	105.100	-0.100	-0.0833
				3/31/2005	10/18/2006	566	105.300	105.300	0.000	0.0000
47	27-16	ABB-ITE-27	480V-UVD	4/20/1992	3/18/1994	697	104.500	104.800	0.300	0.2500
				4/20/1992	3/18/1994	697	104.900	0.000	-104.900	-87.4167
48	27-16	ABB-ITE-27	480V-UVD	3/18/1994	4/9/1995	387	104.900	104.600	-0.300	-0.2500
				3/18/1994	4/9/1995	387	105.200	0.000	-105.200	-87.6667
49	27-16	ABB-ITE-27	480V-UVD	4/9/1995	4/22/1996	379	105.100	105.300	0.200	0.1667
				4/9/1995	4/22/1996	379	105.300	0.000	-105.300	-87.7500
50	27-16	ABB-ITE-27	480V-UVD	4/22/1996	10/31/1997	557	104.900	104.900	0.000	0.0000
				4/22/1996	10/31/1997	557	105.100	0.000	-105.100	-87.5833
51	27-16	ABB-ITE-27	480V-UVD	10/31/1997	3/5/1999	490	105.500	105.700	0.200	0.1667
				10/31/1997	3/5/1999	490	105.600	0.000	-105.600	-88.0000
52	27-16	ABB-ITE-27	480V-UVD	3/5/1999	10/2/2000	577	105.200	105.200	0.000	0.0000
				3/5/1999	10/2/2000	577	105.500	0.000	-105.500	-87.9167
53	27-16	ABB-ITE-27	480V-UVD	10/2/2000	4/3/2002	548	105.300	105.610	0.310	0.2583
				10/2/2000	4/3/2002	548	105.600	0.000	-105.600	-88.0000
54	27-16	ABB-ITE-27	480V-UVD	4/3/2002	9/24/2003	539	105.500	105.700	0.200	0.1667
				4/3/2002	9/24/2003	539	105.800	0.000	-105.800	-88.1667
55	27-16	ABB-ITE-27	480V-UVD	9/24/2003	3/31/2005	554	105.400	104.900	-0.500	-0.4167
				9/24/2003	3/31/2005	554	105.600	0.000	-105.600	-88.0000
56	27-16	ABB-ITE-27	480V-UVD	3/31/2005	10/17/2006	565	105.200	105.200	0.000	0.0000
				3/31/2005	10/17/2006	565	105.500	105.600	0.100	0.0833
57	27B-14	ABB-ITE-27	480V-UVD	4/10/1995	4/10/1996	366	105.000	104.300	-0.700	-0.5833
				4/10/1995	4/10/1996	366	105.200	0.000	-105.200	-87.6667
58	27B-14	ABB-ITE-27	480V-UVD	4/10/1996	10/28/1997	566	105.100	105.200	0.100	0.0833
				4/10/1996	10/28/1997	566	105.900	0.000	-105.900	-88.2500
59	27B-14	ABB-ITE-27	480V-UVD	10/28/1997	3/3/1999	491	105.300	105.600	0.300	0.2500
				10/28/1997	3/3/1999	491	105.600	0.000	-105.600	-88.0000
60	27B-14	ABB-ITE-27	480V-UVD	3/3/1999	9/26/2000	573	105.500	105.700	0.200	0.1667
				3/3/1999	9/26/2000	573	106.200	0.000	-106.200	-88.5000
61	27B-14	ABB-ITE-27	480V-UVD	9/26/2000	3/26/2002	546	105.400	105.600	0.200	0.1667
				9/26/2000	3/26/2002	546	105.700	0.000	-105.700	-88.0833
62	27B-14	ABB-ITE-27	480V-UVD	3/26/2002	9/29/2003	552	105.300	105.100	-0.200	-0.1667
				3/26/2002	9/29/2003	552	105.800	0.000	-105.800	-88.1667
63	27B-14	ABB-ITE-27	480V-UVD	9/29/2003	4/3/2005	552	105.400	105.000	-0.400	-0.3333
				9/29/2003	4/3/2005	552	105.700	0.000	-105.700	-88.0833
64	27B-14	ABB-ITE-27	480V-UVD	4/3/2005	10/18/2006	563	105.200	105.200	0.000	0.0000

Test Calibration Points: 2 ***Function: ITE-27***

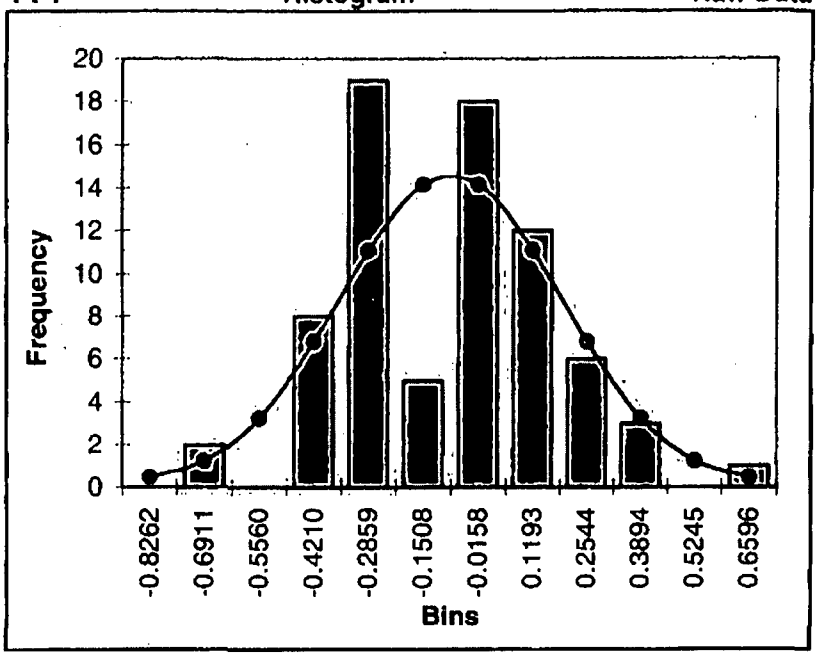
Calib. Set No.	TAG	MODEL	FUNCTION	A/L Date	A/F Date	Days	A/L Value	A/F Value	DELTA Vac	DELTA %Span
				4/3/2005	10/18/2006	563	105.400	105.500	0.100	0.0833
65	27-14	ABB-ITE-27	480V-UVD	4/8/1992	3/16/1994	707	104.500	104.800	0.300	0.2500
				4/8/1992	3/16/1994	707	104.600	0.000	-104.600	-87.1667
66	27-14	ABB-ITE-27	480V-UVD	3/16/1994	4/9/1995	389	104.800	104.600	-0.200	-0.1667
				3/16/1994	4/9/1995	389	105.200	0.000	-105.200	-87.6667
67	27-14	ABB-ITE-27	480V-UVD	4/9/1995	4/10/1996	367	105.000	104.900	-0.100	-0.0833
				4/9/1995	4/10/1996	367	105.300	0.000	-105.300	-87.7500
68	27-14	ABB-ITE-27	480V-UVD	4/10/1996	10/28/1997	566	104.900	105.000	0.100	0.0833
				4/10/1996	10/28/1997	566	105.500	0.000	-105.500	-87.9167
69	27-14	ABB-ITE-27	480V-UVD	10/28/1997	3/3/1999	491	105.200	105.500	0.300	0.2500
				10/28/1997	3/3/1999	491	105.400	0.000	-105.400	-87.8333
70	27-14	ABB-ITE-27	480V-UVD	3/3/1999	9/26/2000	573	105.200	105.000	-0.200	-0.1667
				3/3/1999	9/26/2000	573	105.700	0.000	-105.700	-88.0833
71	27-14	ABB-ITE-27	480V-UVD	9/26/2000	3/25/2002	545	105.200	105.200	0.000	0.0000
				9/26/2000	3/25/2002	545	105.300	0.000	-105.300	-87.7500
72	27-14	ABB-ITE-27	480V-UVD	3/25/2002	9/29/2003	553	105.300	104.800	-0.500	-0.4167
				3/25/2002	9/29/2003	553	105.400	0.000	-105.400	-87.8333
73	27-14	ABB-ITE-27	480V-UVD	9/29/2003	4/3/2005	552	105.200	104.800	-0.400	-0.3333
				9/29/2003	4/3/2005	552	105.400	0.000	-105.400	-87.8333
74	27-14	ABB-ITE-27	480V-UVD	4/3/2005	10/15/2006	560	105.200	105.000	-0.200	-0.1667
				4/3/2005	10/15/2006	560	105.400	105.100	-0.300	-0.2500

Function: ITE-27

Bin	Freq	Exp Freq
-0.8262	0	0.4588
-0.6911	2	1.2284
-0.5560	0	3.2634
-0.4210	8	6.8006
-0.2859	19	11.0926
-0.1508	5	14.1710
-0.0158	18	14.1710
0.1193	12	11.0926
0.2544	6	6.8006
0.3894	3	3.2634
0.5245	0	1.2284
0.6596	1	0.4588
0.7946		
> ±3 s	0	

Mean= -0.0158
Bin Size= 0.1351
s= 0.2701

Pt-1 Histogram Raw Data

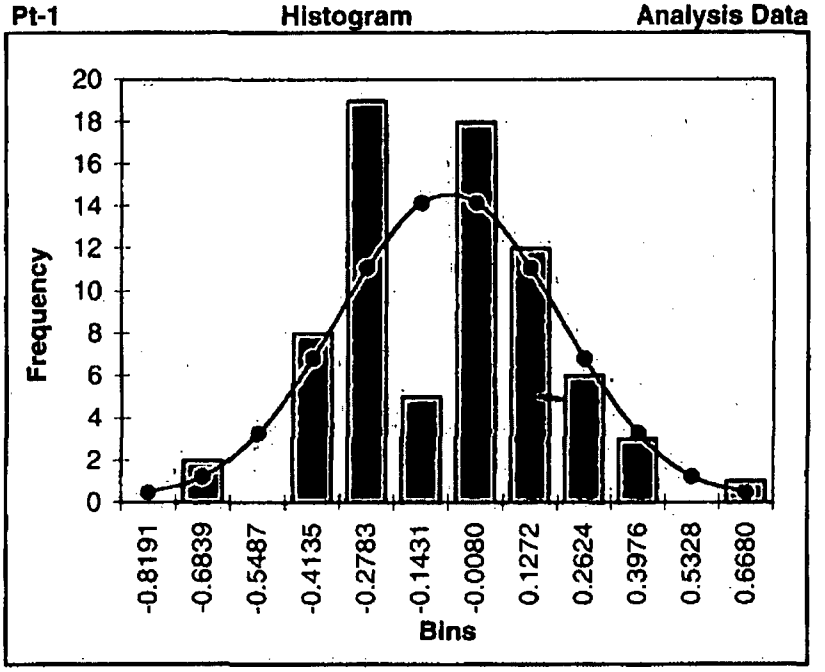


Time Int. = 1 Start = 366 End = 708

Pt-1 Histogram Analysis Data

Bin	Freq	Exp Freq
-0.8191	0	0.4588
-0.6839	2	1.2284
-0.5487	0	3.2634
-0.4135	8	6.8006
-0.2783	19	11.0926
-0.1431	5	14.1710
-0.0080	18	14.1710
0.1272	12	11.0926
0.2624	6	6.8006
0.3976	3	3.2634
0.5328	0	1.2284
0.6680	1	0.4588
0.8031		
> ±3 s	0	

Mean= -0.0080
Bin Size= 0.1352
s= 0.2704

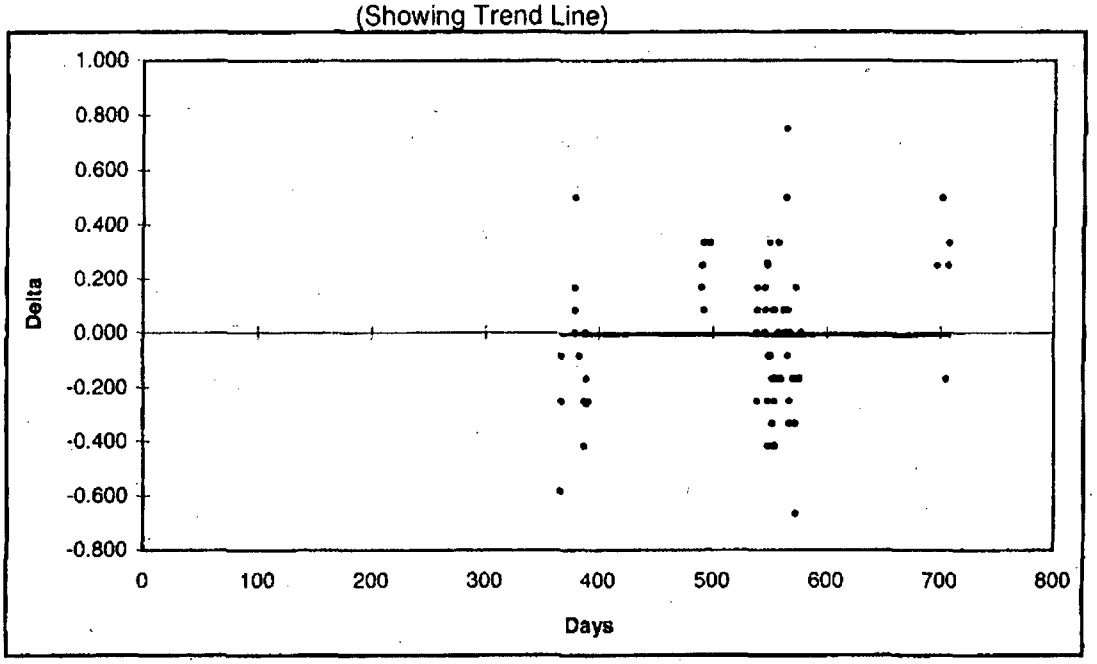


This application is
Creat

Function:ITE-27

Pt-1

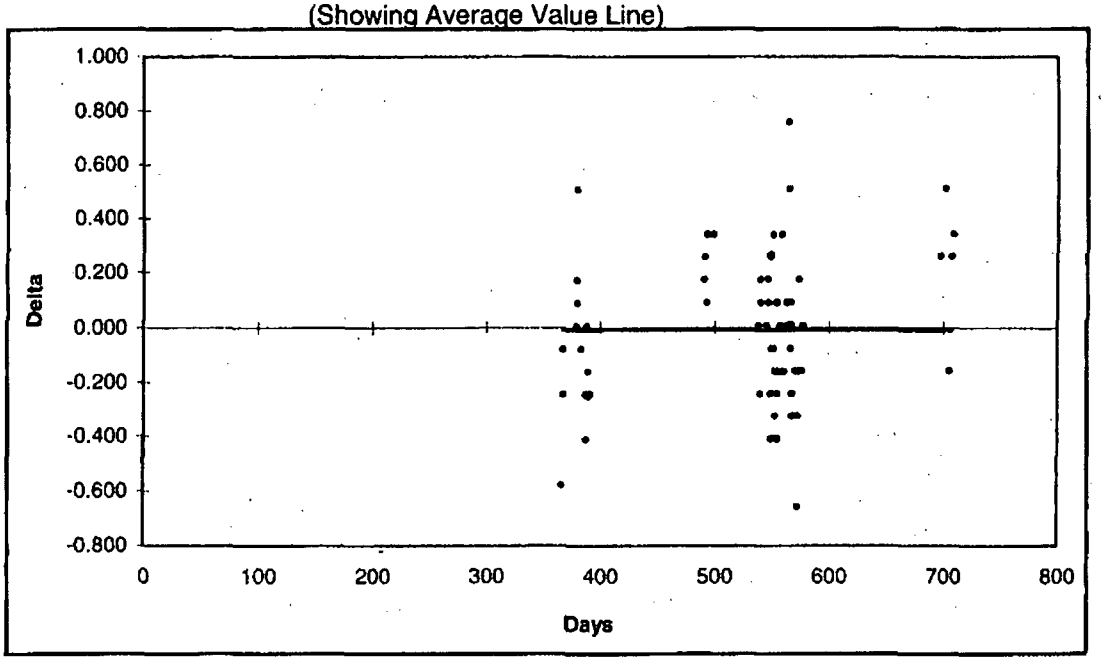
Scatter Plot: Raw Data
(Showing Trend Line)



y= -1.48E-05 x + 0
r^2= -0.002622
Drift Rate= -0.005401 % Per Year

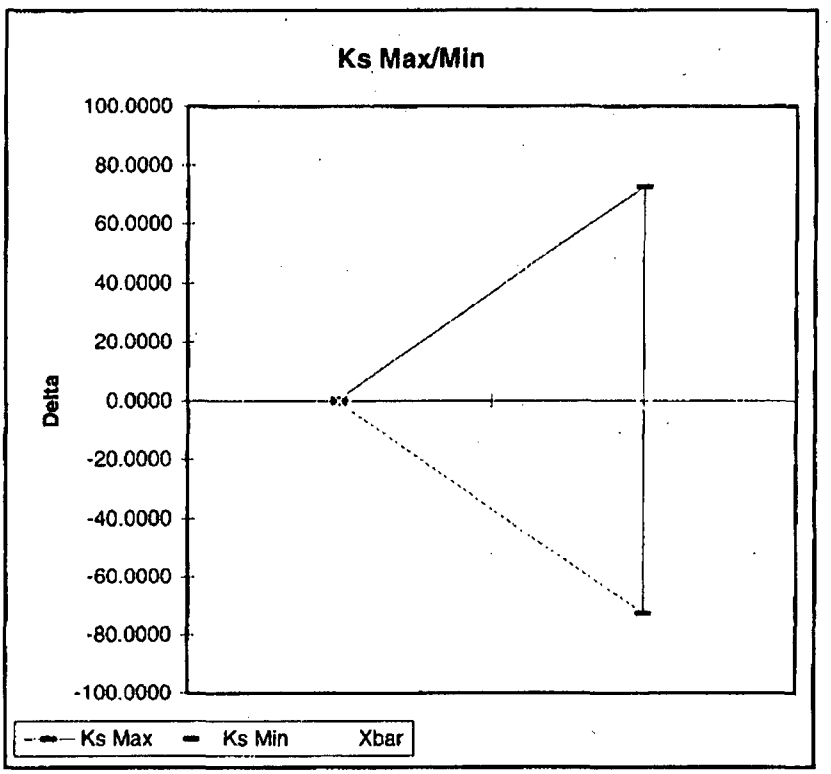
Time Interval = 1
Start = 366
End = 708

Scatter Plot: Analysis Data
(Showing Average Value Line)



Function= **ITE-27**

Two-Sided



Ks Results Summary

Function= **ITE-27**
Time Interval = 1

Two-Sided

Setpoint:	Trip	Reset
Conf. Level =	0.95	0.95
Probability =	0.95	0.95
s=	0.2704	31.8195
K=	2.2878	2.2878
Ks(max) =	0.6185	72.7966
Ks(min) =	-0.6185	-72.7966
xbar =	-0.0080	-2.5373
Ks(max)+xbar=	0.6106	70.2593
Ks(min)+xbar=	-0.6265	-75.3339
Drit Rate(per year)=	-0.0054	-52.4543
y intercept=	0.0000	0.0000

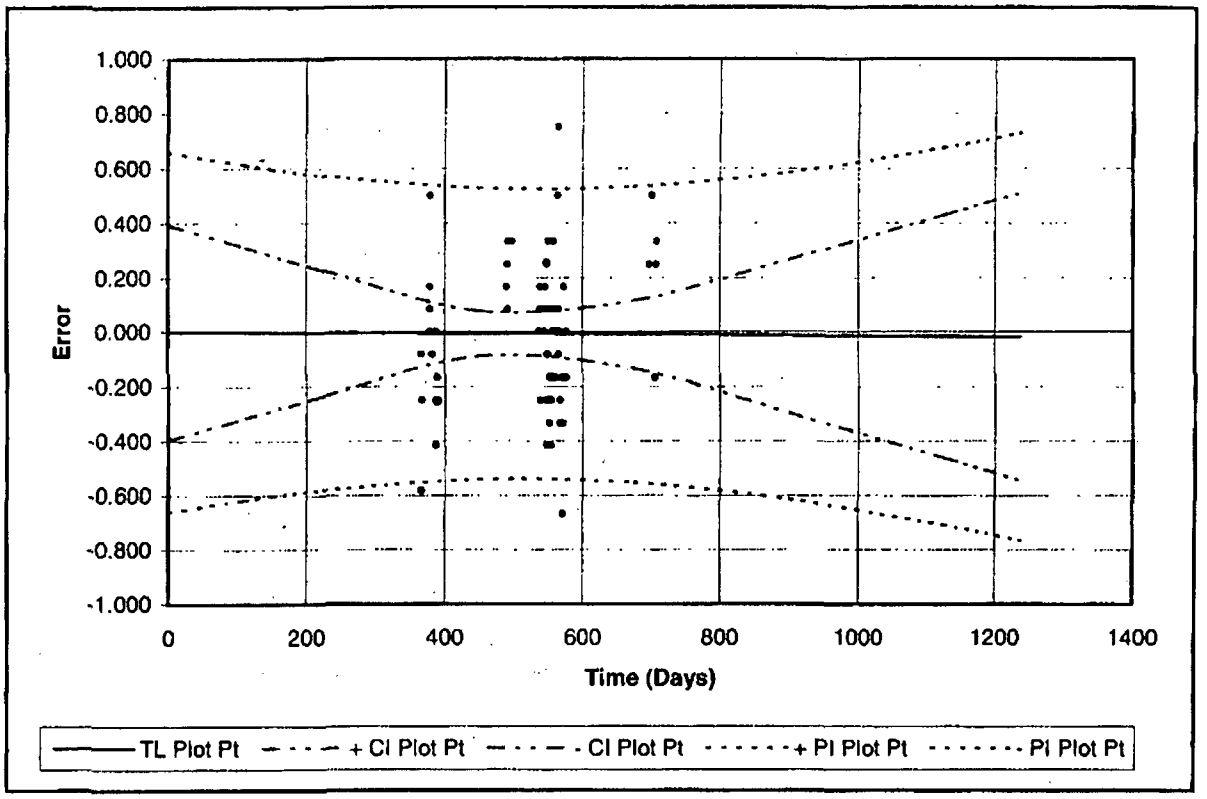
Normality Test Results Summary

Function= ITE-27
Time Interval = 1

Two-Sided

Setpoint:	Trip	Reset
Test Type=	D-prime	D-prime
Number Points=	74	74
Normal=	YES	NO
D-prime=	178.5429	143.9672
Crit Val Lo=	172.3000	172.3000
Crit Val Hi=	182.5000	182.5000
X(min)=	-0.6582	-35.0687
X(max)=	0.758345946	82.08153032
Alpha=	0.02	0.02

Two Sided Interval Plot Pt-1



Days	Trend Line	Confidence Interval			Prediction Interval		
	TL Plot Pt	+/- Value	+ CI Plot Pt	- CI Plot Pt	+/- Value	+ PI Plot Pt	- PI Plot Pt
0	0.0000	0.3944	0.3944	-0.3944	0.6600	0.6600	-0.6600
112.5	-0.0017	0.3126	0.3109	-0.3142	0.6147	0.6130	-0.6163
225	-0.0033	0.2317	0.2283	-0.2350	0.5777	0.5744	-0.5811
450	-0.0067	0.0840	0.0773	-0.0906	0.5359	0.5292	-0.5425
675	-0.0100	0.1253	0.1153	-0.1352	0.5439	0.5339	-0.5539
900	-0.0133	0.2821	0.2688	-0.2954	0.5997	0.5864	-0.6131
1125	-0.0166	0.4458	0.4292	-0.4625	0.6920	0.6753	-0.7086
1237.5	-0.0183	0.5283	0.5099	-0.5466	0.7478	0.7295	-0.7661

Number of Points = 74
t Value= 1.993462
Trendline Slope= -1.48E-05 %Span / Day
Trendline Intercept= 0 %Span
s= 0.26549 %Span
alpha= 0.05

Time Int. = 1
Start = 366
End = 708

F2000
OPERATING MANUAL

Doble Engineering Company
85 Walnut Street, Watertown, MA 02172

OPERATING MANUAL

DOBLE F2000 FAMILY

of

POWER SYSTEM PROTECTION APPARATUS

TEST & CALIBRATION EQUIPMENT

DOBLE ENGINEERING COMPANY, 85 Walnut Street, Watertown, MA 02172, U.S.A. (617) 926-4900

OPERATING MANUAL

DOBLE F2000 FAMILY
of
POWER SYSTEM PROTECTION APPARATUS
TEST & CALIBRATION EQUIPMENT

NOTICE

This manual describes all members of the F2000 family of Protection Apparatus Test & Calibration Equipment equipped with and/or controlled by F2000 Firmware version r2.00 or higher. All F2100, F2200, F2500, and F2350 Test Instruments must be equipped with version r2.00 or higher for proper operation when connected to other F2000 instruments in a multiunit system. The F2000 Slave Sources will not operate properly if their controlling Test Instrument has a lower version. Verify each Test Instrument's Firmware revision level by pressing its SLAVE switch. The revision number is displayed in Source 1's AMPLITUDE window. Contact Doble's Customer Service Department at (617)926-4900, extension 321 for updated Firmware.

Firmware version r2.00 only provides 0.01A resolution on the 5A range of the F2350, not 0.001A as listed in this manual. The higher resolution will be made available in a later revision that will be sent to all registered owners.

Firmware Revision R2.00 does not support IP with the F2500 source 1. This facility will be made available in a later revision that will be sent to all registered users.

SECTION VI
SPECIFICATIONS

*

SYSTEM CONTROLS

RAMP/SET ..... SET: sets each amplitude/phase angle digit individually;

RAMP: increments/decrements amplitude/phase angle value continuously. (at different rates).

SYSTEM OUTPUT ..... turns every source that has been 'Enabled' on (lighted) or off (dark).

ZERO X ..... SOURCE (amplitude changes occur at each source's zero crossing);

SYSTEM (amplitude changes occur simultaneously at system's reference).

FREQUENCY ..... LINE SYNCH (tracks power line); XTAL (crystal reference).

FREQUENCY

Base Frequency ..... 50 or 60 Hertz, crystal or line synchronized.

Selectable Frequencies ..... 2nd through 10th harmonic of BASE FREQ.

Accuracy ..... standard crystal = ±0.01%; precision crystal = ±0.0005%.

Line Synchronization ..... signal frequency tracks line frequency for variations of ± 1 Hz on nominal base frequency (50 or 60 Hz).

Variable Frequency Options . F2010 Minicontroller, ProTesT II. 25.00 to 99.99 and 100.0 to 600.0 Hz.

Resolution ..... 0.01 Hz from 25.00 to 99.99 Hz; 0.1 Hz from 100.0 Hz to 600.0 Hz.

SOURCE CONTROLS

SOURCE 1 ..... F2100/F2200: selects voltage source designation;

F2350: left selects High or Low Power Mode, right selects source designation.

F2500: left selects voltage or current mode, right selects source designation.

SOURCE 2 ..... F2100: selects current source designation;

F2200/F2500: left selects voltage or current mode, right selects source designation.

Value Switches ..... up increments, down decrements;

individually (SET mode) or continuously (RAMP mode).

ON/ENABLE ..... ON: turns source on or off individually.

ENABLE: enables/disables on/off control by SYSTEM OUTPUT.

HERTZ/RANGE ..... right: cyclicly selects ranges and AutoRange mode;

left: selects 1st through 10th harmonic of base frequency.

OUTPUTS

AC Voltage (F2100/F2200/F2500)

Designations ..... standard: VA, VB, VC; VM (F2825 option).
extended: VR, VS, VT, VR, VY, VB.

Ranges ..... three: 75/150/300 volts @ 80 VA.
75 volts: 0.01–75.00 V rms to 1.066 A rms (≥70.31 Ω)
150 volts: 0.1–150.0 V rms to 0.533 A rms (≥281.2 Ω)
300 volts: 0.1–300.0 V rms to 0.266 A rms (≥1.125K Ω)

Accuracy ..... 10–100% of range: ±0.25% of setting typical,
±0.5% of setting maximum @ 20–30°C;
±1% of setting absolute maximum @ 0–50°C.
0–10% of range: ±0.1% of range.

Resolution ..... 75 V range = 0.01 V, 150 and 300 V ranges = 0.1 V

Load Power ..... 80 VA continuous at maximum range at 50 or 60 Hz.

Load Power Factor ..... 0–1, leading or lagging.

Derating ..... power and voltage decreases linearly to 50% of specifications from 45 down to 25 Hz, and for input voltages less that 105/210 V.

Total Harmonic Distortion ..... 1% typical; 2% maximum, at 50 or 60 Hz.

Phase Angle ..... 0 to ±359.9°,

Phase Accuracy ..... ±0.2° typical; ±0.5° maximum, @ 50/60 Hz.

Error Detection ..... >1% amplitude and phase, >2% distortion audible beeper and blinking ER message.

Output Protection ..... short circuit proof, current limiting.

High Voltage Alarm ..... blinking red indicator when output ≥20 V.

DC Voltage (F2410)

Designation (in Master's SOURCE) ... DV.

Ranges (in Master's RANGE) ..... three: 75/150/300 volts @ 80 W.

Amplitude (in Master's AMPL) ..... 75 volts: 7.5–75.00 V (≥70.31 Ω)
150 volts: 15–150.0 V (≥281.2 Ω)
300 volts: 30–300.0 V (≥1.125K Ω)

Accuracy ..... ±1% of setting and ±1 V.

Resolution ..... 75 V range = 0.01 V, 150 and 300 V ranges = 0.1 V.

Load Power ..... 80 W continuous at maximum range.

Ripple ..... ≤5% of range peak-to-peak @ maximum load.

AC Current (F2100/F2200/F2300/F2300A/F2350/F2500)

Designations ..... F2100/F2200/F2500: standard = I1, I2, I3, IP; IM (F2825 option);
extended = IR, IS, IT; IR, IY, IB.

F2300/F2300A/F2350: standard: low power = L1, L2, L3;
LM (2825 option);
high power=H1, H2, H3; HM (2825 option).
extended: low power = LR, LS, LT; LR, LY, LB;
high power=HR, HS, HT; HR, HY, HB.

Westinghouse

Type EMPL Potential Transformers

600 and 1200 Volts, Indoor or Outdoor
Primary Volts: 240 Through 600, 60 Hertz

Application

Type EMPL is a rubber molded potential transformer. It is designed to meet 0.3 accuracy for 75 va and 85% pf as well as for 40 va and 20% pf which is the typical requirement of installations using two meters with phase shifting transformer.

Ratings

ASA metering accuracy class (60 Hz.):
0.3 Class for W, X, Y Burdens
1.2 Class for Z Burdens

Thermal Ratings:
750 Va at 30°C Ambient
500 Va at 55°C Ambient

Temperature Rise:
55°C at 30°C Ambient
30°C at 55°C Ambient

Construction Features

Core and Coils

Pre-molded forms are used for the winding spool and terminal brackets. A wound type core is assembled with the coil by bending the two securely into a cradle form. This rigid assembly is then completely enclosed in rubber.

Primary and Secondary Terminals

The terminals are stud type. Polarity markings and high and low voltage identification are molded in raised letters on the body of the transformer. Sealable terminal covers can be supplied for both high and low voltage.

The indoor 1200 Volt Type EMPL can be supplied with fuses. The fuse assembly, complete with two Type H 2 Amp fuses, style number 562 477, is mounted on top of the unit.

Base Mounting

A detachable aluminum base comes with all ratings. In the 600-volt class this is designed to meet NEMA standards style number 3, and for 1200 volt class to meet NEMA standards style number 2.

Bases for 600 and 1200 volt transformers are interchangeable.

Further Information

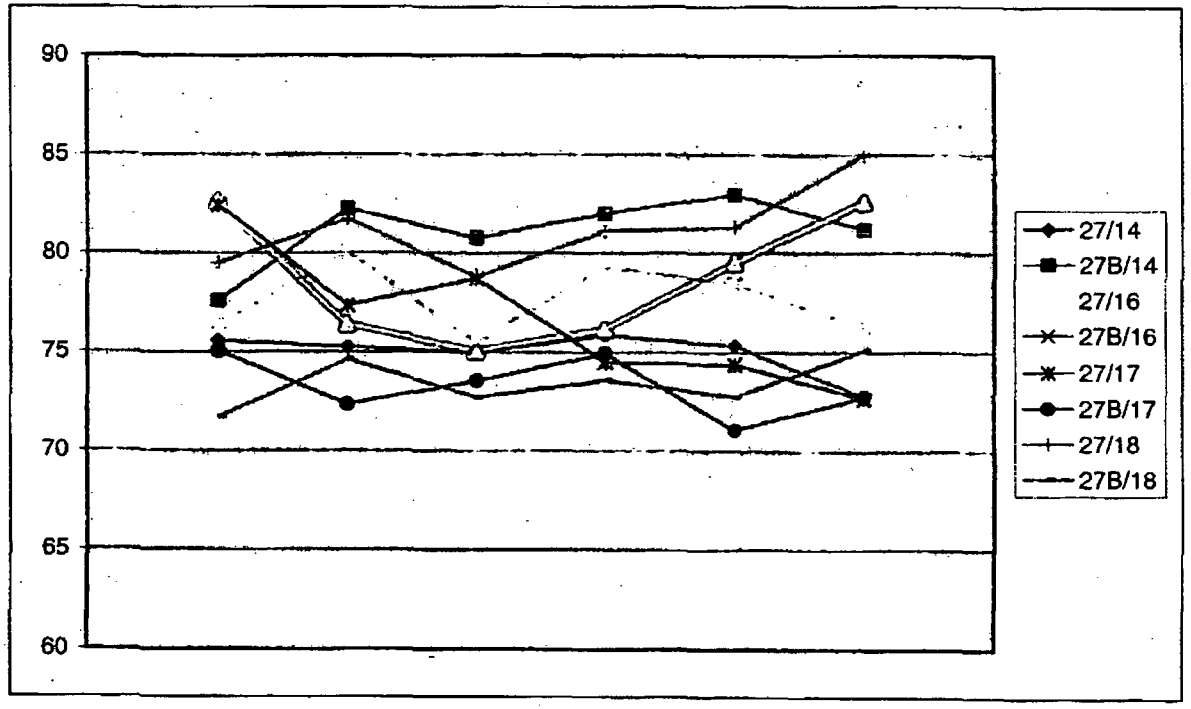
Prices: See Price List 44-020

Selector Guide

Primary Volts	Winding Ratio	Without Terminal Cover Style Number	With Terminal Covers Style Number
600 Volt Class, 10 Kv BIL: Indoor or Outdoor			
240/416 Y	2:1	254A481G01	254A483G01
288/500 Y	2.4:1	254A481G02	254A483G02
300/520 Y	2.5:1	254A481G03	254A483G03
480/480 Y	4:1	254A481G04	254A483G04
600/600 Y	5:1	254A481G05	254A483G05
1200 Volt Class, 30 Kv BIL: Indoor or Outdoor			
240/416 Y	2:1	254A481G31	254A483G31
288/500 Y	2.4:1	254A481G32	254A483G32
300/520 Y	2.5:1	254A481G33	254A483G33
480/832 Y	4:1	254A481G34	254A483G34
600/1040 Y	5:1	254A481G35	254A483G35
1200 Volt Class, 30 Kv BIL: Indoor, Fused			
240/416 Y	2:1	254A481G26	
288/500 Y	2.4:1	254A481G27	
300/520 Y	2.5:1	254A481G28	
480/832 Y	4:1	254A481G29	
600/1040 Y	5:1	254A481G30	

June, 1969
Supersedes Descriptive Bulletin 44-206, dated April, 1968
S. O. C. 5547.00

	19801039	19902777	20100651	20202647	20400377	20500524	Mean	Min	Max	Range of Test Results
27/14	75.53	75.23	74.95	75.81	75.3	72.8	74.93667	72.8	75.81	3.01
27B/14	77.57	82.25	80.75	82.02	83	81.2	81.13167	77.57	83	5.43
27/16	82.59	76.37	75.03	76.13	79.5	82.6	78.70333	75.03	82.6	7.57
27B/16	76.38	80.02	75.4	79.27	78.4	76.2	77.61167	75.4	80.02	4.62
27/17	82.43	77.32	78.7	74.49	74.4	72.7	76.67333	72.7	82.43	9.73
27B/17	75.04	72.38	73.57	74.91	71.1	72.8	73.3	71.1	75.04	3.94
27/18	79.49	81.71	78.75	81.09	81.3	85	81.22333	78.75	85	6.25
27B/18	71.72	74.62	72.73	73.59	72.8	75.1	73.42667	71.72	75.1	3.38
Mean	77.59375	77.4875	76.235	77.16375	76.975	77.3				
Min	71.72	72.38	72.73	73.59	71.1	72.7				
Max	82.59	82.25	80.75	82.02	83	85				



WORK ORDER DISPATCH PAGE 1 OF 15

****** CONTROLLED COPY ****** CONTROLLED COPY ****** CONTROLLED COPY ******

WO # 19801039 01 TYPE N UNIT 1 DATE 02/23/98 PRI 4271
TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

EQUIPMENT IDENTIFICATION NUMBER SECTION

EQUIPMENT ID LIST DESC SYS TRAIN
SR CLS LOCATION PMT/OPT RESP ENG
LOCATION DESC

INITIATION SECTION

PROBLEM/WORK REQUESTED

CALIBRATE UV & GROUND ALARM RELAYS PER PR-1.1
CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS ON BUS 14,
BUS 16, BUS 17 AND BUS 18.

THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED CONT Y

INITIATOR SYS DATE 02/23/98

PLANNING SECTION

P/2 SYS 504 P/2 LOC 373 HP 1 QC 2 FW 0 TAGOUT # MATERIALS REQ

ESTIMATED RESOURCES SECTION

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRT	SRP	SQC			
EST CREW SIZE	2	4	1	1			
EST MANHOURS	40.0	12.0	5	2.0			

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
EST CREW SIZE							8
EST MANHOURS							54.5

ACTUAL RESOURCES SECTION

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRT	SRP	SQC			
ACT CREW SIZE	2	2	1	1			
ACT MANHOURS	40	6	1.5	1			

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
ACT CREW SIZE							6
ACT MANHOURS							47.5

7584 - 1330

PR-1.1.27

ATTACHMENT 1
27 RELAY 27/14

DEVICE 27/14
SERIAL NUMBER 6020
CIRCUIT NO. BUS 14
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211R2175
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2 V	105.7 V	105.2V - 105.7V As close to 105.2 as practical	105.2 V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.95 Sec	39.0 to 41.0 seconds	40.33 Sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	75.53 Sec	✓	

PICK UP TEST: (REFERENCE FOR PT 9.1.14 ONLY)

NOTE: Raise voltage **VERY SLOWLY** until relay picks up.

AS-LEFT PICK UP VOLTS
105.5 V

Relay and case visual inspection: ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Viola DATE 3/5/99

REVIEWED BY: D Miller DATE 3-25-99

ATTACHMENT 3
27 RELAY 27B/14

DEVICE 27B/14
SERIAL NUMBER 3175-1
CIRCUIT NO. Bus 14
RELAY TYPE ITE-27
BULLETIN 18.4.7.2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE B C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.3 V	106.2 V	105.2 - 105.7V As close to 105.2V as practical	105.5 V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6TL 120V to 92V = 40 secs (suddenly applied)	35.0 to 45.0 seconds	40.185ec	39.0 to 41.0 seconds	40.385ec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	CHECK ONE	
			Pass	Fail
0 to 300 seconds	120V to 104.2V (suddenly applied)	77.57 sec	✓	

PICK UP TEST (REFERENCE FOR PT-9.1.14 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.6 V

Relay and case visual inspection ☒ SAT ☐ UNSAT

COMPLETED BY Mike Viola DATE 3/3/99

REVIEWED BY B. Milby DATE 3-22-99

ATTACHMENT 6
27 RELAY 27/16

DEVICE 27/16
SERIAL NUMBER 3181-1
RELAY TYPE ITE-27
BULLETIN 18.47.2
PHASE A B

APPLICATION Bus Undervoltage
CIRCUIT NO BUS 16
MODEL/STYLE NO 211B1175D
CURVE NO T.V.C. 605817

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.5 V	105.7V	105.2 - 105.7V As close to 105.2V as practical	105.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6TL 120V to 92V = 40 secs (suddenly applied)	35.0 to 45.0 seconds	40.94 Sec	39.0 to 41.0 seconds	40.12 Sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 to 300 seconds	120V to 104.2V (suddenly applied)	82.59 Sec	✓	

PICK-UP TEST (REFERENCE FOR PT 9.1.16 ONLY)

NOTE Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
105.5 V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Viola DATE: 3/5/99

REVIEWED BY: D Mills DATE: 3-22-99

PR-1.1.34

ATTACHMENT 8
27 RELAY 27B/16

DEVICE 27B/16
SERIAL NUMBER 6022
CIRCUIT NO. BUS 16
RELAY TYPE ITE 27
BULLETIN 18.4.7.2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211R1175
CURVE NO. T.V.C. 605817
PHASE B - C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2 V	105.4 V	105.2V - 105.7V As close to 105.2 as practical	105.3 V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.21 Sec	39.0 to 41.0 seconds	40.365 Sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	76.385 Sec	X	

PICK UP TEST: (REFERENCE FOR PT-9.1.16 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.4 V

Relay and case visual inspection: ☒ SAT ☐ UNSAT

COMPLETED BY: Mike Vio GA DATE 3/6/99

REVIEWED BY: D Miller DATE 3-22-99

ATTACHMENT 11
27 RELAY 27/17

DEVICE 27/17
SERIAL NUMBER 3176-1
CIRCUIT NO. BUS 17
RELAY TYPE ITE-27
BULLETIN 18.4.7.2

APPLICATION Bus Undervoltage
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE A B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2 V	105.3 V	105.2 - 105.7V As close to 105.2V as practical	105.3 V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.23 sec	39.0 to 41.0 seconds	40.69 sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	82.43 Sec	✓	

PICK UP TEST (REFERENCE FOR PT 9.1.17 ONLY)

***NOTE**: Raise voltage **VERY SLOWLY** until relay picks up.*

AS-LEFT PICK UP VOLTS
105.4 V

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Viola DATE: 3/8/99

REVIEWED BY: D. Miller DATE: 3 22 99

PR-1.1.39

ATTACHMENT 13
27 RELAY 27B/17

DEVICE 27B/17
SERIAL NUMBER 3179-1
CIRCUIT NO. Bus 17
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE B C X

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.3 V	105.7 V	105.2V - 105.7V As close to 105.2 as practical	105.2 V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.61 Sec	39.0 to 41.0 seconds	40.61 Sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	75.04 Sec	✓	

PICK UP TEST (REFERENCE FOR PT 9.1.17 ONLY)

NOTE: Raise voltage **VERY SLOWLY** until relay picks up.

AS-LEFT PICK-UP VOLTS
105.5 V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Kiola DATE: 3/8/99

REVIEWED BY: D Miller DATE: 3-22-99

7384 - 1245

PR 1 1 42

ATTACHMENT 16
27 RELAY 27/18

DEVICE 27/18 MV
SERIAL NUMBER ~~6173-1~~ 3182-1
CIRCUIT NO BUS 1B
RELAY TYPE ITE-27
BULLETIN 18.4.7.2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO 211B1175D
CURVE NO T.V.C. 605817
PHASE A B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.3 V	105.7 V	105.2V - 105.7V As close to 105.2 as practical	105.4 V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.18 Sec	39.0 to 41.0 seconds	40.62 Sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	19.49 Sec	✓	

PICK UP TEST (REFERENCE FOR PT 9.1.18 ONLY)

NOTE Raise voltage VERY SLOWLY until relay picks up

AS LEFT PICK UP VOLTS
105.6 V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY Mike Viola DATE 3/9/99

REVIEWED BY D Miller DATE 3-22-99

ATTACHMENT 18
27 RELAY 27B/18

DEVICE 27B/18
SERIAL NUMBER 3177-1
CIRCUIT NO. BUS 18
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO: T.V.C. 605820
PHASE B C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2 V	106.1 V	105.2V - 105.7V As close to 105.2 as practical	105.6 V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.19 Sec	39.0 to 41.0 seconds	40.96 Sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	71.72 Sec	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.18 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS LEFT PICK UP VOLTS
105.8 V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY Mike Viola DATE: 3/9/99

REVIEWED BY: D. Miller DATE: 3-22-99

WORK ORDER DISPATCH PAGE 1 OF 14

****** CONTROLLED COPY ****** CONTROLLED COPY ******* CONTROLLED COPY ******

WO # 19902777 01 TYPE UNIT 1 DATE 08/14/99 PRI 3A
TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

EQUIPMENT IDENTIFICATION NUMBER SECTION

EQUIPMENT ID LIST DESC SYS TRAIN
SR CLS LOCATION PMT/OPT RESP ENG
LOCATION DESC

INITIATION SECTION

PROBLEM/WORK REQUESTED

CALIBRATE UV & GROUND ALARM RELAYS PER PR 1.1

CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS ON BUS 14,

BUS 16, BUS 17 AND BUS 18

THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED CONT Y

INITIATOR SYS DATE 08/14/99

PLANNING SECTION

P/2 SYS 504 P/2 LOC 373 HP 1 QC 2 FW 0 TAGOUT # MATERIALS REQ

ESTIMATED RESOURCES SECTION

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRT	SRP	SQC			
EST CREW SIZE	2	4	1	1			
EST MANHOURS	40.0	12.0	5	2.0			

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
EST CREW SIZE							8
EST MANHOURS							54.5

ACTUAL RESOURCES SECTION

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRT	SRP	SQC			
ACT CREW SIZE	2						
ACT MANHOURS	40						

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
ACT CREW SIZE							2
ACT MANHOURS							40

ATTACHMENT 1
27 RELAY 27/14

DEVICE 27/14u
SERIAL NUMBER 6020
CIRCUIT NO. BUS 14
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION: BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211R2175
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2V	105.0V	105.2V - 105.7V As close to 105.2 as practical	105.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	4040	39.0 to 41.0 seconds	4009

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	1523	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.14 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
105.3V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: _____ DATE: 9.26.00

REVIEWED BY: _____ DATE: 9 Oct 00

ATTACHMENT 3
27 RELAY, 27B/14

DEVICE 27B/14
SERIAL NUMBER 3175-1
CIRCUIT NO. Bus 14
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE B - C

DROPOUT TEST

Setting	As-Founds Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V.	Plus or minus 1 volt of previous As-Left Test	105.5V	105.7V	105.2 - 105.7V As close to 105.2V as practical	105.4V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6TL 120V to 92V = 40 secs (suddenly applied)	35.0 to 45.0 seconds	40.46	39.0 to 41.0 seconds	40.69

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	CHECK ONE	
			Pass	Fail
0 to 300 seconds	120V to 104.2V (suddenly applied)	82.25"	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.14 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.7V

Relay and case visual inspection ☒ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9/6/00

REVIEWED BY: [signature] DATE: 9/6/00

ATTACHMENT 6
27 RELAY 27/16

DEVICE 1 27/16
SERIAL NUMBER 3181-1
RELAY TYPE ITE-27
BULLETIN 18.4.7-2
PHASE A - B

APPLICATION Bus Undervoltage
CIRCUIT NO BUS 16
MODEL/STYLE NO 211B1175D
CURVE NO T.V.C. 6058176

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2V	104.8	105.2 - 105.7V As close to 105.2V as practical	105.3V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6TL 120V to 92V = 40 secs (suddenly applied)	35.0 to 45.0 seconds	39.74	39.0 to 41.0 seconds	39.14

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 to 300 seconds	120V to 104.2V (suddenly applied)	76.37	✓	

PICK UP TEST (REFERENCE FOR PT-9.1.16 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.6V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: _____ DATE 10-2-00

REVIEWED BY: _____ DATE 10-2-00

ATTACHMENT 8
27 RELAY 27B/16

DEVICE 27B/16
SERIAL NUMBER 6022
CIRCUIT NO. BUS 16
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211R1175
CURVE NO. T.V.C. 605817
PHASE B - C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.3V	105.1V	105.2V - 105.7V As close to 105.2 as practical	105.1V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
.6 TL 120V to 92V = .40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.24	39.0 to 41.0 seconds	40.37

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	80.02	✓	

PICK UP TEST - (REFERENCE FOR PT-9.1.16 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.2V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 10 2 00

REVIEWED BY: [signature] DATE: 02 OCT 00

ATTACHMENT 11
27 RELAY 27/17

DEVICE 27/17
SERIAL NUMBER 3176-1
CIRCUIT NO. BUS 17
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION Bus Undervoltage
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.3	104.9V	105.2 - 105.7V As close to 105.2V as practical	105.4V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.90	39.0 to 41.0 seconds	40.06

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	17.32	✓	

PICK UP TEST (REFERENCE FOR PT-9.1.17 ONLY)

NOTE - Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS:
105.7V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE 9-30-10

REVIEWED BY: [signature] DATE 10-2-10

ATTACHMENT 13
27 RELAY 27B/17

DEVICE 27B/17
SERIAL NUMBER 3179-1
CIRCUIT NO. Bus 17
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE B - C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2V	104.4V ~~105.0V~~	105.2V - 105.7V As close to 105.2 as practical	105.1V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.91	39.0 to 41.0 seconds	39.83

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One: Pass	Check One: Fail
0 - 300 seconds	120V to 104.2V~ (suddenly applied)	72.38	✓	

PICK-UP TEST: (REFERENCE FOR PT-9.1.17 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS:
105.8V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9-30-00

REVIEWED BY: [signature] DATE: 10-2-00

ATTACHMENT 16
27 RELAY 27/18

DEVICE 27/18
SERIAL NUMBER 3182-1
CIRCUIT NO. BUS 18
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.4V	105.0V	105.2V - 105.7V As close to 105.2 as practical	105.3V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.76	39.0 to 41.0 seconds	40.51

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	81.71	✓	

PICK UP TEST (REFERENCE FOR PT-9.1.18 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
105.4V

Relay and case visual inspection: ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9.26.00

REVIEWED BY: [signature] DATE: 10-2-00

ATTACHMENT 18
27 RELAY-27B/18

DEVICE 27B/18
SERIAL NUMBER 3177-1
CIRCUIT NO BUS-18
RELAY TYPE ITE-27
BULLETIN 18.47-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO 211B1175D
CURVE NO T.V.C. 605820
PHASE B - C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.6V	105.3V	105.2V - 105.7V As close to 105.2 as practical	105.3V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	41.20	39.0 to 41.0 seconds	40.16 41.32

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
0 - 300 seconds	120V to 104.2V (suddenly applied)	74.62	✓	

PICK UP TEST (REFERENCE FOR PT-9.1.10 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS LEFT PICK UP VOLTS
105.5V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9.21.00

REVIEWED BY: [signature] DATE: 10.3.00

5095.814

WORK ORDER DISPATCH PAGE 1 OF 13

****** CONTROLLED COPY ****** CONTROLLED COPY ****** CONTROLLED COPY ******

WO # 20100651 01 TYPE UNIT 2 DATE 02/09/01 PRI 3A
TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

EQUIPMENT IDENTIFICATION NUMBER SECTION

EQUIPMENT ID LIST DESC SYS TRAIN
SR CLS LOCATION PMT/OPT RESP ENG
LOCATION DESC

INITIATION SECTION

PROBLEM/WORK REQUESTED

CALIBRATE UV & GROUND ALARM RELAYS PER PR 1 1

CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS FOR BUS 14,
BUS 16, BUS 17 AND BUS 18

THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED

CONT Y

INITIATOR SYS DATE 02/09/01

PLANNING SECTION

P/2 SYS 504 ROOM CD 373 HP 1 QC 2 FW 0 TAGOUT # MATERIALS REQ

ESTIMATED RESOURCES SECTION

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRT	SRP	SQC			
EST CREW SIZE	2	4	1	1			
EST MANHOURS	40.0	12.0	5	2.0			

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
EST CREW SIZE							8
EST MANHOURS							54.5

ACTUAL RESOURCES SECTION

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRT	SRP	SQC			
ACT CREW SIZE	2						
ACT MANHOURS	40						

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
ACT CREW SIZE							2
ACT MANHOURS							40

8093.856

PR-1.1.33

ATTACHMENT 1
27 RELAY 27/14

DEVICE 27/14
SERIAL NUMBER 6020
CIRCUIT NO. BUS 14
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211R2175
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2 V	105.2V	105.2V - 105.7V As close to 105.2 as practical	105.3V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.1"	39.0 to 41.0 seconds	40.0"

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	74.95V	X	

PICK UP TEST: (REFERENCE FOR PT-9.1.14 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
105.40V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 3/25/02

REVIEWED BY: D Mills DATE: 4-4-02

8093.858

PR-1.1.35

ATTACHMENT 3
27 RELAY 27B/14

DEVICE 27B/14
SERIAL NUMBER 3175-1
CIRCUIT NO. Bus 14
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 60581?
PHASE B - C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.40V	105.80V	105.2 - 105.7V As close to 105.2V as practical	105.35V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6TL 120V to 92V = 40 secs (suddenly applied)	35.0 to 45.0 seconds	40.13"	39.0 to 41.0 seconds	40.55"

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	CHECK ONE	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	80.15"	X	

PICK UP TEST: (REFERENCE FOR PT-9-1.14 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.60V

Relay and case visual inspection ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 3/26/02

REVIEWED BY: D. Miller DATE: 4-4-02

ATTACHMENT 6
27 RELAY 27/16

DEVICE 27/16
SERIAL NUMBER 3181-1
RELAY TYPE ITE-27
BULLETIN 18.4.7-2
PHASE A - B

APPLICATION Bus Undervoltage
CIRCUIT NO. BUS 16
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.30V	105.4V	105.2 - 105.7V As close to 105.2V as practical	105.50V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6TL 120V to 92V = 40 secs (suddenly applied)	35.0 to 45.0 seconds	39.22"	39.0 to 41.0 seconds	39.73"

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	75.03"	X	

PICK UP TEST: (REFERENCE FOR PT-9.1.16 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
105.80V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 4/3/02

REVIEWED BY: D Mullin DATE: 4-4-02

ATTACHMENT 8
27 RELAY, 27B/16

DEVICE 27B/16
SERIAL NUMBER 6022
CIRCUIT NO. BUS 16
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211R1175
CURVE NO T.V.C. 605817
PHASE B C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.10V	105.40V	105.2V - 105.7V As close to 105.2 as practical	105.40V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.35"	39.0 to 41.0 seconds	39.97"

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	75.40"	X	

PICK-UP TEST: (REFERENCE FOR PT-9.1.16 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK-UP VOLTS
105.60V

Relay and case visual inspection ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 4/3/02

REVIEWED BY: L. Miller DATE: 4-4-02

3093-866

PR-1.1.43

ATTACHMENT 11
27 RELAY 27/17

DEVICE 27/17
SERIAL NUMBER 3176-1
CIRCUIT NO. BUS 17
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION Bus Undervoltage
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.4V	105.3V	105.2 - 105.7V As close to 105.2V as practical	105.30V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.48"	39.0 to 41.0 seconds	40.44"

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Chuck One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	78.70" tw	X	

PICK UP TEST: (REFERENCE FOR PT-9.1.17 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
105.50V

Relay and case visual inspection ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 4/2/02

REVIEWED BY: D. Miller DATE: 4-4-02

8093.868

PR-1.1.45

ATTACHMENT 13
27 RELAY 27B/17

DEVICE 27B/17
SERIAL NUMBER 3179-A
CIRCUIT NO Bus 17
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO 211B1175D
CURVE NO T.V.C. 605817
PHASE B C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.10V	105.5V	105.2V - 105.7V As close to 105.2 as practical	105.20V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	39.97"	39.0 to 41.0 seconds	40.10"

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	73.51"	X	

PICK UP TEST: (REFERENCE FOR PT-9.1.17 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
105.50V

Relay and case visual inspection: ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 4/3/02

REVIEWED BY: Donville DATE: 4-4-02

ATTACHMENT 16
27 RELAY 27/18

DEVICE 27/18
SERIAL NUMBER 3182-1
CIRCUIT NO. BUS 1B
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.30V	105.40V	105.2V - 105.7V As close to 105.2 as practical	105.40V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.47"	39.0 to 41.0 seconds	40.31"

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	78.15"	X	

PICK UP TEST: (REFERENCE FOR PT-9.1.18 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.60V

Relay and case visual inspection ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 3/26/02

REVIEWED BY: D. Mills DATE: 4-4-02

ATTACHMENT 18
27 RELAY 27B/18

DEVICE 27B/18
SERIAL NUMBER 3177-1
CIRCUIT NO. BUS-18
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605820
PHASE B - C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.30V	105.50V	105.2V - 105.7V As close to 105.2 as practical	105.50V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	41.16"	39.0 to 41.0 seconds	40.90"

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	72.73"	X	

PICK UP TEST: (REFERENCE FOR PT-9.1.18 ONLY)

NOTE: Raise voltage **VERY SLOWLY** until relay picks up.

AS LEFT PICK UP VOLTS
105.70V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 3/26/02

REVIEWED BY: J. Mello DATE: 4-4-02

WORK ORDER DISPATCH PAGE 1 OF 12

****** CONTROLLED COPY ****** CONTROLLED COPY ******* CONTROLLED COPY ******

WO # 20202647 01 TYPE UNIT 2 DATE 10/04/02 PRI 3A
TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

---------- EQUIPMENT IDENTIFICATION NUMBER SECTION ----------

EQUIPMENT ID LIST _____ DESC _____ SYS ____ TRAIN __
SR CLS ____ LOCATION _____ PMT/OPT _ RESP ENG _____
LOCATION DESC _____

---------- INITIATION SECTION ----------

PROBLEM/WORK REQUESTED

CALIBRATE UV & GROUND ALARM RELAYS PER PR-1.1

CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS FOR BUS 14,
BUS 16, BUS 17 AND BUS 18.

THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED

CONT Y

INITIATOR SYS DATE 10/04/02

---------- PLANNING SECTION ----------

P/2 SYS 504 ROOM CD AD11 HP 1 QC 2 FW 0 TAGOUT # _____ MATERIALS REQ

---------- ESTIMATED RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRP	SQC	SRI			
EST CREW SIZE	2	1	1	2			
EST MANHOURS	40.0	1.0	2.0	2.8			

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							6
EST CREW SIZE							16
EST MANHOURS							51 43.0

---------- ACTUAL RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRP	SQC	SRI			
ACT CREW SIZE	2	1	1	2			
ACT MANHOURS	40	1	2	8			

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							4
ACT CREW SIZE							15
ACT MANHOURS							

ATTACHMENT 1
27 RELAY 27/14

DEVICE 27/14 — APPLICATION BUS UNDERVOLTAGE
SERIAL NUMBER 6020 — PT RATIO 480V/120V
CIRCUIT NO. BUS 14 — MODEL/STYLE NO. 211R2175
RELAY TYPE ITE-27 — CURVE NO. T.V.C. 605817
BULLETIN 18.4.7-2 — PHASE A - B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.3V	104.8V	105.2V - 105.7V As close to 105.2 as practical	105.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.8S	39.0 to 41.0 seconds	40.18

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	158	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.14 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.4V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9-29-03

REVIEWED BY: [signature] DATE: 9-30-03

ATTACHMENT 3
27 RELAY 27B/14

DEVICE 27B/14
SERIAL NUMBER 3175-1
CIRCUIT NO. Bus 14
RELAY TYPE ITE-27
BULLETIN 18.47-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 1211B1175D
CURVE NO. T.V.C. 605817
PHASE B - C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.3V	105.1V	105.2 - 105.7V As close to 105.2V as practical	105.4V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6TL 120V to 92V = 40 secs (suddenly applied)	35.0 to 45.0 seconds	41.30	39.0 to 41.0 seconds	40.23

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	CHECK ONE	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	82.02	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.14 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.7V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE 9-25-03

REVIEWED BY: [signature] DATE 9-30-03

ATTACHMENT 6
27 RELAY 27/16

DEVICE 27/16 — APPLICATION Bus Undervoltage
SERIAL NUMBER 3181-1 — CIRCUIT NO. BUS 16
RELAY TYPE ITE-27 — MODEL/STYLE NO. 211B1175D
BULLETIN 18.4.7-2 — CURVE NO. T.V.C. 605817
PHASE A B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.5V	105.7V	105.2 - 105.7V As close to 105.2V as practical	105.4V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6TL 120V to 92V = 40 secs (suddenly applied)	35.0 to 45.0 seconds	39.65	39.0 to 41.0 seconds	39.77

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One: Pass	Check One: Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	76.13	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.16 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
104.0V & 105.6V

Relay and case visual inspection: ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9-24-03

REVIEWED BY: [signature] DATE: 9-30-03

ATTACHMENT 8
27 RELAY 27B/16

DEVICE 27B/16
SERIAL NUMBER 6022
CIRCUIT NO. BUS 16
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211R1175
CURVE NO. T.V.C. 605817
PHASE B - C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.4V	105V	105.2V - 105.7V As close to 105.2 as practical	105.3V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
.6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.3	39.0 to 41.0 seconds	40.49

DROPOUT TIME AT MINIMUM TECH SPEC LIMITS

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	79.7	✓	

PICK UP TEST (REFERENCE FOR PT-9.1.16 ONLY)

NOTE Raise voltage **VERY SLOWLY** until relay picks up

AS-LEFT PICK UP VOLTS
105.4V

Relay and case visual inspection ☒ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9-24-03

REVIEWED BY: [signature] DATE: 9-30-03

ATTACHMENT 11
27 RELAY 27/17

DEVICE 27/17
SERIAL NUMBER 3176-1
CIRCUIT NO. BUS 17
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION Bus Undervoltage
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE A B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.3V	105.4V	105.2 - 105.7V As close to 105.2V as practical	105.3V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	39.47	39.0 to 41.0 seconds	40.05

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	74.49	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.17 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.7V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9-23-03

REVIEWED BY: [signature] DATE: 9-30-03

ATTACHMENT 13
27 RELAY 27B/17

DEVICE 27B/17
SERIAL NUMBER 3179-1
CIRCUIT NO. Bus 17
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE B - C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2V	105.2V	105.2V - 105.7V As close to 105.2 as practical	105.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V @ 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.40	39.0 to 41.0 seconds	40.40

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	74.91	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.17 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up

AS-LEFT PICK UP VOLTS
105.4V

Relay and case visual inspection ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9-23-03

REVIEWED BY: [signature] DATE: 9-23-03

ATTACHMENT 16
27 RELAY 27/18

DEVICE 27/18
SERIAL NUMBER 3182-1
CIRCUIT NO. BUS 1B
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.4V	105.2V	105.2V - 105.7V As close to 105.2 as practical	105.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.7	39.0 to 41.0 seconds	40.5

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	80.9	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.18 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
105.5V

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9-30-03

REVIEWED BY: [signature] DATE: 9-30-03

ATTACHMENT 18
27 RELAY 27B/18

DEVICE 27B/18
SERIAL NUMBER 3177-1
CIRCUIT NO. BUS 18
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605820
PHASE B C

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.5V	105.6V	105.2V - 105.7V As close to 105.2 as practical	105.3V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
.6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	41.0	39.0 to 41.0 seconds	40.0

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT

Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	73.59	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.18 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS LEFT PICK UP VOLTS
105.5V

Relay and case visual inspection: ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9.30.03

REVIEWED BY: [signature] DATE: 9.3.03

******* CONTROLLED COPY ******* CONTROLLED COPY ******* CONTROLLED COPY *******

WO # 20400377 01 TYPE _ UNIT 2 DATE 20040123 PRI 3

TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

---------- EQUIPMENT IDENTIFICATION NUMBER SECTION ----------

EQUIPMENT ID: LIST DESC: _____ SYS: ____ TRAIN: __

SR CLS: ___ LOCATION: _____ PMT/OPT: _ RESP ENG: _____

LOCATION DESC: _____

---------- INITIATION SECTION ----------

PROBLEM/WORK REQUESTED:

CALIB UV & GND ALM REL PER PR-1.1
CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS FOR BUS 14, BUS 16, BUS 17 AND BUS 18.
THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED

CALIBRATE THE FOLLOWING DEVICES:

27/14, 27D/14, 27B/14, 27D/B/14, 64/14

27/16, 27D/16, 27B/16, 17D/B/16, 64/16

27/17, 27D/17, 27B/17, 27D/B/17, 64/17

27/18, 27D/18, 27B/18, 27D/B/18, 64/18

INITIATOR: SYS _____ DATE: 01/23/2004

---------- PLANNING SECTION ----------

ROOM CD AD11 HP 1 QC 2 FW 0 TAGOUT # _____ MATERIALS REQ _

---------- ESTIMATED RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRP					
EST CREW SIZE	2	1					
EST MANHOURS	40.0	1.0					
	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
EST CREW SIZE							3
EST MANHOURS							41.0

---------- ACTUAL RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRP					
ACT CREW SIZE	2	0					
ACT MANHOURS	40.0	0.0					
	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS 2 / 48
GROUP CODE							

ATTACHMENT 1
27 RELAY 27/14

DEVICE 27/14
SERIAL NUMBER 6020
CIRCUIT NO. BUS 14
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211R2175
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2V	104.8V	105.2V to 105.7V As close to 105.2 as practical	105.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.6sec	39.0 to 41.0 seconds	40.0sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT				
Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	75.3 sec	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.14 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK UP VOLTS
105.4V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Zachin Phillips DATE: 4/3/05

REVIEWED BY: D Miller DATE: 4-3-05

ATTACHMENT 3
27 RELAY 27B/14

DEVICE 27B/14
SERIAL NUMBER 3175-1
CIRCUIT NO. Bus 14
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE B - C

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.4V	105.0V	105.2 to 105.7V As close to 105.2V as practical	105.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6TL 120V to 92V = 40 secs (suddenly applied)	35.0 to 45.0 seconds	40.2 sec	39.0 to 41.0 seconds	40.2 sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT				
Acceptance Criteria	Applied Volts	Present As-Left	CHECK ONE	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	83.0 sec	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.14 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
105.4V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Jasmine Phillips DATE: 4/3/05

REVIEWED BY: D Miller DATE: 4-3-05

ATTACHMENT 6
27 RELAY 27/16

DEVICE 27/16
SERIAL NUMBER 3181-1
RELAY TYPE ITE-27
BULLETIN 18.4.7-2
PHASE A - B

APPLICATION Bus Undervoltage
CIRCUIT NO. BUS 16
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.4V	104.9V	105.2 to 105.7V As close to 105.2V as practical	105.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6TL 120V to 92V = 40 secs (suddenly applied)	35.0 to 45.0 seconds	40.5 sec	39.0 to 41.0 seconds	40.0 sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT				
Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	79.5 sec	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.16 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK UP VOLTS
105.5V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Joshua Phillips DATE: 3/31/05

REVIEWED BY: D Miller DATE: 4-

~~ATTACHMENT~~ 8
27 RELAY 27B/16

DEVICE 27B/16
SERIAL NUMBER 6022
CIRCUIT NO. BUS 16
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211R1175
CURVE NO. T.V.C. 605817
PHASE B - C

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.3V	105.0V	105.2V to 105.7V As close to 105.2 as practical	105.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.4 sec	39.0 to 41.0 seconds	40.3 sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT				
Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	78.4 sec	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.16 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK UP VOLTS
105.3V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Zachary Phillips DATE: 3/31/05

REVIEWED BY: D Miller DATE: 4-3-05

ATTACHMENT 11
27 RELAY 27/17

DEVICE 27/17
SERIAL NUMBER 3172-1
CIRCUIT NO. BUS 17
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION Bus Undervoltage
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	~~105.2V~~ zP 105.3V	~~105.5V~~ zP 105.2V	105.2 to 105.7V As close to 105.2V as practical	zP ~~105.6V~~ 105.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	39.7sec	39.0 to 41.0 seconds	39.7sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT				
Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	74.4sec	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.17 ONLY)

NOTE: *Raise voltage **VERY SLOWLY** until relay picks up.*

AS-LEFT PICK UP VOLTS
105.6V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Jerdin Phillips DATE: 3/27/05

REVIEWED BY: D Smith DATE: 4-3-05

~~ATTACHMENT~~ 13
27 RELAY 27B/17

DEVICE 27B/17
SERIAL NUMBER 3179-1
CIRCUIT NO. Bus 17
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE B - C

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2V	~~105.2V~~ ZP 105.0V	105.2V to 105.7V As close to 105.2 as practical	105.5V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.3sec	39.0 to 41.0 seconds	39.7sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT				
Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	71.1sec	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.17 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
~~105.2V~~ ZP 105.8V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Zachary C. Phillips DATE: 3-30-05

REVIEWED BY: D. Miller DATE: 4-3

ATTACHMENT 16
27 RELAY 27/18

DEVICE 27/18
SERIAL NUMBER 3182-1
CIRCUIT NO. BUS 18
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605817
PHASE A - B

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2V	104.9V	105.2V to 105.7V As close to 105.2 as practical	105.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.9 sec	39.0 to 41.0 seconds	40.4 sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT				
Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	81.3 sec	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.18 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK UP VOLTS
105.5 V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Jadine Riddle DATE: 3/31/05

REVIEWED BY: D Mills DATE: 4-3-05

ATTACHMENT 18
27 RELAY 27B/18

DEVICE 27B/18
SERIAL NUMBER 3177-1
CIRCUIT NO. BUS 18
RELAY TYPE ITE-27
BULLETIN 18.4.7-2

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 211B1175D
CURVE NO. T.V.C. 605820
PHASE B - C

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
105.2V	Plus or minus 1 volt of previous As-Left Test	105.2V	104.8V ~~104.8V~~ ZP	105.2V to 105.7V As close to 105.2 as practical	105.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
6 TL 120V to 92V = 40 seconds (suddenly applied)	35.0 to 45.0 seconds	40.7 sec	39.0 to 41.0 seconds	40.2 sec

DROPOUT TIME AT MINIMUM TECH SPEC LIMIT				
Acceptance Criteria	Applied Volts	Present As-Left	Check One	
			Pass	Fail
45 to 125 seconds	120V to 104.2V (suddenly applied)	72.8sec	✓	

PICK UP TEST: (REFERENCE FOR PT-9.1.18 ONLY)

NOTE: Raise voltage VERY SLOWLY until relay picks up.

AS-LEFT PICK UP VOLTS
105.4 V

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Jashin Phillips DATE: 3/31/05

REVIEWED BY: D Reilly DATE: 4-3-05

WO # 20500524 02 TYPE _ UNIT 2 DATE 20050128 PRI 3

TYPE MAINT F WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

---------- EQUIPMENT IDENTIFICATION NUMBER SECTION ----------

EQUIPMENT ID: LIST DESC: _____ SYS: ____ TRAIN: __

SR CLS: ___ LOCATION: _____ PMT/OPT: _ RESP ENG: _____

LOCATION DESC: _____

---------- INITIATION SECTION ----------

PROBLEM/WORK REQUESTED:

CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS FOR BUS 14, BUS 16, BUS 17 AND BUS 18 PER PR-1.1
THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED

PLANT IMPACT: UNDERVOLTAGE CHANNEL WILL BE INOPERABLE PER STEP 5.2.1 OF PR-1.1.

RISK: NUCLEAR: N7 MEDIUM
INDUSTRIAL: NONE
CORPORATE: NONE
ENVIRONMENTAL: NONE
RADIOLOGICAL: NONE

CALIBRATE THE FOLLOWING DEVICES: See email

27/14,	27D/14,	27B/14,	27D/B/14,	64/14
27/16,	27D/16,	27B/16,	27D/B/16,	64/16
27/17	27D/17	27B/17,	27D/B/17	64/17
27/18,	27D/18,	27B/18,	27D/B/18,	64/18

INITIATOR: SYS DATE: 01/28/2005

---------- PLANNING SECTION ----------

ROOM CD AD11 HP 1 QC 2 FW 0 TAGOUT # _____ MATERIALS REQ _

---------- ESTIMATED RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRP	SQC	SRT	____	____	
EST CREW SIZE	2	1	1	1	____	____	
EST MANHOURS	40.0	1.0	2.0	1.0	____	____	
	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE	____	____	____	____	____	____	
EST CREW SIZE	____	____	____	____	____	____	~~5~~ 2
EST MANHOURS	____	____	____	____	____	____	~~44.0~~ 46

---------- ACTUAL RESOURCES SECTION ----------

ATTACHMENT 1
27 RELAY 27/14

DEVICE 27/14 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 6020 PT RATIO 480V/120V

CIRCUIT NO. BUS 14 MODEL/STYLE NO. 211R2175

RELAY TYPE ITE-27 CURVE NO. T.V.C. 605817

BULLETIN 18.4.7-2 PHASE A - B

PICK-UP TEST		
Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts
105.4	105.1	104.3 to 106.5

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts	As-Left Tolerance volts	As-Left volts
105.2	105.2	105.0	104.1 to 106.3	105.2 to 105.7	105.5

DROP-OUT TIME TEST to 92V					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 1.2 sec	As-Left Tolerance seconds	As-Left seconds
6 TL 40 seconds 120V to 92V (suddenly applied)	40.0	40.76	38.8 to 41.2	39.0 to 41.0	40.3

DROP-OUT TIME TEST AT 104.2V					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 8.7 sec	As-Left Tolerance seconds	As-Left seconds
45 to 125 seconds 120V to 104.2V (suddenly applied)	75.3	77.6	66.6 to 84.0	N/A	72.8

PICK-UP TEST: (REFERENCE FOR PT-9.1.14 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK-UP VOLTS
105.6

Relay shows some signs of High heat @ 125VDC input.

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-Up and Drop-out Tests ☑ SAT ☐ UNSAT

COMPLETED BY: T. Mueen DATE: 10/15/06

REVIEWED BY: [signature] DATE: 10/18/06

ATTACHMENT 3
27 RELAY 27B/14

DEVICE 27B/14 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 3175-1 PT RATIO 480V/120V

CIRCUIT NO. Bus 14 MODEL/STYLE NO. 211B1175D

RELAY TYPE ITE-27 CURVE NO. T.V.C. 605817

BULLETIN 18.4.7-2 PHASE B - C

PICK-UP TEST		
Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts
105.4	105.5	104.3 to 106.5

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts	As-Left Tolerance volts	As-Left volts
105.2	105.2	105.2	104.1 to 106.3	105.2 to 105.7	105.2

DROP-OUT TIME TEST to 92V					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 1.2 sec	As-Left Tolerance seconds	As-Left seconds
6 TL 40 seconds 120V to 92V (suddenly applied)	40.2	41.3	39.0 to 41.4	39.0 to 41.0	41.0

DROPOUT TIME TEST AT 104.2V					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 8.7 sec	As-Left Tolerance seconds	As-Left seconds
45 to 125 seconds 120V to 104.2V (suddenly applied)	83.0	81.6	74.3 to 91.7	N/A	81.2

PICK-UP TEST: (REFERENCE FOR PT-9.1.14 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK-UP VOLTS
105.5

Relay shows some signs of high heat @ 125VDC Inputs.

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: T. Murray DATE: 10/15/06

REVIEWED BY: T. Susko DATE: 10/18/06

ATTACHMENT 6
27 RELAY 27/16

DEVICE 27/16 APPLICATION Bus Undervoltage

SERIAL NUMBER 3181-1 CIRCUIT NO. BUS 16

RELAY TYPE ITE-27 MODEL/STYLE NO. 211B1175D

BULLETIN 18.4.7-2 CURVE NO. T.V.C. 605817

PHASE A - B

PICK-UP TEST		
Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts
105.5	105.6	104.4 to 106.6

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts	As-Left Tolerance volts	As-Left volts
105.2	105.2	105.2	104.1 to 106.3	105.2 to 105.7	105.2

DROP-OUT TIME TEST to 92V					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 1.2 sec	As-Left Tolerance seconds	As-Left seconds
6 TL 40 seconds 120V to 92V (suddenly applied)	40.0	39.5	38.8 to 41.2	39.0 to 41.0	39.8

DROP-OUT TIME TEST AT 104.2V					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 8.7 sec	As-Left Tolerance seconds	As-Left seconds
45 to 125 seconds 120V to 104.2V (suddenly applied)	79.5	80.5	70.8 to 88.2	N/A	82.6

PICK-UP TEST: (REFERENCE FOR PT-9.1.16 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK-UP VOLTS
105.6

Relay shows some signs of high heat @ 125VDC inputs

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: T. Murray DATE: 10/17/06

DA-EE-93-006-05 REVIEWED BY: Thomas E. Reiner DATE: 10/18/06

ATTACHMENT 8
27 RELAY 27B/16

DEVICE 27B/16 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER ~~5022~~ 6021 * PT RATIO 480V/120V

CIRCUIT NO. BUS 16 MODEL/STYLE NO. 211R1175

RELAY TYPE ITE-27 CURVE NO. T.V.C. 6058?7

BULLETIN 18.4.7-2 PHASE B - C

PICK-UP TEST		
Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts
105.3	105.2	104.2 to 106.4

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts	As-Left Tolerance volts	As-Left volts
105.2	105.2	105.1	104.1 to 106.3	105.2 to 105.7	105.4

DROP-OUT TIME TEST to 92V					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 1.2 sec	As-Left Tolerance seconds	As-Left seconds
6 TL 40 seconds 120V to 92V (suddenly applied)	40.3	40.7	39.1 to 41.5	39.0 to 41.0	40.2

DROP-OUT TIME TEST AT 104.2V					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 8.7 sec	As-Left Tolerance seconds	As-Left seconds
45 to 125 seconds 120V to 104.2V (suddenly applied)	78.4	83.1	69.7 to 87.1	N/A	76.2

PICK-UP TEST: (REFERENCE FOR PT-9.1.16 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK-UP VOLTS
105.5

old relays showed some signs of high heat @ 125VDC input

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

* NEW RELAY

COMPLETED BY: P. Tomlinson DATE: 10/18/06

REVIEWED BY: T Ronco DATE: 10/18/06

ATTACHMENT 11
27 RELAY 27/17

DEVICE 27.17 APPLICATION Bus Undervoltage

SERIAL NUMBER 3172-1 PT RATIO 480V:120V

CIRCUIT NO. BUS 17 MODEL/STYLE NO. 211B1175D

RELAY TYPE ITE-27 CURVE NO. T.V.C. 605817

BULLETIN 18.4.7-2 PHASE A - B

PICK-UP TEST		
Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts
105.6	105.8	104.5 to 106.7

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts	As-Left Tolerance volts	As-Left volts
105.2	105.2	105.4	104.1 to 106.3	105.2 to 105.7	105.5

DROP-OUT TIME TEST to 92V					
Setting seconds	Prev. As-Left seconds	As-Found seconds	As-Found Tolerance: Prev. As-Left ± 1.2 sec	As-Left Tolerance seconds	As-Left seconds
6 TL 40 seconds 120V to 92V (suddenly applied)	39.7	40.1	38.5 to 40.9	39.0 to 41.0	40.0

DROP-OUT TIME TEST AT 104.2V					
Setting seconds	Prev. As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 8.7 sec	As-Left Tolerance seconds	As-Left seconds
45 to 125 seconds 120V to 104.2V (suddenly applied)	74.4	72.8	65.7 to 83.1	N/A	72.7

PICK-UP TEST: (REFERENCE FOR PT-9.1.17 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK-UP VOLTS
105.9

Relay shows some signs of high heat @ 125VDC input.

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: T. Murray DATE: 10/18/06

REVIEWED BY: [signature] DATE: 10/18/06

ATTACHMENT 13
27 RELAY 27B/17

DEVICE 27B/17 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 3179-1 PT RATIO 480V/120V

CIRCUIT NO. Bus 17 MODEL/STYLE NO. 211B1175D

RELAY TYPE ITE-27 CURVE NO. T.V.C. 605817

BULLETIN 18.4.7-2 PHASE B - C

PICK-UP TEST		
Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts
105.8	105.7	104.7 to 106.9

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Prev. As-Left ± 1.1 volts	As-Left Tolerance volts	As-Left volts
105.2	105.5	105.5	104.4 to 106.6	105.2 to 105.7	105.5

DROP-OUT TIME TEST to 92V					
Setting seconds	Prev. As-Left seconds	As-Found seconds	As-Found Tolerance: Prev. As-Left ± 1.2 sec	As-Left Tolerance seconds	As-Left seconds
6 TL 40 seconds 120V to 92V (suddenly applied)	39.7	40.7	38.5 to 40.9	39.0 to 41.0	40.9

DROP-OUT TIME TEST AT 104.2V					
Setting seconds	Prev. As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 8.7 sec	As-Left Tolerance seconds	As-Left seconds
45 to 125 seconds 120V to 104.2V (suddenly applied)	71.1	72.7	62.4 to 79.8	N/A	72.8

PICK-UP TEST: (REFERENCE FOR PT-9.1.17 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK-UP VOLTS
105.8

Relay shows some sign of high heat @ 125VDC inputs.

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☐ SAT ☐ UNSAT

COMPLETED BY: T. Murray DATE: 10/18/06

REVIEWED BY: Thomas E DATE: 10/18/06

ATTACHMENT 16
27 RELAY 27/18

DEVICE 27/18 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 3182-1 PT RATIO 480V:120V

CIRCUIT NO. BUS 1B MODEL/STYLE NO. 211B11?5D

RELAY TYPE ITE-27 CURVE NO. T.V.C. 605817

BULLETIN 18.4.7-2 PHASE A - B

PICK-UP TEST		
Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts
105.5	105.5	104.4 to 106.6

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Prev. As-Left ± 1.1 volts	As-Left Tolerance volts	As-Left volts
105.2	105.2	105.3	104.1 to 106.3	105.2 to 105.7	105.3

DROP-OUT TIME TEST to 92V					
Setting seconds	Prev. As-Left seconds	As-Found seconds	As-Found Tolerance: Prev. As-Left ± 1.2 sec	As-Left Tolerance seconds	As-Left seconds
6 TL 40 seconds 120V to 92V (suddenly applied)	40.4	40.8	39.2 to 41.6	39.0 to 41.0	40.8

DROP-OUT TIME TEST AT 104.2V					
Setting seconds	Prev. As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 8.? sec	As-Left Tolerance seconds	As-Left seconds
45 to 125 seconds 120V to 104.2V (suddenly applied)	81.3	84.4	72.6 to 90.0	N/A	85.0

PICK-UP TEST: (REFERENCE FOR PT-9.1.18 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK-UP VOLTS
105.6

Relay shows some sign of high heat @ 125 VDC input.

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: Peter Jonkman DATE: 10/14/06

REVIEWED BY: T. Thomas DATE: 10/18/06

ATTACHMENT 18
27 RELAY 27B/18

DEVICE 27B/18 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 3177-1 PT RATIO 480V/120V

CIRCUIT NO. BUS 18 MODEL/STYLE NO. 211B1175D

RELAY TYPE ITE-27 CURVE NO. T.V.C. 605820

BULLETIN 18.4.7-2 PHASE B - C

PICK-UP TEST		
Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.1 volts
105.4	105.5	104.3 to 106.5

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Prev. As-Left ± 1.1 volts	As-Left Tolerance volts	As-Left volts
105.2	105.2	105.3	104.1 to 106.3	105.2 to 105.?	105.3

DROP-OUT TIME TEST to 92V					
Setting seconds	Prev. As-Left seconds	As-Found seconds	As-Found Tolerance: Prev. As-Left ± 1.2 sec	As-Left Tolerance seconds	As-Left seconds
6 TL 40 seconds 120V to 92V (suddenly applied)	40.2	40.8	39.0 to 41.4	39.0 to 41.0	40.5

DROP-OUT TIME TEST AT 104.2V					
Setting seconds	Prev. As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 8.7 sec	As-Left Tolerance seconds	As-Left seconds
45 to 125 seconds 120V to 104.2V (suddenly applied)	72.8	73.6	64.1 to 81.5	N/A	75.1

PICK-UP TEST: (REFERENCE FOR PT-9.1.18 ONLY)

NOTE: Raise voltage **VERY SLOWLY until relay picks up.**

AS-LEFT PICK-UP VOLTS
105.6

Relay showed some sign of high heat @ 125 VDC input.

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: Patty Tomlinson DATE: 10/15/06

REVIEWED BY: Thomas J [illegible] DATE: 10/18/06

WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electrical Code (ANSI C1) and/or any other requirements applicable to the User.

Installation, operation, and maintenance should be performed only by qualified personnel.

TM-102402

TECHNICAL MANUAL
OPERATION AND MAINTENANCE INSTRUCTIONS
FOR
POWER SYSTEM POLYMETER
MODEL 325

1 APRIL 1980

Revised 1 March 1983

DRANETZ TECHNOLOGIES, INC.
1000 New Durham Road, CN-91, Edison, N.J. 08818

Table 1-1. MODEL 828 POLYMETER SPECIFICATIONS

VOLTAGE MEASUREMENT (Both sections)	
Input ranges	0-1.5, 15, 150, and 660 volts RMS** Full Scale
Accuracy	±0.3% of reading; ±0.05% Full Scale down to 5% Full Scale
Frequency Range	47 to 450 Hz
Frequency Range for rated accuracy	47-63 Hz*
Input resistance	5000 ohms/volt (transformer isolated) all ranges
Readout display	5 Digits
CURRENT MEASUREMENT (Both sections)	
Input ranges	0-0.15, 1.5, 15, and 100 Amperes RMS Full Scale
Accuracy	±0.3% of reading; ±0.03% Full Scale down to 3% Full Scale
Frequency Range	47 to 450 Hz
Frequency Range for rated accuracy	47-63 Hz*
Insertion resistance	0.002 ohm maximum (transformer isolated) all ranges
Readout Display	5 Digits
TIME MEASUREMENT (Left section only)	
Time interval range	0 to 999.99 seconds (0.01-second increments) 0 to 99.999 seconds (0.001-second increments) 0 to 9999.9 cycles (periods) of power line frequency (0.1-cycle increments)
Accuracy	±0.003% of reading ±1 L.S.D. (Least significant digit)

*Normally adjusted and calibrated at 60 Hz unless otherwise specified.

**Operation between 600 volts RMS and 1000 volts RMS is possible with no degradation of accuracy. However, operation above 600 volts RMS does not conform with safety specification ANSI-C39.5.

Table 1-1. MODEL 326 POLYMETER SPECIFICATIONS (cont)

FREQUENCY MEASUREMENT (Option 101)

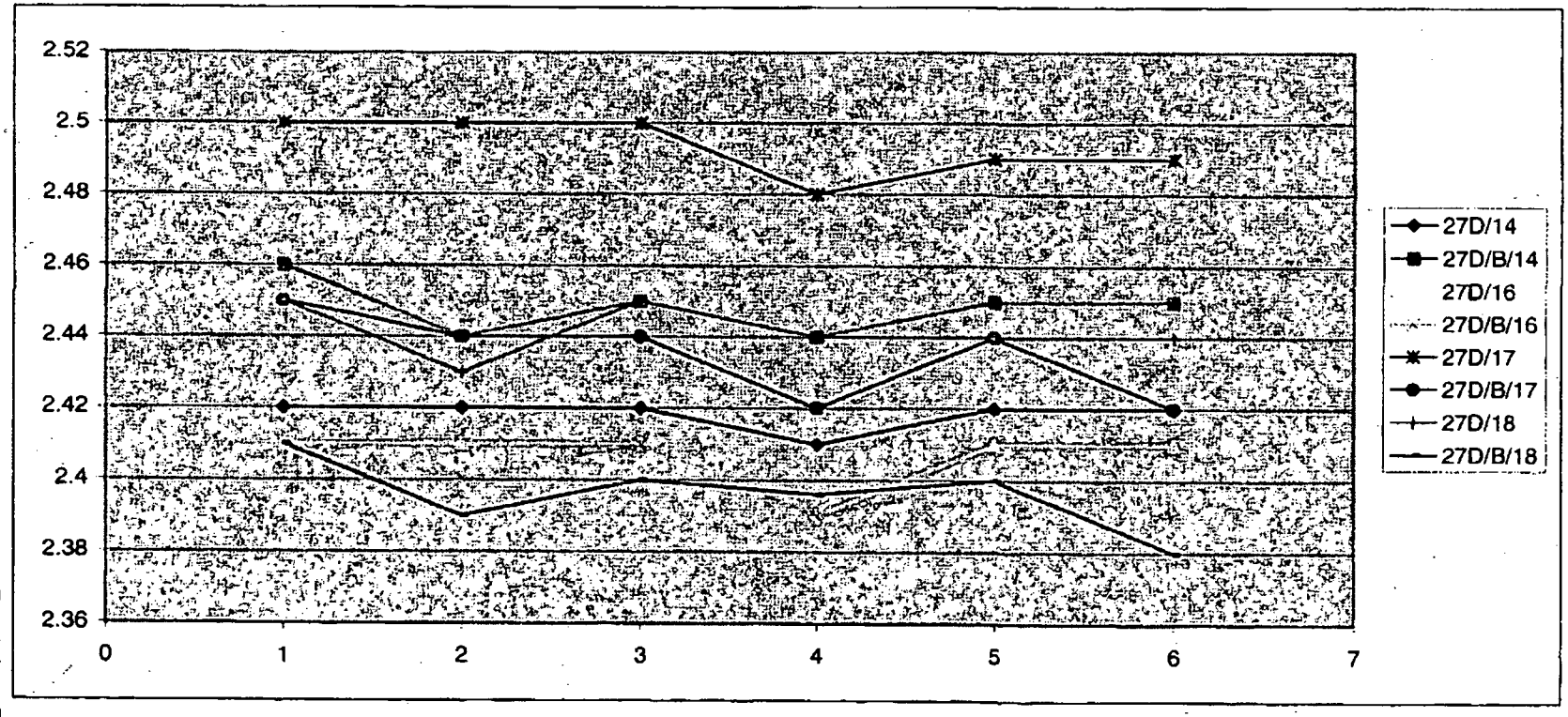
(Limit to left channel displays on right channel only.)

Operating mode	Updates after each measurement at a rate of every 1.25 seconds (.8 Hz) or 0.2 seconds (5 Hz). Holds last reading on stop trigger command.
Frequency range	20.000 to 450.000 Hz
Resolution	0.01 Hz, 0.1 second measuring time 0.001 Hz, 1.0 second measuring time
Accuracy	±0.002 Hz ±1 L.S.D.

MEASURING MODES (Apply to V-I measurements)

Trigger/Normal/Maximum	(Selectable by panel pushbutton switches, controlling both sections)
Trigger	Measurement is started and stopped by trigger signal applied to front panel START and STOP input jacks Requires DC step voltage change: ±10 volt minimum ±200 volt maximum or AC voltage 10-220 volts RMS or external contact closure Input impedance is approximately 30K ohms Can also be controlled by START/STOP/RESET pushbuttons at bottom of front panel. Eight readings per second are displayed in this mode.
Normal	Measurements are made continuously, 2 readings per second are displayed
Maximum	A "maximum-value" circuit stores the highest value of AC measured during a measurement interval and displays that value in the digital readout

	19801039	19902777	20100651	20202647	20400377	20500524	Mean	Min	Max	Range of Test Results
	1	2	3	4	5	6				
27D/14	2.42	2.42	2.42	2.41	2.42	2.42	2.418333333	2.41	2.42	0.01
27D/B/14	2.46	2.44	2.45	2.44	2.45	2.45	2.448333333	2.44	2.46	0.02
27D/16	2.41	2.41	2.41	2.39	2.41	2.41	2.406666667	2.39	2.41	0.02
27D/B/16	2.41	2.4	2.41	2.39	2.4	2.39	2.4	2.39	2.41	0.02
27D/17	2.5	2.5	2.5	2.48	2.49	2.49	2.493333333	2.48	2.5	0.02
27D/B/17	2.45	2.44	2.44	2.42	2.44	2.42	2.435	2.42	2.45	0.03
27D/18	2.45	2.43	2.45	2.44	2.44	2.44	2.441666667	2.43	2.45	0.02
27D/B/18	2.41	2.39	2.4	2.396	2.4	2.38	2.396	2.38	2.41	0.03
Mean	2.43875	2.42875	2.435	2.42075	2.43125	2.425				
Min	2.41	2.39	2.4	2.39	2.4	2.38				
Max	2.5	2.5	2.5	2.48	2.49	2.49				



WORK ORDER DISPATCH PAGE 1 OF 15

****** CONTROLLED COPY ****** CONTROLLED COPY ****** CONTROLLED COPY ******

WO # 19801039 01 TYPE N UNIT 1 DATE 02/23/98 PRI 4271
TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

EQUIPMENT IDENTIFICATION NUMBER SECTION

EQUIPMENT ID LIST ____ DESC ____ SYS ____ TRAIN ____
SR CLS ____ LOCATION ____ PMT/OPT _ RESP ENG ____
LOCATION DESC ____

INITIATION SECTION

PROBLEM/WORK REQUESTED

CALIBRATE UV & GROUND ALARM RELAYS PER PR-1.1

CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS ON BUS 14, BUS 16, BUS 17 AND BUS 18

THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED CONT Y

INITIATOR SYS DATE 02/23/98

PLANNING SECTION

P/2 SYS 504 P/2 LOC 373 HP 1 QC 2 FW 0 TAGOUT # ____ MATERIALS REQ ____

ESTIMATED RESOURCES SECTION

	LEAD	SP1	SP2	SP3	SP4	SP5		
GROUP CODE	ERT	SRT	SRP	SQC	___	___		
EST CREW SIZE	2	4	1	1	___	___		
EST MANHOURS	40.0	12.0	.5	2.0	___	___		
	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS	
GROUP CODE	___	___	___	___	___	___		
EST CREW SIZE	___	___	___	___	___	___	8	
EST MANHOURS	___	___	___	___	___	___	54.5	

ACTUAL RESOURCES SECTION

	LEAD	SP1	SP2	SP3	SP4	SP5		
GROUP CODE	ERT	SRT	SRP	SQC	___	___		
ACT CREW SIZE	2	2	1	1	___	___		
ACT MANHOURS	40	6	.5	1	___	___		
	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS	
GROUP CODE	___	___	___	___	___	___		
ACT CREW SIZE	___	___	___	___	___	___	6	
ACT MANHOURS	___	___	___	___	___	___	47.5	

ATTACHMENT 2
27 RELAY 27D/14

DEVICE 27D/14
SERIAL NUMBER 2195
CIRCUIT NO. BUS 14
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pick Up Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7 V	93.6V	93.7 - 54.2V As close to 93.7 as practical	93.7V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2 V	93.1 V	93.2 - 93.7V As close to 93.2V as practical	93.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.42 Sec	2.28 - 2.52 secs	2.43 Sec

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Viola DATE: 3/3/99
REVIEWED BY: D Miller DATE: 3-22-99

ATTACHMENT 4
27 RELAY 27D/B/14

DEVICE 27D/B/14
SERIAL NUMBER 2196
CIRCUIT NO. Bus 14
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

RELAY APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. Definite
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pick Up Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7 V	93.5 V	93.7 - 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2 V	93.1 V	93.2V - 93.7V As close to ~~93.2~~ ~~93.7V~~ as practical	93.3V

P&I
mv
DM

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.46 Sec	2.28 - 2.52 seconds	2.46sec

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Viola DATE: 3/4/99
REVIEWED BY: D Mueller DATE: 3-22-99

ATTACHMENT 7
27 RELAY 27D/16

DEVICE 27D/16
SERIAL NUMBER 2197
CIRCUIT NO. BUS 16
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7V	93.7V	93.7 - 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2 V	93.1V	93.2V - 93.7V As close to 93.7V as practical	93.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.41 sec	2.28 - 2.52 seconds	2.41 sec

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Viola DATE: 3/5/99
REVIEWED BY: D Miller DATE: 3-22-99

ATTACHMENT 9
27 RELAY 27D/B/16

DEVICE 27D/B/16
SERIAL NUMBER 2198
CIRCUIT NO. BUS 16
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7 V	93.5 V	93.7 - 94.2V As close to 93.7V as practical	93.7 V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2 V	93.0 V	93.2V - 93.7V As close to 93.2V as practical	93.3 V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.41 sec	2.28 - 2.52 seconds	2.405ec

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Viola DATE: 3/6/99
REVIEWED BY: D Miller DATE: 3-22-99

PR: 1.1:38

ATTACHMENT 12
27 RELAY 27D/17

DEVICE 27D/17
SERIAL NUMBER 2199
CIRCUIT NO. BUS 17
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. Definite
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.8V	93.8V	93.7 - 94.2V As close to 93.7V as practical	93.8V

DROPOUT TEST

D&I MU WMM

Setting	As-Found Tolerance	Previous ~~Present~~ As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2V	93.2V	93.2V - 93.7V As close to 93.2V as practical	93.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.50 Sec	2.28 - 2.52 seconds	2.50 Sec

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Viola DATE: 3/8/99
REVIEWED BY: D Miller DATE: 3-22-99

PR-1.1:40

ATTACHMENT 14
27 RELAY 27D/B/17

DEVICE 27D/B/17
SERIAL NUMBER 2200
CIRCUIT NO. BUS 17
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7 V	93.6V.	93.7 - 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2 V	93.0 V	93.2V - 93.7V As close to 93.2V as practical	93.2 V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.45 Sec	2.28 - 2.52 seconds	2.45 Sec

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Viola DATE: 3/8/99
REVIEWED BY: D Miller DATE: 3-25-99

PR-1.1:43

ATTACHMENT 17
27 RELAY 27D/18

DEVICE 27D/18
SERIAL NUMBER 2201
CIRCUIT NO. BUS 18
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7V	93.5V	93.7 - 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST

Setting	As-Found Tolerance	~~Present~~ Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2V	93.1V	93.2V - 93.7V As close to 93.2V as practical	93.2V

P&I mu Dmy

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V ≤ 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.45Sec	2.28 - 2.52 seconds	2.45 Sec

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Mike ViolA DATE: 3/9/99
REVIEWED BY: D Mueller DATE: 3-22-99

ATTACHMENT 19
27 RELAY 27D/B/18

DEVICE 27D/B/18
SERIAL NUMBER 2202
CIRCUIT NO. BUS 18
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7V	93.6V	93.7 - 94.2V As close to 93.7V as practical	93.7V

D&I MV DM

DROPOUT TEST

Setting	As-Found Tolerance	~~Previous~~ ~~Present~~ As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.3V	93.2V	93.2V - 93.7V As close to 93.2V as practical	93.3V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.41 sec	2.28 - 2.52 seconds	2.45sec

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Mike Viola DATE: 3/9/99
REVIEWED BY: D Miller DATE: 3-22-99

WORK ORDER DISPATCH PAGE 1 OF 14

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WO # 19902777 01 TYPE _ UNIT 1 DATE 08/14/99 PRI 3A
TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

---------- EQUIPMENT IDENTIFICATION NUMBER SECTION ----------

EQUIPMENT ID LIST _____ DESC _____ SYS ____ TRAIN __
SR CLS ____ LOCATION _____ PMT/OPT _ RESP ENG _____
LOCATION DESC _____

---------- INITIATION SECTION ----------

PROBLEM/WORK REQUESTED

CALIBRATE UV & GROUND ALARM RELAYS PER PR-1.1

CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS ON BUS 14,

BUS 16, BUS 17 AND BUS 18

THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED CONT Y

INITIATOR SYS DATE 08/14/99

---------- PLANNING SECTION ----------

P/2 SYS 504 P/2 LOC 373 HP 1 QC 2 FW 0 TAGOUT # _____ MATERIALS REQ _

---------- ESTIMATED RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRT	SRP	SQC			
EST CREW SIZE	2	4	1	1			
EST MANHOURS	40.0	12.0	5	2.0			

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
EST CREW SIZE							8
EST MANHOURS							54.5

---------- ACTUAL RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRT	SRP	SQC			
ACT CREW SIZE	2						
ACT MANHOURS	40						

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
ACT CREW SIZE							2
ACT MANHOURS							40

ATTACHMENT 2
27 RELAY 27D/14

DEVICE 27D/14
SERIAL NUMBER 2195
CIRCUIT NO. BUS 14
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pick Up Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.7v	93.7 - 94.2V As close to 93.7 as practical	93.7v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previcus As-Left Test	93.2v	93.2v	93.2 - 93.7V As close to 93.2V as practical	93.2v

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.42"	2.28 - 2.52 secs	2.42"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Todd M Poole DATE: 9-26-00

REVIEWED BY: W F Miller DATE: 02 oct 00

ATTACHMENT 4
27 RELAY 27D/B/14

DEVICE 27D/B/14
SERIAL NUMBER 2196
CIRCUIT NO. Bus 14
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

RELAY APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. Definite
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pick Up Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.8v	93.7 - 94.2V As close to 93.7V as practical	93.8v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.3v	93.3v	93.2V - 93.7V As close to 93.2V as practical	93.3v

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.44"	2.28 - 2.52 seconds	2.44"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Todd M Poole DATE: 9.26.00

REVIEWED BY: W.F. Miller DATE: 02 Oct 00

PR-1.1.39

ATTACHMENT 7
27 RELAY 27D/16

DEVICE 27D/16
SERIAL NUMBER 2197
CIRCUIT NO. BUS 16
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7 ✓	93.7 ✓	93.7 - 94.2V As close to 93.7V as practical	93.7 ✓

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2 ✓	93.2 ✓	93.2V - 93.7V As close to 93.2V as practical	93.2 ✓

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.41"	2.28 - 2.52 seconds	2.41"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 10-2-00

REVIEWED BY: [signature] DATE: 02 oct 00

ATTACHMENT 9
27 RELAY 27D/B/16

DEVICE 27D/B/16
SERIAL NUMBER 2198
CIRCUIT NO. BUS 16
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.8v	93.7 - 94.2V As close to 93.7V as practical	93.8v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.3v	93.4v	93.2V - 93.7V As close to 93.2V as practical	93.4v

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.40"	2.28 - 2.52 seconds	2.40"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 10-2-00

REVIEWED BY: [signature] DATE: 02 oct 00

ATTACHMENT 12
27 RELAY 27D/17

DEVICE 27D/17
SERIAL NUMBER 2199
CIRCUIT NO. BUS 17
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. Definite
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.8v	93.7v	93.7 - 94.2V As close to 93.7V as practical	93.7v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2v	93.10	93.2V - 93.7V As close to 93.2V as practical	93.10

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.50"	2.28 - 2.52 seconds	2.50"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Todd M Pile DATE: 9-30-00

REVIEWED BY: W Fomby DATE: 10-2-00

ATTACHMENT 14
27 RELAY 27D/B/17

DEVICE 27D/B/17
SERIAL NUMBER 2200
CIRCUIT NO. BUS 17
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.8v	93.7 - 94.2V As close to 93.7V as practical	93.8v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2v	93.2v	93.2V - 93.7V As close to 93.2V as practical	93.2v

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.44"	2.28 - 2.52 seconds	2.45"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Todd M. Poole DATE: 9-30-06

REVIEWED BY: W Smith DATE: 10-2-06

ATTACHMENT 17
27 RELAY 27D/18

DEVICE 27D/18
SERIAL NUMBER 2201
CIRCUIT NO. BUS 18
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO: 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.8v	93.7 - 94.2V As close to 93.7V as practical	93.8v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2v	93.4v	93.2V - 93.7V As close to 93.2V as practical	93.4v

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.43	2.28 - 2.52 seconds	2.45

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Todd M. Pulse DATE: 9-26-00

REVIEWED BY: W Tomlin DATE: 10-2-00

ATTACHMENT 19
27 RELAY 27D/B/18

DEVICE 27D/B/18
SERIAL NUMBER 2202
CIRCUIT NO. BUS 18
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.8v	93.7 - 94.2V As close to 93.7V as practical	93.8v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.3v	93.4v	93.2V - 93.7V As close to 93.2V as practical	93.4v

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.39"	2.28 - 2.52 seconds	2.39

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9-26-00

REVIEWED BY: [signature] DATE: 10-2-00

WORK ORDER DISPATCH PAGE 1 OF 13

****** CONTROLLED COPY ****** CONTROLLED COPY ******* CONTROLLED COPY ******

WO # 20100651 01 TYPE _ UNIT 2 DATE 02/09/01 PRI 3A
TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

---------- EQUIPMENT IDENTIFICATION NUMBER SECTION ----------

EQUIPMENT ID LIST _____ DESC _____ SYS ____ TRAIN __
SR CLS ____ LOCATION _____ PMT/OPT _ RESP ENG _____
LOCATION DESC _____

---------- INITIATION SECTION ----------

PROBLEM/WORK REQUESTED

CALIBRATE UV & GROUND ALARM RELAYS PER PR-1.1

CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS FOR BUS 14,

BUS 16, BUS 17 AND BUS 18.

THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED

CONT Y

INITIATOR SYS DATE 02/09/01

---------- PLANNING SECTION ----------

P/2 SYS 504 ROOM CD 373 HP 1 QC 2 FW 0 TAGOUT # _____ MATERIALS REQ'D

---------- ESTIMATED RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRT	SRP	SQC	___	___	
EST CREW SIZE	2	4	1	1	___	___	
EST MANHOURS	40.0	12.0	.5	2.0	___	___	

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE	___	___	___	___	___	___	
EST CREW SIZE	___	___	___	___	___	___	8
EST MANHOURS	___	___	___	___	___	___	54.5

---------- ACTUAL RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRT	SRP	SQC	___	___	
ACT CREW SIZE	2	___	___	___	___	___	
ACT MANHOURS	40	___	___	___	___	___	

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE	___	___	___	___	___	___	
ACT CREW SIZE	___	___	___	___	___	___	2
ACT MANHOURS	___	___	___	___	___	___	40

ATTACHMENT 2
27 RELAY 27D/14

DEVICE 27D/14
SERIAL NUMBER 2195
CIRCUIT NO. BUS 14
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pick Up Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.70V	93.80V	93.7 - 94.2V As close to 93.7 as practical	93.80V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.20V	93.30V	93.2 - 93.7V As close to 93.2V as practical	93.30V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.42"	2.28 - 2.52 secs	2.42"

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: E Weber DATE: 3/25/02

REVIEWED BY: D Miller DATE: 4-4-02

ATTACHMENT 4
27 RELAY 27D/B/14

DEVICE 27D/B/14
SERIAL NUMBER 2196
CIRCUIT NO. Bus 14
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

RELAY APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. Definite
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pick Up Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.80V	93.70V	93.7 - 94.2V As close to 93.7V as practical	93.70V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.30V	93.20V	93.2V - 93.7V As close to 93.2V as practical	93.20V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.45"	2.28 - 2.52 seconds	2.45"

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 3/26/02

REVIEWED BY: D Miller DATE: 4-4-02

ATTACHMENT 7
27 RELAY 27D/16

DEVICE 27D/16
SERIAL NUMBER 2197
CIRCUIT NO. BUS 16
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.70V	93.70V	93.7 - 94.2V As close to 93.7V as practical	93.70V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.20V	93.30V	93.2V - 93.7V As close to 93.2V as practical	93.30V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.41"	2.28 - 2.52 seconds	2.41"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 4/3/02

REVIEWED BY: D Miller DATE: 4-4-02

ATTACHMENT 9
27 RELAY 27D/B/16

DEVICE 27D/B/16
SERIAL NUMBER 2198
CIRCUIT NO. BUS 16
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.80V	93.70V	93.7 - 94.2V As close to 93.7V as practical	93.70V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.40V	93.30V	93.2V - 93.7V As close to 93.2V as practical	93.30V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.41"	2.28 - 2.52 seconds	2.41"

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 4/3/02

REVIEWED BY: D. Miller DATE: 4-4-02

ATTACHMENT 12
27 RELAY 27D/17

DEVICE 27D/17
SERIAL NUMBER 2199
CIRCUIT NO. BUS 17
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. Definite
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.70V	93.70V	93.7 - 94.2V As close to 93.7V as practical	93.70V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.10V	93.20V	93.2V - 93.7V As close to 93.2V as practical	93.20V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.50"	2.28 - 2.52 seconds	2.50"

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 4/2/02
REVIEWED BY: D. Miller DATE: 4-4-02

ATTACHMENT 14
27 RELAY 27D/B/17

DEVICE 27D/B/17
SERIAL NUMBER 2200
CIRCUIT NO. BUS 17
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.80V	93.70V	93.7 - 94.2V As close to 93.7V as practical	93.70V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.20V	93.20V	93.2V - 93.7V As close to 93.2V as practical	93.20V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.44"	2.28 - 2.52 seconds	2.44"

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 4/3/02

REVIEWED BY: D Miller DATE: 4-4-02

ATTACHMENT 17
27 RELAY 27D/18

DEVICE 27D/18
SERIAL NUMBER 2201
CIRCUIT NO. BUS 18
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.80V	93.70V	93.7 - 94.2V As close to 93.7V as practical	93.70V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.40V	93.20V	93.2V - 93.7V As close to 93.2V as practical	93.20V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.45"	2.28 - 2.52 seconds	2.45"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: E Weber DATE: 3/26/02

REVIEWED BY: D Mills DATE: 4-4-02

ATTACHMENT 19
27 RELAY 27D/B/18

DEVICE 27D/B/18
SERIAL NUMBER 2202
CIRCUIT NO. BUS 18
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.80V	93.70V	93.7 - 94.2V As close to 93.7V as practical	93.70V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.40V	93.30V	93.2V - 93.7V As close to 93.2V as practical	93.30V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.40"	2.28 - 2.52 seconds	2.40"

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: E. Weber DATE: 3/26/02

REVIEWED BY: L. Miller DATE: 4-4-02

WORK ORDER DISPATCH PAGE 1 OF 12

****** CONTROLLED COPY ****** CONTROLLED COPY ******* CONTROLLED COPY ******

WO # 20202647 01 TYPE UNIT 2 DATE 10/04/02 PRI 3A
TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

---------- EQUIPMENT IDENTIFICATION NUMBER SECTION ----------

EQUIPMENT ID LIST _____ DESC _____ SYS ___ TRAIN __
SR CLS ___ LOCATION _____ PMT/OPT _ RESP ENG _____
LOCATION DESC _____

---------- INITIATION SECTION ----------

PROBLEM/WORK REQUESTED

CALIBRATE UV & GROUND ALARM RELAYS PER PR-1.1

CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS FOR BUS 14,

BUS 16, BUS 17 AND BUS 18.

THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED

CONT Y

INITIATOR SYS DATE 10/04/02

---------- PLANNING SECTION ----------

P/2 SYS 504 ROOM CD AD11 HP 1 QC 2 FW 0 TAGOUT # _____ MATERIALS REQ _

---------- ESTIMATED RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRP	SQC	SRT			
EST CREW SIZE	2	1	1	2			
EST MANHOURS	40.0	1.0	2.0	~~2.9~~			

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							6 ~~16~~
EST CREW SIZE							
EST MANHOURS							5~~43.0~~

---------- ACTUAL RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRP	SQC	SRT			
ACT CREW SIZE	2	1	1	2			
ACT MANHOURS	40	1	2	8			

	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
ACT CREW SIZE							4
ACT MANHOURS							51

ATTACHMENT 2
27 RELAY 27D/14

DEVICE 27D/14
SERIAL NUMBER 2195
CIRCUIT NO. BUS 14
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pick Up Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.8V	93.8V	93.7 - 94.2V As close to 93.7 as practical	93.8V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.3V	93.3V	93.2 - 93.7V As close to 93.2V as practical	93.3V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.41"	2.28 - 2.52 secs	2.41"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Jodd M. Pike DATE: 9-29-03

REVIEWED BY: Wayne J. Mills DATE: 9-30-03

TACHMENT 4
27 RELAY 27D/B/14

DEVICE 27D/B/14
SERIAL NUMBER 2196
CIRCUIT NO. Bus 14
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

RELAY APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. Definite
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pick Up Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.8v	93.7 - 94.2V As close to 93.7V as practical	93.8v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2v	93.4v	93.2V - 93.7V As close to 93.2V as practical	93.4v

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	.244"	2.28 - 2.52 seconds	.244"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Todd M. Pool DATE: 9-29-03

REVIEWED BY: [signature] DATE: 9-30-03

ATTACHMENT 7
27 RELAY 27D/16

DEVICE 27D/16
SERIAL NUMBER 2197
CIRCUIT NO. BUS 16
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.8v	93.7 - 94.2V As close to 93.7V as practical	93.8v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.3v	93.4v	93.2V - 93.7V As close to 93.2V as practical	93.4v

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.39"	2.28 - 2.52 seconds	2.39"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Todd M. Pike DATE: 9-24-03

REVIEWED BY: Wayne Miller DATE: 9-30-03

ATTACHMENT 9
27 RELAY 27D/B/16

DEVICE 27D/B/16
SERIAL NUMBER 2198
CIRCUIT NO. BUS 16
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7V	93.8V	93.7 - 94.2V As close to 93.7V as practical	93.8V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.3V	93.4V	93.2V - 93.7V As close to 93.2V as practical	93.4V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.39"	2.28 - 2.52 seconds	2.39"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Todd M. Poole DATE: 9-24-03

REVIEWED BY: [signature] DATE: 9-30-03

ATTACHMENT 12
27 RELAY 27D/17

DEVICE 27D/17
SERIAL NUMBER 2199
CIRCUIT NO. BUS 17
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. Definite
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7V	93.8V	93.7 - 94.2V As close to 93.7V as practical	93.8V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2V	93.3V	93.2V - 93.7V As close to 93.2V as practical	93.3V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.48"	2.28 - 2.52 seconds	2.45"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Todd M. Pelo DATE: 9-23-03
REVIEWED BY: Wayne T. Miller DATE: 9-30-03

ATTACHMENT 14
27 RELAY 27D/B/17

DEVICE 27D/B/17
SERIAL NUMBER 2200
CIRCUIT NO. BUS 17
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.9v	93.7 - 94.2V As close to 93.7V as practical	93.7v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2v	93.40v	93.2V - 93.7V As close to 93.2V as practical	93.2v

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.42"	2.28 - 2.52 seconds	2.44"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9-23-03

REVIEWED BY: [signature] DATE: 9-30-03

ATTACHMENT 17
27 RELAY 27D/18

DEVICE 27D/18
SERIAL NUMBER 2201
CIRCUIT NO. BUS 18
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST					
Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.8v	93.7 - 94.2V As close to 93.7V as practical	93.9v

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2v	93.3v	93.2V - 93.7V As close to 93.2V as practical	93.4v

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.44	2.28 - 2.52 seconds	2.43"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Todd M. Pelo DATE: 9-30-03

REVIEWED BY: [signature] DATE: 9-30-03

ATTACHMENT 19
27 RELAY 27D/B/18

DEVICE 27D/B/18
SERIAL NUMBER 2202
CIRCUIT NO. BUS 18
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7v	93.8v	93.7 - 94.2V As close to 93.7V as practical	93.8v

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.3v	93.4v	93.2V - 93.7V As close to 93.2V as practical	93.4v

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 - 2.75 seconds	2.396"	2.28 - 2.52 seconds	2.397"

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: [signature] DATE: 9-30-03

REVIEWED BY: [signature] DATE: 9-30-03

******* CONTROLLED COPY ******* CONTROLLED COPY ******* CONTROLLED COPY *******

WO # 20400377 01 TYPE _ UNIT 2 DATE 20040123 PRI 3

TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

---------- EQUIPMENT IDENTIFICATION NUMBER SECTION ----------

EQUIPMENT ID: LIST DESC: _____ SYS: ____ TRAIN: __

SR CLS: ____ LOCATION: _____ PMT/OPT: _ RESP ENG: _____

LOCATION DESC: _____

---------- INITIATION SECTION ----------

PROBLEM/WORK REQUESTED:

CALIB UV & GND ALM REL PER PR-1.1
CALIBRATE UNDERVOLTAGE & GROUND ALARM RELAYS FOR BUS 14,
BUS 16, BUS 17 AND BUS 18.
THIS REP TASK CONTAINS EQUIPMENT WHICH IS TECH SPEC RELATED

CALIBRATE THE FOLLOWING DEVICES:

27/14, 27D/14, 27B/14, 27D/B/14, 64/14

27/16, 27D/16, 27B/16, 17D/B/16, 64/16

27/17, 27D/17, 27B/17, 27D/B/17, 64/17

27/18, 27D/18, 27B/18, 27D/B/18, 64/18

INITIATOR: SYS DATE: 01/23/2004

---------- PLANNING SECTION ----------

ROOM CD AD11 HP 1 QC 2 FW 0 TAGOUT # _____ MATERIALS REQ _

---------- ESTIMATED RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRP					
EST CREW SIZE	2	1					
EST MANHOURS	40.0	1.0					
	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS
GROUP CODE							
EST CREW SIZE							3
EST MANHOURS							41.0

---------- ACTUAL RESOURCES SECTION ----------

	LEAD	SP1	SP2	SP3	SP4	SP5	
GROUP CODE	ERT	SRP					
ACT CREW SIZE	2	0					
ACT MANHOURS	45.0	0.0					
	SP6	SP7	SP8	SP9	SP10	SP11	TOTALS 2
GROUP CODE							48

ATTACHMENT 2
27 RELAY 27D/14

DEVICE 27D/14
SERIAL NUMBER 2195
CIRCUIT NO. BUS 14
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST					
Setting	As-Found Tolerance	Previous As-Left Pick Up Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.8V	93.7V	93.7 to 94.2V As close to 93.7 as practical	93.7V

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.3V	93.2V	93.2 to 93.7V As close to 93.2V as practical	93.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 to 2.75 seconds	2.42sec	2.28 to 2.52 secs	2.42sec

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Zachin Phillips DATE: 4/3/05

REVIEWED BY: D Miller DATE: 4-3-05

ATTACHMENT 4
27 RELAY 27D/B/14

DEVICE 27D/B/14
SERIAL NUMBER 2196
CIRCUIT NO. Bus 14
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

RELAY APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. Definite
PHASE B - C

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pick Up Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.8V	93.7V	93.7 to 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.4V	93.2V	93.2V to 93.7V As close to 93.2V as practical	93.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 to 2.75 seconds	2.45 sec	2.28 to 2.52 seconds	2.45 sec

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Zachary Phillips DATE: 4/3/05

REVIEWED BY: D Miller DATE: 4-3-05

ATTACHMENT 7
27 RELAY 27D/16

DEVICE 27D/16
SERIAL NUMBER 2197
CIRCUIT NO. BUS 16
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.8V	93.7V	93.7 to 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.4V	93.2V	93.2V to 93.7V As close to 93.2V as practical	93.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 to 2.75 seconds	2.41 sec	2.28 to 2.52 seconds	2.41 sec

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Zachin Phillips DATE: 3/31/05

REVIEWED BY: D Miller DATE: 4-3-05

ATTACHMENT 9
27 RELAY 27D/B/16

DEVICE 27D/B/16
SERIAL NUMBER 2198
CIRCUIT NO. BUS 16
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST					
Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.8V	93.7V	93.7 to 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.4V	93.2V	93.2V to 93.7V As close to 93.2V as practical	93.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 to 2.75 seconds	2.40sec	2.28 to 2.52 seconds	2.40sec

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Zachary Phillips DATE: 3/31/05

REVIEWED BY: D Miller DATE: 4-3-05

ATTACHMENT 12
27 RELAY 27D/17

DEVICE 27D/17
SERIAL NUMBER 2199
CIRCUIT NO. BUS 17
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. Definite
PHASE A - B

PICKUP TEST

Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.8V	93.6V	93.7 to 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST

Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.3V	93.1V	93.2V to 93.7V As close to 93.2V as practical	93.2V

DROPOUT TIME TEST

Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 to 2.75 seconds	2.49 sec	2.28 to 2.52 seconds	2.49 sec

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Zachary C. Phillips DATE: 3/30/05

REVIEWED BY: D Mills DATE: 4-3-05

~~ATTACHMENT~~ 14
27 RELAY 27D/B/17

DEVICE 27D/B/17
SERIAL NUMBER 2200
CIRCUIT NO. BUS 17
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST					
Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7V	93.4V	93.7 to 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2V	92.9V	93.2V to 93.7V As close to 93.2V as practical	93.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 to 2.75 seconds	2.44 sec	2.28 to 2.52 seconds	2.44 sec

Relay and case visual inspection. ☑ SAT ☐ UNSAT

COMPLETED BY: Joachim Phillips DATE: 3/30/05

REVIEWED BY: D Miller DATE: 4-3-05

~~ATTACHMENT~~ 17
27 RELAY 27D/18

DEVICE 27D/18
SERIAL NUMBER 2201
CIRCUIT NO. BUS 18
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE A - B

PICKUP TEST					
Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7V	93.6V	93.7 to 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2V	93.1V	93.2V to 93.7V As close to 93.2V as practical	93.2V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 to 2.75 seconds	2.44sec	2.28 to 2.52 seconds	2.44 sec

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Jackie Phillips DATE: 3/31/05

REVIEWED BY: D Miller DATE: 4-3-05

ATTACHMENT 19
27 RELAY 27D/B/18

DEVICE 27D/B/18
SERIAL NUMBER 2202
CIRCUIT NO. BUS 18
RELAY TYPE ABB-27N
BULLETIN 7.4.1.7-7

APPLICATION BUS UNDERVOLTAGE
PT RATIO 480V/120V
MODEL/STYLE NO. 411T4175-HF
CURVE NO. DEFINITE
PHASE B - C

PICKUP TEST					
Setting	As-Found Tolerance	Previous As-Left Pickup Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.7V	Plus or minus 1 volt of previous As-Left Test	93.7V	93.6V	93.7 to 94.2V As close to 93.7V as practical	93.7V

DROPOUT TEST					
Setting	As-Found Tolerance	Previous As-Left Dropout Voltage	Present As-Found	As-Left Tolerance	Present As-Left
93.2V	Plus or minus 0.6 volt of previous As-Left Test	93.2V	93.2V	93.2V to 93.7V As close to 93.2V as practical	93.3V

DROPOUT TIME TEST				
Setting	As-Found Tolerance	Present As-Found	As-Left Tolerance	Present As-Left
2TL 120V to 92.6V = 2.4 secs (suddenly applied)	2.05 to 2.75 seconds	2.40sec	2.28 to 2.52 seconds	2.40sec

Relay and case visual inspection. ☒ SAT ☐ UNSAT

COMPLETED BY: Zachary Phillips DATE: 3/31/05

REVIEWED BY: D Miller DATE: 4-3-05

79926 WORK ORDER DISPATCH Page 1 of 1

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WO # 20500524 TYPE _ UNIT 2 DATE 20050128 PRI 3

TYPE MAINT P WORK TYPE P SUB TYPE S ACT SAFETY S RESP GROUP P/MAIN

---------- WORK COMPLETED ATTACHMENT SHEET ----------

DOCUMENT DETAILED SUMMARIES OF AS FOUND CONDITIONS, ACTIONS TAKEN AND FAILURE ASSESSMENT. ADDITIONAL SHEETS MAY BE ATTACHED TO THE WORK ORDER AS NEEDED.

AS FOUND CONDITIONS:

RELAYS TESTED SAT. FOR BUS 18 10/15/06 BT
RELAYS TESTED SAT. FOR BUS 14 10/17/06 BT
TARGET ON THE 27B/16 RELAY FOUND STICKING
RELAYS ON BUS 6 TESTED SAT. 10/19/06 BT
all 27 and 27/B relays show signs of high heat at the 125VDC inputs.

ACTION TAKEN:

REPLACED 27B/16 RELAY WITH NEW RELAY FROM STOREROOM. NEW SERIAL NUMBER 6021

FAILURE ASSESSMENT/RCM EVALUATION:

ATTACHMENT 2
27 RELAY 27D/14

DEVICE 27D/14 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 2195 PT RATIO 480V/120V

CIRCUIT NO. BUS 14 MODEL/STYLE NO. 411T4175-HF

RELAY TYPE ABB-27N CURVE NO. DEFINITE

BULLETIN 7.4.1.7-7 PHASE A - B

PICK-UP TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.0 volts	As-Left Tolerance volts	As-Left volts
93.7	93.7	93.8	92.7 To 94.7	93.7 to 94.2 As close to 93.7 as practical	93.8

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 0.53	As-Left Tolerance volts	As-Left volts
93.2	93.2	93.3	92.67 To 93.73	93.2 to 93.7 As close to 93.2 as practical	93.2

DROP-OUT TIME TEST					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 0.06 sec	As-Left Tolerance seconds	As-Left seconds
2 TL 2.4 seconds 120V to 92.6V (suddenly applied)	2.42	2.42	2.36 To 2.48	2.28 to 2.52	2.42

Relay and case visual inspection ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: T. Murray DATE: 10/15/06

REVIEWED BY: [signature] DATE: 10/18/06

ATTACHMENT 4
27 RELAY 27D/B/14

DEVICE 27D/B/14 RELAY APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 2196 PT RATIO 480V:120V

CIRCUIT NO. Bus 14 MODEL/STYLE NO. 411T4175-HF

RELAY TYPE ABB-27N CURVE NO. Definite

BULLETIN 7.4.1.7-7 PHASE B - C

PICK-UP TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.0 volts	As-Left Tolerance volts	As-Left volts
93.7	93.7	93.8	92.7 To 94.7	93.7 to 94.2 As close to 93.7 as practical	93.8

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 0.53	As-Left Tolerance volts	As-Left volts
93.2	93.2	93.3	92.67 To 93.73	93.2 to 93.7 As close to 93.2 as practical	93.3

DROP-OUT TIME TEST					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 0.06 sec	As-Left Tolerance seconds	As-Left seconds
2 TL 2.4 seconds 120V to 92.6V (suddenly applied)	2.45	2.45	2.39 ~~2.36~~ To 2.51	2.38 to 2.52	2.45

10/15/06

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: T. Murray DATE: 10/15/06

REVIEWED BY: J. Simon DATE: 10/18/06

ATTACHMENT 7
27 RELAY 27D/16

DEVICE 27D/16 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 2197 PT RATIO 480V/120V

CIRCUIT NO. BUS 16 MODEL/STYLE NO. 411T4175-HF

RELAY TYPE ABB-27N CURVE NO. DEFINITE

BULLETIN 7.4.1.7-7 PHASE A - B

PICK-UP TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.0 volts	As-Left Tolerance volts	As-Left volts
93.7	93.7	93.8	92.7 To 94.7	93.7 to 94.2 As close to 93.7 as practical	93.8

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 0.53	As-Left Tolerance volts	As-Left volts
93.2	93.2	93.3	92.67 To 93.73	93.2 to 93.7 As close to 93.2 as practical	93.3

DROP-OUT TIME TEST					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 0.06 sec	As-Left Tolerance seconds	As-Left seconds
2 TL 2.4 seconds 120V to 92.6V (suddenly applied)	2.41	2.41	2.35 To 2.47	2.28 to 2.52	2.41

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: R. Tomlinson DATE: 10/17/06

REVIEWED BY: Thomas E. Lawrence DATE: 10/17/06

ATTACHMENT 9
27 RELAY 27D/B/16

DEVICE 27D/B.16 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 2198 PT RATIO 480V/120V

CIRCUIT NO. BUS 16 MODEL/STYLE NO. 411T4175-HF

RELAY TYPE ABB-27N CURVE NO. DEFINITE

BULLETIN 7.4.1.7-7 PHASE B - C

PICK-UP TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.0 volts	As-Left Tolerance volts	As-Left volts
93.7	93.7	93.8	92.7 To 94.7	93.7 to 94.2 As close to 93.7 as practical	93.8

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 0.53	As-Left Tolerance volts	As-Left volts
93.2	93.2	93.3	92.67 To 93.53	93.2 to 93.7 As close to 93.2 as practical	93.3

DROP-OUT TIME TEST					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 0.06 sec	As-Left Tolerance seconds	As-Left seconds
2 TL 2.4 seconds 120V to 92.6V (suddenly applied)	2.40	2.39	2.34 To 2.46	2.28 to 2.52	2.39

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: T. Murray DATE: 10/18/06

REVIEWED BY: Thomas E Lamm DATE: 10/18/06

ATTACHMENT 12
27 RELAY 27D/17

DEVICE 27D/17 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 2129 PT RATIO 480V/120V

CIRCUIT NO. BUS 17 MODEL/STYLE NO. 411T4175-HF

RELAY TYPE ABB-27N CURVE NO. Definite

BULLETIN 7.4.1.7-7 PHASE A - B

PICK-UP TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.0 volts	As-Left Tolerance volts	As-Left volts
93.7	93.7	93.7	92.7 To 94.7	93.7 to 94.2 As close to 93.7 as practical	93.7

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 0.53	As-Left Tolerance volts	As-Left volts
93.2	93.2	93.3	92.67 To 93.73	93.2 to 93.7 As close to 93.2 as practical	93.3

DROP-OUT TIME TEST					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 0.06 sec	As-Left Tolerance seconds	As-Left seconds
2 TL 2.4 seconds 120V to 92.6V (suddenly applied)	2.49	2.49	2.43 To 2.55	2.28 to 2.52	2.49

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: T. Murray DATE: 10/18/06

REVIEWED BY: Thomas E. Lenz DATE: 10/26/06

ATTACHMENT 14
27 RELAY 27D/B/17

DEVICE 27D B/17 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 2300 PT RATIO 480V/120V

CIRCUIT NO. BUS 17 MODEL/STYLE NO. 411T4175-HF

RELAY TYPE ABB-27N CURVE NO. DEFINITE

BULLETIN 7.4.1.7-7 PHASE B - C

PICK-UP TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.0 volts	As-Left Tolerance volts	As-Left volts
93.7	93.7	93.8	92.7 To 94.7	93.7 to 94.2 As close to 93.7 as practical	93.8

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 0.53	As-Left Tolerance volts	As-Left volts
93.2	93.2	93.3	92.67 To 93.73	93.2 to 93.7 As close to 93.2 as practical	93.3

DROP-OUT TIME TEST					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 0.06 sec	As-Left Tolerance seconds	As-Left seconds
2 TL 2.4 seconds 120V to 92.6V (suddenly applied)	2.44	2.42	2.38 To 2.50	2.28 to 2.52	2.43

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: T. Murray DATE: 10/18/06

REVIEWED BY: Thomas E. Lemon DATE: 10/18/06

ATTACHMENT 17
27 RELAY 27D/18

DEVICE 27D/18 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 2201 PT RATIO 480V/120V

CIRCUIT NO. BUS 18 MODEL/STYLE NO. 411T4175-HF

RELAY TYPE ABB-27N CURVE NO. DEFINITE

BULLETIN 7.4.1.7-7 PHASE A - B

PICK-UP TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.0 volts	As-Left Tolerance volts	As-Left volts
93.7	93.7	93.8	92.7 To 94.7	93.7 to 94.2 As close to 93.7 as practical	93.7

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 0.53	As-Left Tolerance volts	As-Left volts
93.2	93.2	93.3	93.73 To 92.67	93.2 to 93.7 As close to 93.2 as practical	93.3

DROP-OUT TIME TEST					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 0.06 sec	As-Left Tolerance seconds	As-Left seconds
2 TL 2.4 seconds 120V to 92.6V (suddenly applied)	2.44	2.44	2.38 To 2.50	2.28 to 2.52	2.44

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: Peter Tardiff DATE: 10/14/06

REVIEWED BY: Thomas E Lussier DATE: 10/16/06

ATTACHMENT 19
27 RELAY 27D/B/18

DEVICE 27D/B 18 APPLICATION BUS UNDERVOLTAGE

SERIAL NUMBER 2202 PT RATIO 480V/120V

CIRCUIT NO. BUS 18 MODEL/STYLE NO. 411T4175-HF

RELAY TYPE ABB-27N CURVE NO. DEFINITE

BULLETIN 7.4.1.7-7 PHASE B - C

PICK-UP TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 1.0 volts	As-Left Tolerance volts	As-Left volts
93.7	93.7	93.7	92.7 To 94.7	93.7 to 94.2 As close to 93.7 as practical	93.7

DROP-OUT TEST					
Setting volts	Previous As-Left volts	As-Found volts	As-Found Tolerance: Previous As-Left ± 0.53	As-Left Tolerance volts	As-Left volts
93.2	93.3	93.3	92.77 To 93.83	93.2 to 93.7 As close to 93.2 as practical	93.3

DROP-OUT TIME TEST					
Setting seconds	Previous As-Left seconds	As-Found seconds	As-Found Tolerance: Previous As-Left ± 0.06 sec	As-Left Tolerance seconds	As-Left seconds
2 TL 2.4 seconds 120V to 92.6V (suddenly applied)	2.40	2.38	2.34 To 2.46	2.28 to 2.52	2.40

Relay and case visual inspection. ☑ SAT ☐ UNSAT

Pick-up and Drop-out tests ☑ SAT ☐ UNSAT

COMPLETED BY: Robert Tomlinson DATE: 10/15/06

REVIEWED BY: Thomas E Lucas DATE: 10/16/06

No. Calib. Sets= 72

Test Calibration Points: 2 **Function: ITE-27D**

Calib. Set No.	TAG	MODEL	FUNCTION	A/L Date	A/F Date	Days	A/L Value	A/F Value	DELTA Vac	DELTA %Span
1	27D-14	ITE-27D	480VSB-UVL	3/16/1994	3/25/1991	-1087	93.200	93.980	0.780	0.6500
				3/16/1994	3/25/1991	-1087	93.900	0.000	-93.900	-78.2500
2	27D-14	ITE-27D	480VSB-UVL	3/25/1991	4/9/1995	1476	93.080	93.100	0.020	0.0167
				3/25/1991	4/9/1995	1476	95.270	93.800	-1.470	-1.2250
3	27D-14	ITE-27D	480VSB-UVL	4/9/1995	4/10/1996	367	93.200	93.200	0.000	0.0000
				4/9/1995	4/10/1996	367	93.800	93.800	0.000	0.0000
4	27D-14	ITE-27D	480VSB-UVL	4/10/1996	10/28/1997	566	93.200	93.300	0.100	0.0833
				4/10/1996	10/28/1997	566	93.800	93.900	0.100	0.0833
5	27D-14	ITE-27D	480VSB-UVL	10/28/1997	3/3/1999	491	93.200	93.100	-0.100	-0.0833
				10/28/1997	3/3/1999	491	93.700	93.600	-0.100	-0.0833
6	27D-14	ITE-27D	480VSB-UVL	3/3/1999	9/26/2000	573	93.200	93.200	0.000	0.0000
				3/3/1999	9/26/2000	573	93.700	93.700	0.000	0.0000
7	27D-14	ITE-27D	480VSB-UVL	9/26/2000	3/25/2002	545	93.200	93.300	0.100	0.0833
				9/26/2000	3/25/2002	545	93.700	93.800	0.100	0.0833
8	27D-14	ITE-27D	480VSB-UVL	3/25/2002	9/29/2003	553	93.300	93.300	0.000	0.0000
				3/25/2002	9/29/2003	553	93.800	93.800	0.000	0.0000
9	27D-14	ITE-27D	480VSB-UVL	9/29/2003	4/3/2005	552	93.300	93.300	0.000	0.0000
				9/29/2003	4/3/2005	552	93.800	93.800	0.000	0.0000
10	27D-B-14	ITE-27D	480VSB-UVL	3/25/1991	3/16/1994	1087	93.180	93.300	0.120	0.1000
				3/25/1991	3/16/1994	1087	94.660	93.600	-1.060	-0.8833
11	27D-B-14	ITE-27D	480VSB-UVL	3/16/1994	4/9/1995	389	93.200	93.100	-0.100	-0.0833
				3/16/1994	4/9/1995	389	93.800	93.700	-0.100	-0.0833
12	27D-B-14	ITE-27D	480VSB-UVL	4/9/1995	4/10/1996	367	93.200	93.200	0.000	0.0000
				4/9/1995	4/10/1996	367	93.700	93.700	0.000	0.0000
13	27D-B-14	ITE-27D	480VSB-UVL	4/10/1996	10/28/1997	566	93.200	93.400	0.200	0.1667
				4/10/1996	10/28/1997	566	93.700	93.800	0.100	0.0833
14	27D-B-14	ITE-27D	480VSB-UVL	10/28/1997	3/4/1999	492	93.200	93.100	-0.100	-0.0833
				10/28/1997	3/4/1999	492	93.700	93.500	-0.200	-0.1667
15	27D-B-14	ITE-27D	480VSB-UVL	3/4/1999	9/26/2000	572	93.300	93.300	0.000	0.0000
				3/4/1999	9/26/2000	572	93.700	93.800	0.100	0.0833
16	27D-B-14	ITE-27D	480VSB-UVL	9/26/2000	3/26/2002	546	93.300	93.200	-0.100	-0.0833
				9/26/2000	3/26/2002	546	93.800	93.700	-0.100	-0.0833
17	27D-B-14	ITE-27D	480VSB-UVL	3/26/2002	9/29/2003	552	93.200	93.200	0.000	0.0000
				3/26/2002	9/29/2003	552	93.700	93.700	0.000	0.0000
18	27D-B-14	ITE-27D	480VSB-UVL	9/29/2003	4/3/2005	552	93.400	93.200	-0.200	-0.1667
				9/29/2003	4/3/2005	552	93.800	93.700	-0.100	-0.0833
19	27D-16	ITE-27D-ABB-27N	480VSB-UVL	3/26/1991	3/18/1994	1088	93.000	93.000	0.000	0.0000
				3/26/1991	3/18/1994	1088	95.250	93.600	-1.650	-1.3750
20	27D-16	ITE-27D-ABB-27N	480VSB-UVL	3/18/1994	4/9/1995	387	93.200	93.100	-0.100	-0.0833
				3/18/1994	4/9/1995	387	93.900	93.800	-0.100	-0.0833
21	27D-16	ITE-27D-ABB-27N	480VSB-UVL	4/9/1995	4/22/1996	379	93.200	93.200	0.000	0.0000

Test Calibration Points: 2 **Function: ITE-27D**

Calib. Set No.	TAG	MODEL	FUNCTION	A/L Date	A/F Date	Days	A/L Value	A/F Value	DELTA Vac	DELTA %Span
				4/9/1995	4/22/1996	379	93.800	93.900	0.100	0.0833
22	27D-16	ITE-27D-ABB-27N	480VSB-UVL	4/22/1996	10/31/1997	557	93.200	93.500	0.300	0.2500
				4/22/1996	10/31/1997	557	93.900	94.000	0.100	0.0833
23	27D-16	ITE-27D-ABB-27N	480VSB-UVL	10/31/1997	3/5/1999	490	93.200	93.100	-0.100	-0.0833
				10/31/1997	3/5/1999	490	93.700	93.700	0.000	0.0000
24	27D-16	ITE-27D-ABB-27N	480VSB-UVL	3/5/1999	10/2/2000	577	93.200	93.200	0.000	0.0000
				3/5/1999	10/2/2000	577	93.700	93.700	0.000	0.0000
25	27D-16	ITE-27D-ABB-27N	480VSB-UVL	10/2/2000	4/3/2002	548	93.200	93.300	0.100	0.0833
				10/2/2000	4/3/2002	548	93.700	93.700	0.000	0.0000
26	27D-16	ITE-27D-ABB-27N	480VSB-UVL	4/3/2002	9/24/2003	539	93.300	93.400	0.100	0.0833
				4/3/2002	9/24/2003	539	93.700	93.800	0.100	0.0833
27	27D-16	ITE-27D-ABB-27N	480VSB-UVL	9/24/2003	3/31/2005	554	93.400	93.200	-0.200	-0.1667
				9/24/2003	3/31/2005	554	93.800	93.700	-0.100	-0.0833
28	27D-B-16	ABB-27N	480VSB-UVL	3/26/1991	3/18/1994	1088	93.090	93.100	0.010	0.0083
				3/26/1991	3/18/1994	1088	95.500	93.600	-1.900	-1.5833
29	27D-B-16	ABB-27N	480VSB-UVL	3/18/1994	4/9/1995	387	93.300	93.200	-0.100	-0.0833
				3/18/1994	4/9/1995	387	93.800	93.800	0.000	0.0000
30	27D-B-16	ABB-27N	480VSB-UVL	4/9/1995	4/22/1996	379	93.200	93.100	-0.100	-0.0833
				4/9/1995	4/22/1996	379	93.800	93.900	0.100	0.0833
31	27D-B-16	ABB-27N	480VSB-UVL	4/22/1996	11/1/1997	558	93.200	93.300	0.100	0.0833
				4/22/1996	11/1/1997	558	93.900	94.100	0.200	0.1667
32	27D-B-16	ABB-27N	480VSB-UVL	11/1/1997	3/6/1999	490	93.200	93.000	-0.200	-0.1667
				11/1/1997	3/6/1999	490	93.700	93.500	-0.200	-0.1667
33	27D-B-16	ABB-27N	480VSB-UVL	3/6/1999	10/2/2000	576	93.300	93.400	0.100	0.0833
				3/6/1999	10/2/2000	576	93.700	93.800	0.100	0.0833
34	27D-B-16	ABB-27N	480VSB-UVL	10/2/2000	4/3/2002	548	93.400	93.300	-0.100	-0.0833
				10/2/2000	4/3/2002	548	93.800	93.700	-0.100	-0.0833
35	27D-B-16	ABB-27N	480VSB-UVL	4/3/2002	9/24/2003	539	93.300	93.400	0.100	0.0833
				4/3/2002	9/24/2003	539	93.700	93.800	0.100	0.0833
36	27D-B-16	ABB-27N	480VSB-UVL	9/24/2003	3/31/2005	554	93.400	93.200	-0.200	-0.1667
				9/24/2003	3/31/2005	554	93.800	93.700	-0.100	-0.0833
37	27D-17	ITE-27D	480VSB-UVL	3/29/1991	3/22/1994	1089	93.120	93.200	0.080	0.0667
				3/29/1991	3/22/1994	1089	95.590	93.800	-1.790	-1.4917
38	27D-17	ITE-27D	480VSB-UVL	3/22/1994	4/10/1995	384	93.200	93.100	-0.100	-0.0833
				3/22/1994	4/10/1995	384	93.800	93.700	-0.100	-0.0833
39	27D-17	ITE-27D	480VSB-UVL	4/10/1995	4/23/1995	13	93.200	93.300	0.100	0.0833
				4/10/1995	4/23/1995	13	93.700	93.800	0.100	0.0833
40	27D-17	ITE-27D	480VSB-UVL	4/23/1995	11/1/1997	923	93.200	93.200	0.000	0.0000
				4/23/1995	11/1/1997	923	93.700	93.800	0.100	0.0833
41	27D-17	ITE-27D	480VSB-UVL	11/1/1997	3/8/1999	492	93.200	93.200	0.000	0.0000
				11/1/1997	3/8/1999	492	93.800	93.800	0.000	0.0000
42	27D-17	ITE-27D	480VSB-UVL	3/8/1999	9/30/2000	572	93.200	93.100	-0.100	-0.0833
				3/8/1999	9/30/2000	572	93.800	93.700	-0.100	-0.0833

Test Calibration Points: 2 **Function: ITE-27D**

Calib. Set No.	TAG	MODEL	FUNCTION	A/L Date	A/F Date	Days	A/L Value	A/F Value	DELTA Vac	DELTA %Span
43	27D-17	ITE-27D	480VSB-UVL	9/30/2000	4/2/2002	549	93.100	93.200	0.100	0.0833
				9/30/2000	4/2/2002	549	93.700	93.700	0.000	0.0000
44	27D-17	ITE-27D	480VSB-UVL	4/2/2002	9/23/2003	539	93.200	93.300	0.100	0.0833
				4/2/2002	9/23/2003	539	93.700	93.800	0.100	0.0833
45	27D-17	ITE-27D	480VSB-UVL	9/23/2003	3/30/2005	554	93.300	93.100	-0.200	-0.1667
				9/23/2003	3/30/2005	554	93.800	93.600	-0.200	-0.1667
46	27D-B-17	ITE-27D	480VSB-UVL	3/29/1991	3/23/1994	1090	93.100	93.300	0.200	0.1667
				3/29/1991	3/23/1994	1090	95.210	93.700	-1.510	-1.2583
47	27D-B-17	ITE-27D	480VSB-UVL	3/23/1994	4/10/1995	383	93.300	93.000	-0.300	-0.2500
				3/23/1994	4/10/1995	383	93.700	93.500	-0.200	-0.1667
48	27D-B-17	ITE-27D	480VSB-UVL	4/10/1995	4/24/1996	380	93.300	93.500	0.200	0.1667
				4/10/1995	4/24/1996	380	93.800	93.900	0.100	0.0833
49	27D-B-17	ITE-27D	480VSB-UVL	4/24/1996	11/2/1997	557	93.200	93.400	0.200	0.1667
				4/24/1996	11/2/1997	557	93.700	93.900	0.200	0.1667
50	27D-B-17	ITE-27D	480VSB-UVL	11/2/1997	3/8/1999	491	93.200	93.000	-0.200	-0.1667
				11/2/1997	3/8/1999	491	93.700	93.600	-0.100	-0.0833
51	27D-B-17	ITE-27D	480VSB-UVL	3/8/1999	9/30/2000	572	93.200	93.200	0.000	0.0000
				3/8/1999	9/30/2000	572	93.700	93.800	0.100	0.0833
52	27D-B-17	ITE-27D	480VSB-UVL	9/30/2000	4/3/2002	550	93.200	93.200	0.000	0.0000
				9/30/2000	4/3/2002	550	93.800	93.700	-0.100	-0.0833
53	27D-B-17	ITE-27D	480VSB-UVL	4/3/2002	9/23/2003	538	93.200	93.400	0.200	0.1667
				4/3/2002	9/23/2003	538	93.700	93.900	0.200	0.1667
54	27D-B-17	ITE-27D	480VSB-UVL	9/23/2003	3/30/2005	554	93.200	92.900	-0.300	-0.2500
				9/23/2003	3/30/2005	554	93.700	93.400	-0.300	-0.2500
55	27D-18	ITE-27D	480VSB-UVL	3/31/1991	3/16/1994	1081	93.020	93.000	-0.020	-0.0167
				3/31/1991	3/16/1994	1081	95.460	93.700	-1.760	-1.4667
56	27D-18	ITE-27D	480VSB-UVL	3/16/1994	4/10/1995	390	93.300	93.200	-0.100	-0.0833
				3/16/1994	4/10/1995	390	93.700	93.600	-0.100	-0.0833
57	27D-18	ITE-27D	480VSB-UVL	4/10/1995	4/11/1996	367	93.300	93.400	0.100	0.0833
				4/10/1995	4/11/1996	367	93.700	93.800	0.100	0.0833
58	27D-18	ITE-27D	480VSB-UVL	4/11/1996	10/28/1997	565	93.400	93.600	0.200	0.1667
				4/11/1996	10/28/1997	565	93.800	93.900	0.100	0.0833
59	27D-18	ITE-27D	480VSB-UVL	10/28/1997	3/9/1999	497	93.200	93.100	-0.100	-0.0833
				10/28/1997	3/9/1999	497	93.700	93.500	-0.200	-0.1667
60	27D-18	ITE-27D	480VSB-UVL	3/9/1999	9/26/2000	567	93.200	93.400	0.200	0.1667
				3/9/1999	9/26/2000	567	93.700	93.800	0.100	0.0833
61	27D-18	ITE-27D	480VSB-UVL	9/26/2000	3/26/2002	546	93.400	93.200	-0.200	-0.1667
				9/26/2000	3/26/2002	546	93.800	93.700	-0.100	-0.0833
62	27D-18	ITE-27D	480VSB-UVL	3/26/2002	9/30/2003	553	93.200	93.300	0.100	0.0833
				3/26/2002	9/30/2003	553	93.700	93.800	0.100	0.0833
63	27D-18	ITE-27D	480VSB-UVL	9/30/2003	3/31/2005	548	93.400	93.100	-0.300	-0.2500
				9/30/2003	3/31/2005	548	93.900	93.600	-0.300	-0.2500
64	27D-B-18	ITE-27D	480VSB-UVL	3/31/1991	3/17/1994	1082	93.080	92.900	-0.180	-0.1500

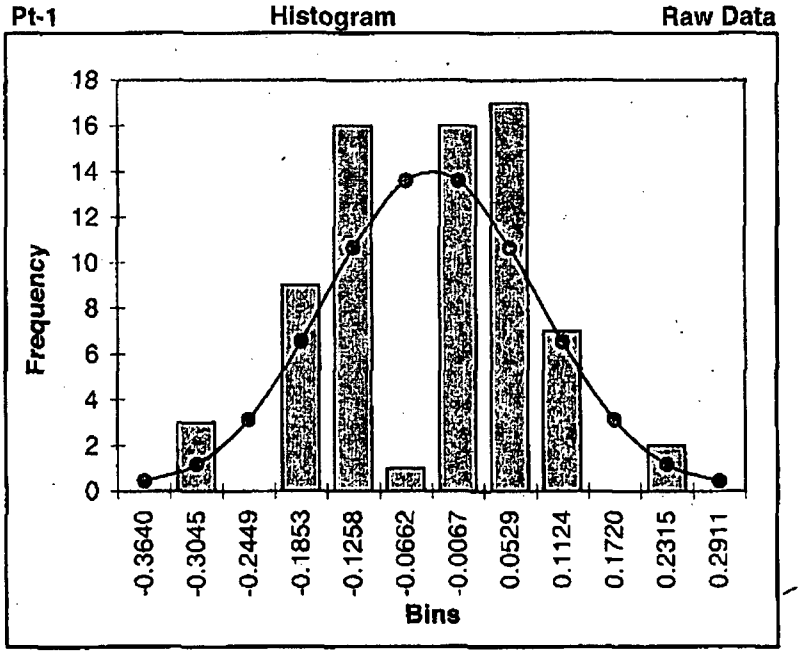
Test Calibration Points: 2 **Function: ITE-27D**

Calib. Set No.	TAG	MODEL	FUNCTION	A/L Date	A/F Date	Days	A/L Value	A/F Value	DELTA Vac	DELTA %Span
				3/31/1991	3/17/1994	1082	94.790	93.500	-1.290	-1.0750
65	27D-B-18	ITE-27D	480VSB-UVL	3/17/1994	4/11/1995	390	93.300	93.200	-0.100	-0.0833
				3/17/1994	4/11/1995	390	93.800	93.700	-0.100	-0.0833
66	27D-B-18	ITE-27D	480VSB-UVL	4/11/1995	4/12/1996	367	93.200	93.300	0.100	0.0833
				4/11/1995	4/12/1996	367	93.700	93.800	0.100	0.0833
67	27D-B-18	ITE-27D	480VSB-UVL	4/12/1996	10/28/1997	564	93.300	93.600	0.300	0.2500
				4/12/1996	10/28/1997	564	93.800	93.900	0.100	0.0833
68	27D-B-18	ITE-27D	480VSB-UVL	10/28/1997	3/9/1999	497	93.300	93.200	-0.100	-0.0833
				10/28/1997	3/9/1999	497	93.700	93.600	-0.100	-0.0833
69	27D-B-18	ITE-27D	480VSB-UVL	3/9/1999	9/26/2000	567	93.300	93.400	0.100	0.0833
				3/9/1999	9/26/2000	567	93.700	93.800	0.100	0.0833
70	27D-B-18	ITE-27D	480VSB-UVL	9/26/2000	3/26/2002	546	93.400	93.300	-0.100	-0.0833
				9/26/2000	3/26/2002	546	93.800	93.700	-0.100	-0.0833
71	27D-B-18	ITE-27D	480VSB-UVL	3/26/2002	9/30/2003	553	93.300	93.400	0.100	0.0833
				3/26/2002	9/30/2003	553	93.700	93.800	0.100	0.0833
72	27D-B-18	ITE-27D	480VSB-UVL	9/30/2003	3/31/2005	548	93.400	93.200	-0.200	-0.1667
				9/30/2003	3/31/2005	548	93.800	93.600	-0.200	-0.1667

Function: ITE-27D

Bin	Freq	Exp Freq
-0.3640	0	0.4402
-0.3045	3	1.1786
-0.2449	0	3.1311
-0.1853	9	6.5249
-0.1258	16	10.6429
-0.0662	1	13.5965
-0.0067	16	13.5965
0.0529	17	10.6429
0.1124	7	6.5249
0.1720	0	3.1311
0.2315	2	1.1786
0.2911	0	0.4402
0.3506		
> ±3 s	0	

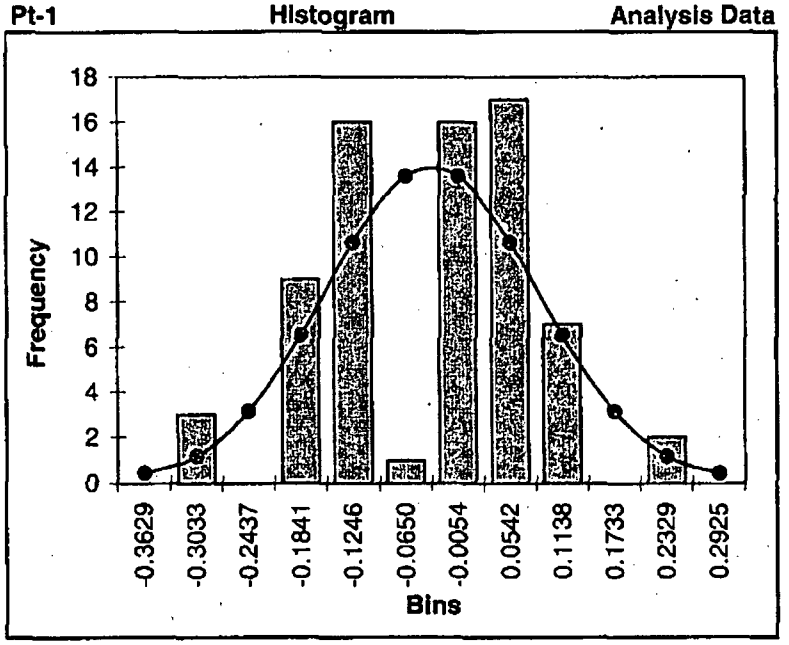
Mean= -0.0067
Bin Size= 0.0596
s= 0.1191



Time Int. = 1 Start = -1087 End = 1476

Bin	Freq	Exp Freq
-0.3629	0	0.4402
-0.3033	3	1.1786
-0.2437	0	3.1311
-0.1841	9	6.5249
-0.1246	16	10.6429
-0.0650	1	13.5965
-0.0054	16	13.5965
0.0542	17	10.6429
0.1138	7	6.5249
0.1733	0	3.1311
0.2329	2	1.1786
0.2925	0	0.4402
0.3521		
> ±3 s	0	

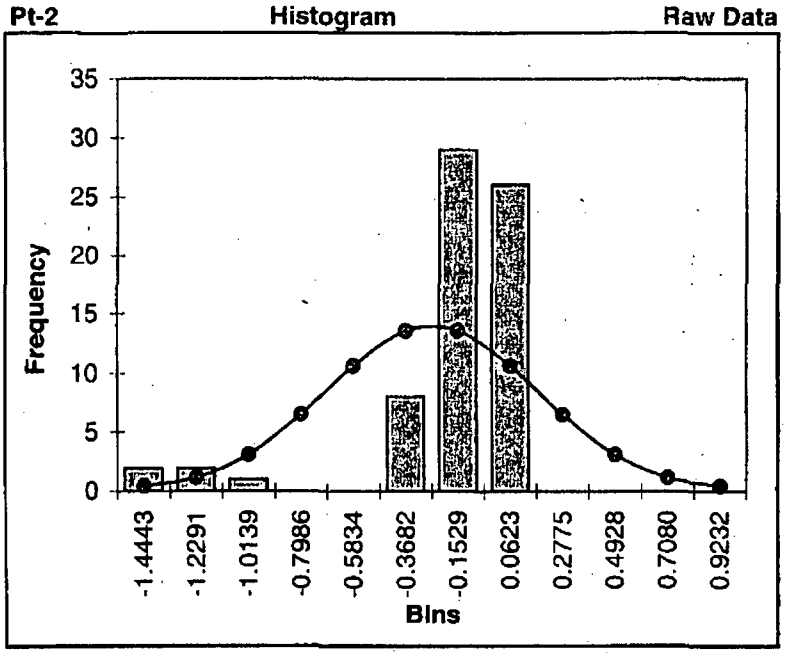
Mean= -0.0054
Bin Size= 0.0596
s= 0.1192



Function: ITE-27D

Bin	Freq	Exp Freq
-1.4443	2	0.4402
-1.2291	2	1.1786
-1.0139	1	3.1311
-0.7986	0	6.5249
-0.5834	0	10.6429
-0.3682	8	13.5965
-0.1529	29	13.5965
0.0623	26	10.6429
0.2775	0	6.5249
0.4928	0	3.1311
0.7080	0	1.1786
0.9232	0	0.4402
1.1385		
> ±3 s	3	

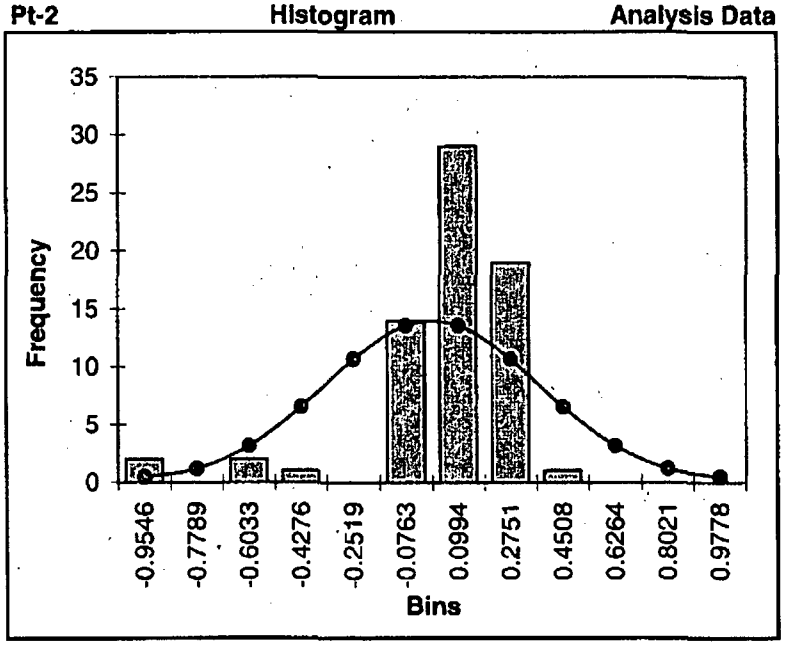
Mean= -0.1529
Bin Size= 0.2152
s= 0.4305



Time Int. = 1 Start = -1087 End = 1476

Bin	Freq	Exp Freq
-0.9546	2	0.4402
-0.7789	0	1.1786
-0.6033	2	3.1311
-0.4276	1	6.5249
-0.2519	0	10.6429
-0.0763	14	13.5965
0.0994	29	13.5965
0.2751	19	10.6429
0.4508	1	6.5249
0.6264	0	3.1311
0.8021	0	1.1786
0.9778	0	0.4402
1.1534		
> ±3 s	3	

Mean= 0.0994
Bin Size= 0.1757
s= 0.3513

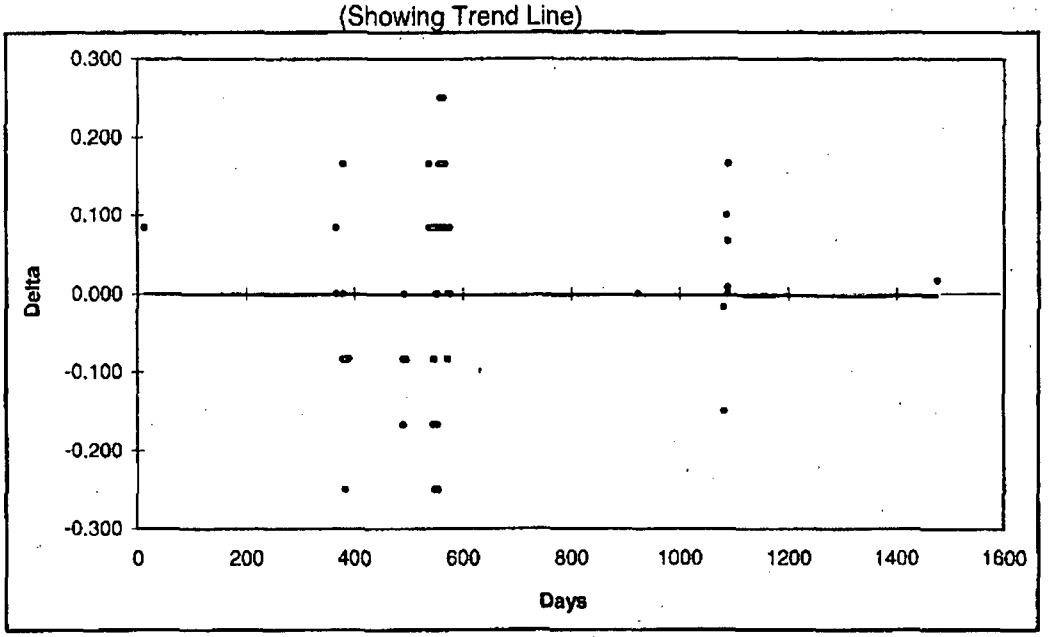


This application is
Creat

Function:ITE-27D

Pt-1

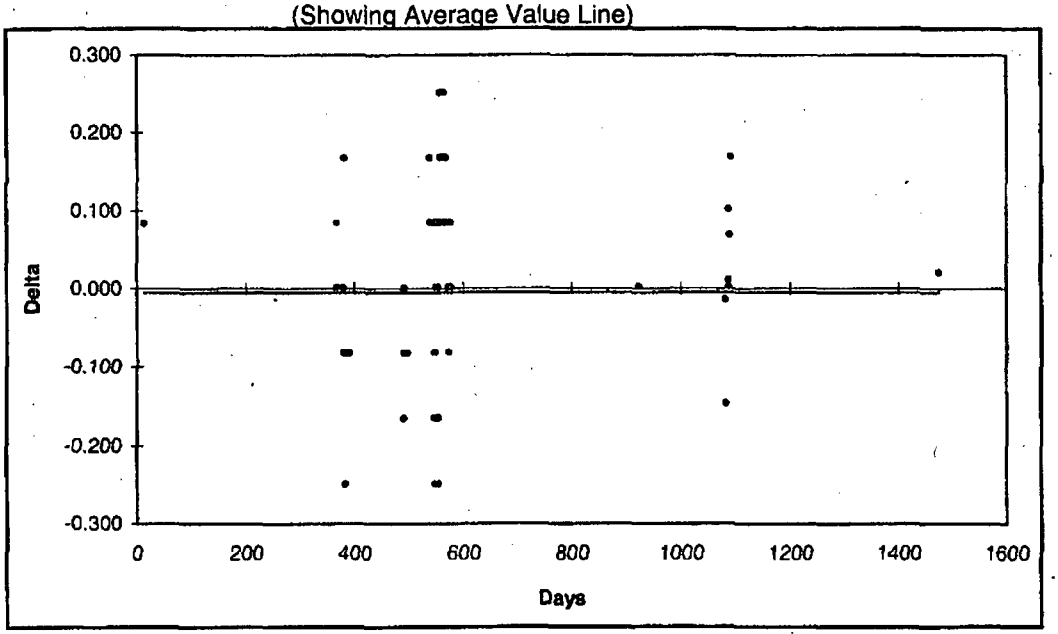
Scatter Plot: Raw Data
(Showing Trend Line)



y= -2.24E-06 x + 0
r^2= -0.003106
Drift Rate= -0.000818 % Per Year

Time Interval = 1
Start = -1087
End = 1476

Scatter Plot: Analysis Data
(Showing Average Value Line)

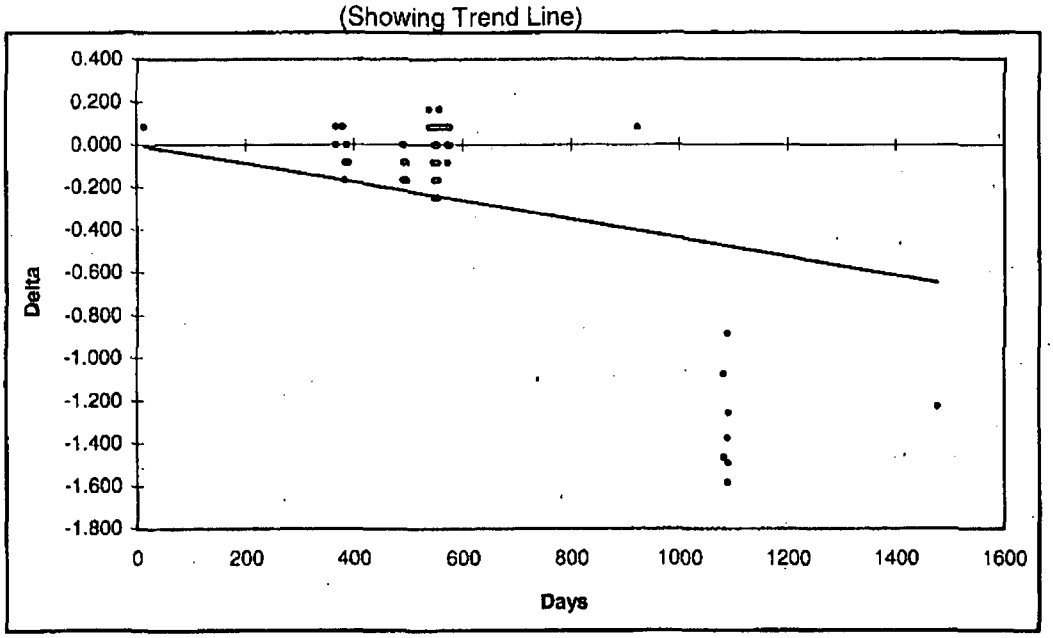


This application is
Creat

Function:ITE-27D

Pt-2

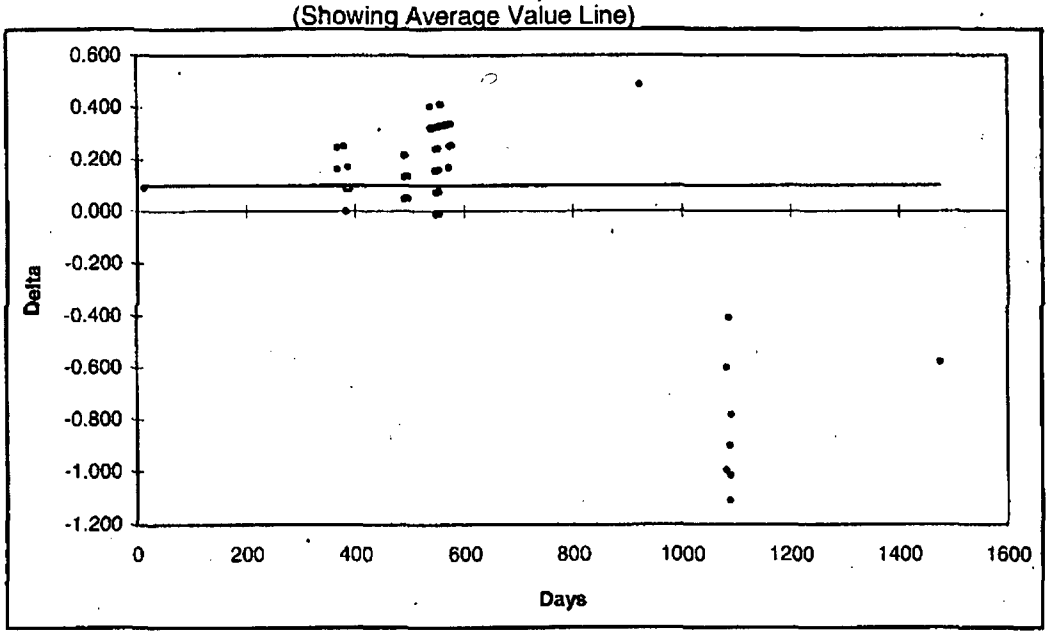
Scatter Plot: Raw Data
(Showing Trend Line)



y= -0.000438 x + 0
r^2= 0.278966
Drift Rate= -0.159726 % Per Year

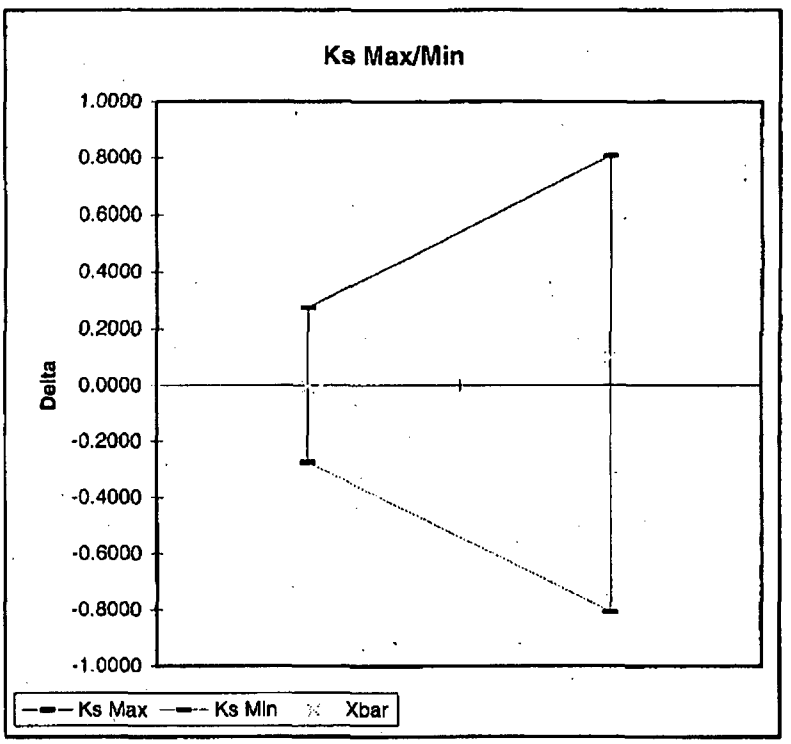
Time Interval = 1
Start = -1087
End = 1476

Scatter Plot: Analysis Data
(Showing Average Value Line)



Function= **ITE-27D**

Two-Sided



Ks Results Summary

Function= ITE-27D
Time Interval = 1

Two-Sided

Setpoint:	Trip	Reset
Conf. Level =	0.95	0.95
Probability =	0.95	0.95
s=	0.1192	0.3513
K=	2.2962	2.2962
Ks(max) =	0.2736	0.8067
Ks(min) =	-0.2736	-0.8067
xbar =	-0.0054	0.0994
Ks(max)+xbar=	0.2682	0.9062
Ks(min)+xbar=	-0.2790	-0.7073
Drit Rate(per year)=	-0.0008	-0.1597
y intercept=	0.0000	0.0000

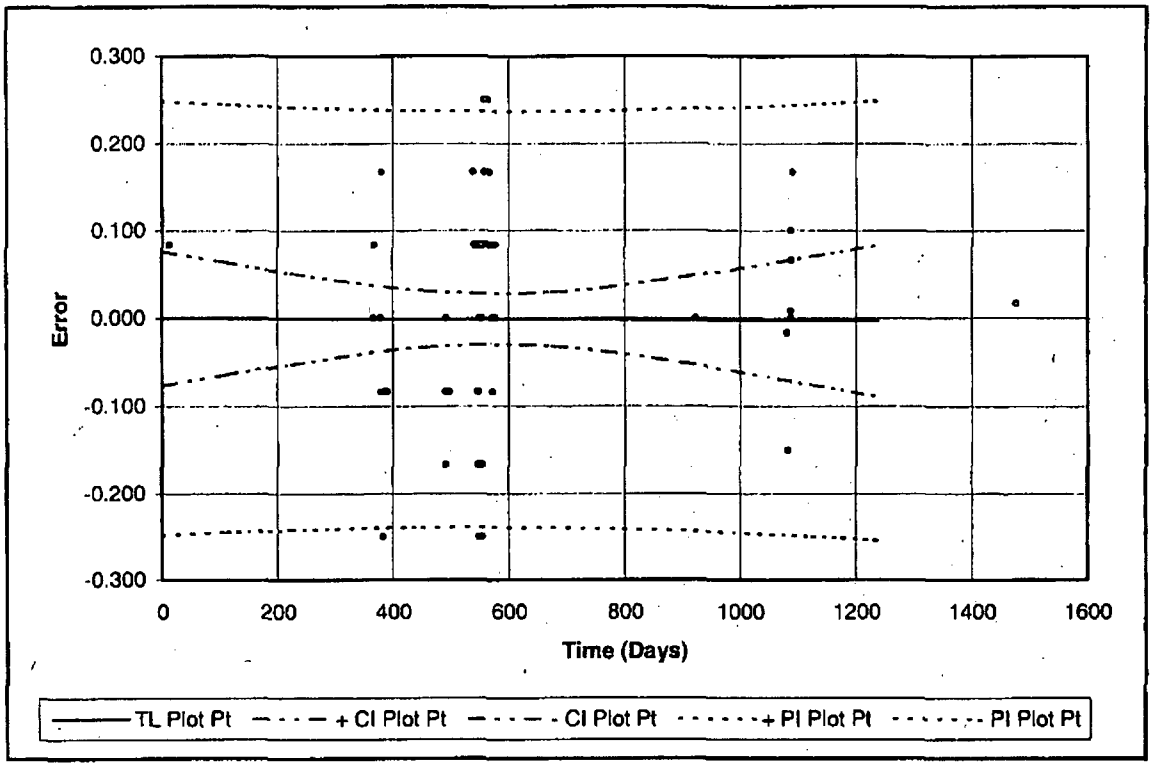
Normality Test Results Summary

Function= **ITE-27D**
Time Interval = 1

Two-Sided

Setpoint:	Trip	Reset
Test Type=	D-prime	D-prime
Number Points=	71	71
Normal=	YES	NO
D-prime=	167.9709	132.8793
Crit Val Lo=	163.1000	163.1000
Crit Val Hi=	171.3000	171.3000
X(min)=	-0.2491	-1.1072
X(max)=	0.25126413	0.487243985
Alpha=	0.05	0.05

Two Sided Interval Plot Pt-1

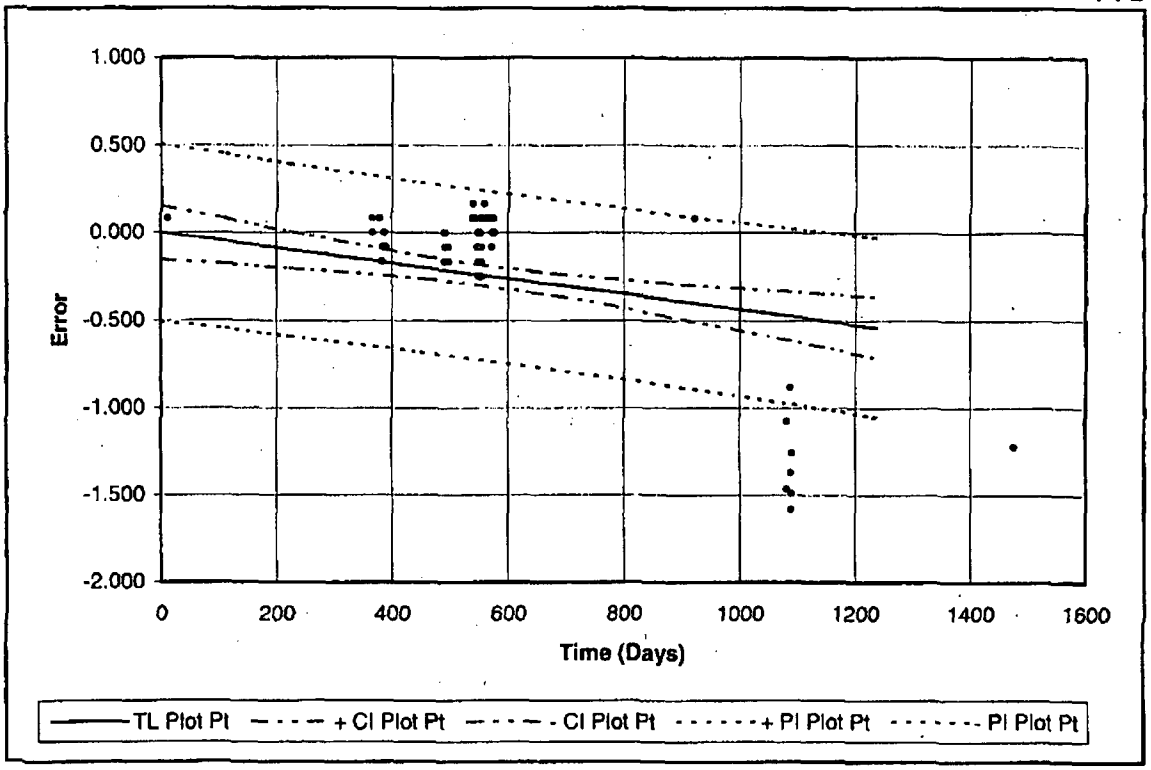


Days	Trend Line TL Plot Pt	Confidence Interval +/- Value	Confidence Interval + CI Plot Pt	Confidence Interval - CI Plot Pt	Prediction Interval +/- Value	Prediction Interval + PI Plot Pt	Prediction Interval - PI Plot Pt
0	0.0000	0.0762	0.0762	-0.0762	0.2481	0.2481	-0.2481
112.5	-0.0003	0.0636	0.0633	-0.0638	0.2445	0.2443	-0.2448
225	-0.0005	0.0515	0.0510	-0.0520	0.2417	0.2412	-0.2422
450	-0.0010	0.0321	0.0310	-0.0331	0.2383	0.2373	-0.2393
675	-0.0015	0.0305	0.0290	-0.0320	0.2381	0.2366	-0.2396
900	-0.0020	0.0486	0.0466	-0.0507	0.2411	0.2391	-0.2431
1125	-0.0025	0.0730	0.0705	-0.0755	0.2471	0.2446	-0.2497
1237.5	-0.0028	0.0859	0.0832	-0.0887	0.2513	0.2485	-0.2540

Number of Points = 71
t Value= 1.994945
Trendline Slope= -2.24E-06 *%Span / Day*
Trendline Intercept= 0 %Span
s= 0.118356 %Span
alpha= 0.05

Time Int. = 1
Start = -1087
End = 1476

Two Sided Interval Plot Pt-2



	Trend Line	Confidence Interval			Prediction Interval		
Days	TL Plot Pt	+/- Value	+ CI Plot Pt	- CI Plot Pt	+/- Value	+ PI Plot Pt	- PI Plot Pt
0	0.0000	0.1556	0.1556	-0.1556	0.5064	0.5064	-0.5064
112.5	-0.0492	0.1297	0.0805	-0.1790	0.4990	0.4498	-0.5483
225	-0.0985	0.1051	0.0067	-0.2036	0.4932	0.3948	-0.5917
450	-0.1969	0.0654	-0.1315	-0.2623	0.4863	0.2894	-0.6832
675	-0.2954	0.0623	-0.2331	-0.3577	0.4859	0.1905	-0.7813
900	-0.3938	0.0993	-0.2946	-0.4931	0.4920	0.0982	-0.8858
1125	-0.4923	0.1490	-0.3433	-0.6413	0.5044	0.0121	-0.9967
1237.5	-0.5415	0.1754	-0.3661	-0.7169	0.5128	-0.0287	-1.0544

Number of Points = 71
t Value= 1.994945
Trendline Slope= -0.000438 %Span / Day
Trendline Intercept= 0 %Span
s= 0.241551 %Span
alpha= 0.05

Time Int. = 1
Start = -1087
End = 1476

Standard burdens and accuracy classes

ASA Accuracy Classes for Potential Transformers

Accuracy Class	Limits of Ratio Correction Factor and Transformer Correction Factor	Limits of Power Factor (Lagging) of Metered Power Load
1.2	1.012–0.988	0.6–1.0
0.6	1.006–0.994	0.6–1.0
0.3	1.003–0.997	0.6–1.0

The limits given for each accuracy class apply from 10 percent above rated voltage to 10 percent below rated voltage, at rated frequency, and from no burden on the potential transformer to the specified burden.

ASA Standard Burdens for Potential Transformers

Burden	Volt-amperes	Burden Power Factor
W	12.5	0.10
X	25	0.70
Y	75	0.85
Z	200.	0.85
ZZ	400.	0.85

ASA Accuracy Classes for Metering Current Transformers

Accuracy Class	LIMITS OF RATIO CORRECTION FACTOR AND TRANSFORMER CORRECTION FACTOR				Limits of Power Factor (Lagging) of Metered Power Load
	100% Rated Current		10% Rated Current		
	Min	Max	Min	Max	
1.2	0.988	1.012	0.976	1.024	0.6–1.0
0.6	0.994	1.006	0.988	1.012	0.6–1.0
0.3	0.997	1.003	0.994	1.006	0.6–1.0
0.5	*0.995	*1.005	0.995	1.005	0.6–1.0

* These values also apply to 150 percent rated current.

ASA Standard Burdens for Current Transformers at 60 Cycles

Designation of Burden	BURDEN CHARACTERISTICS		SECONDARY BURDEN AT 60 CYCLES AND 5 AMPERES SECONDARY CURRENT		
	Resistance Ohms	Inductance Millihenrys	Impedance Ohms	Volt-amperes	Power Factor
B-0.1	0.09	0.116	0.1	2.5	0.9
B-0.2	0.18	0.232	0.2	5.0	0.9
B-0.5	0.45	0.580	0.5	12.5	0.9
B-1	0.5	2.3	1.0	25.0	0.5
B-2	1.0	4.6	2.0	50.0	0.5
B-4	2.0	9.2	4.0	100.0	0.5
B-8	4.0	18.4	8.0	200.0	0.5

FOR MORE COMPLETE INFORMATION

about the many dry and liquid-filled types of General Electric instrument transformers, contact your nearest General Electric Apparatus Sales Office or Agent.

Ac Instruments Loss Data, 60 Hertz
Circular Scale K-241, K-231, K-261

Ac Instruments Loss Data, 60 Cycles, Circular Scale K-241, K-231, K-261

Burden on Current Transformers at 5 Amps

Instrument and Rating	Type	Impedance: Ohms	Resistance: Ohms	Inductance: Henries	Volt-Amperes	Power Factor	Watts	Reactive Volt-Amperes
Ammeters, 5 Amps:								
Spiral Vane	KA	.036	.028	.000066	.9	.72	.65	.625
Repulsion-Attraction ①	KA	.015	.012	.000024	.375	.80	.30	.625
Rectifier	KC	.002	.0016	—	.05	.80	.04	—
Wattmeters and Varmeters (Per Element) 5 Amps	KP, KV	.08	.016	.0002	2.0	.20	.4	2.0
Power Factor Meters, 5 Amps	KI	1.74	.14	—	4.35	.82	1.12	—
	KJ	.045	.045	—	1.12	1.0	1.12	—

Burden on Voltage Transformers at 120 Volts

Instrument and Rating	Type	Impedance: Ohms	Resistance: Ohms	Inductance: Henries	Volt-Amperes	Power Factor	Watts	Reactive Volt-Amperes
Voltmeters, 0-150 Volts: 120 Volts:								
Spiral Vane	KA	8640	8420	5.1	1.79	.98	1.75	.40
Repulsion-Attraction ①	KA	7530	7500	1.6	1.92	.996	1.92	—
Rectifier	KC	150,000	150,000	—	.096	1.0	.096	—
Wattmeters and Varmeters, 120 Volts:								
Single Phase, Polyphase	KP, KV	9,000	9,000	—	2.5	1.0	2.5	—
	KP, KV	18,000	18,000	—	1.25	1.0	1.25	—
Phase Shifter	PS-2, MV-832	—	—	—	1.4	.36	.5	1.3
Frequency Meters, 120 Volts	KR3	4,000	4,000	—	3.6	1.0	3.6	—
Power Factor Meters, 120 Volts:								
Single Phase	KI	—	—	—	4.5	.48	2.0	4.1
	KJ	12,000	12,000	—	1.2	1.0	1.2	—
Polyphase	KI	—	—	—	2.2	1.0	2.2	—
	KJ	14,000	14,000	—	1.2	1.0	1.2	—
Synchroscopes, 120 Volts: Running, Incoming	KI	—	—	—	4.6	.45	2.0	4.1
					4.6	.80	3.7	2.8

① All HI-Shock types and commercial types manufactured prior to 1977 are repulsion-attraction.

Model 1040C

PANEL METER CALIBRATOR

Table 1.1 - Current Specifications (continued)

TYPE	DESCRIPTION	
II.	Output, AC Current	
	Range 4	0.1 A to 1.05 A rms
	Range 5	1 A to 7.5 A rms
	AC Current Amplitude Accuracy	+(0.2% of reading +0.05% of full scale) +(0.2% of reading +0.1% of full scale) on Range 5
	Compliance	6 V rms
	Overload Setting	6.5 V rms
	Distortion	0.45% Max
	Frequency	50 Hz to 75 Hz and 333.3 Hz to 500 Hz
	Frequency Accuracy	<0.01% of reading
	Current Output Stability AC and DC	<(0.03% of reading +0.015% of full scale); averaged 1 minute or longer
	Resolution and Setability	<0.1% of reading
	Settling Time	<8 seconds Max

Table 1.2 - Voltage Specifications *

TYPE	DESCRIPTION	
I.	Output, + DC Voltage	
	Range 1	10 mV to 105 mV
	Range 2	0.1 V to 1.05 V
	Range 3	1 V to 10.5 V
	Range 4	10 V to 105 V
	Range 5	100 V to 1050 V
	+DC Voltage Amplitude	+(0.2% of reading +0.05% of full Accuracy scale)
	Burden	15 mA on all ranges
	Overload Set Point	25 mA
	Noise	0.25% rms of reading Max, 10 kHz BW
	Voltage Output Stability	<(0.03% of reading +0.015% of full scale); Averaged for 1 minute or longer.
	Settling Time	<8 seconds
II.	Output, AC Voltage	
	Range 3	1.5 V rms to 15.75 V rms
	Range 4	15 V rms to 157.5 V rms
	Range 5	150 V rms to 750.0 V rms

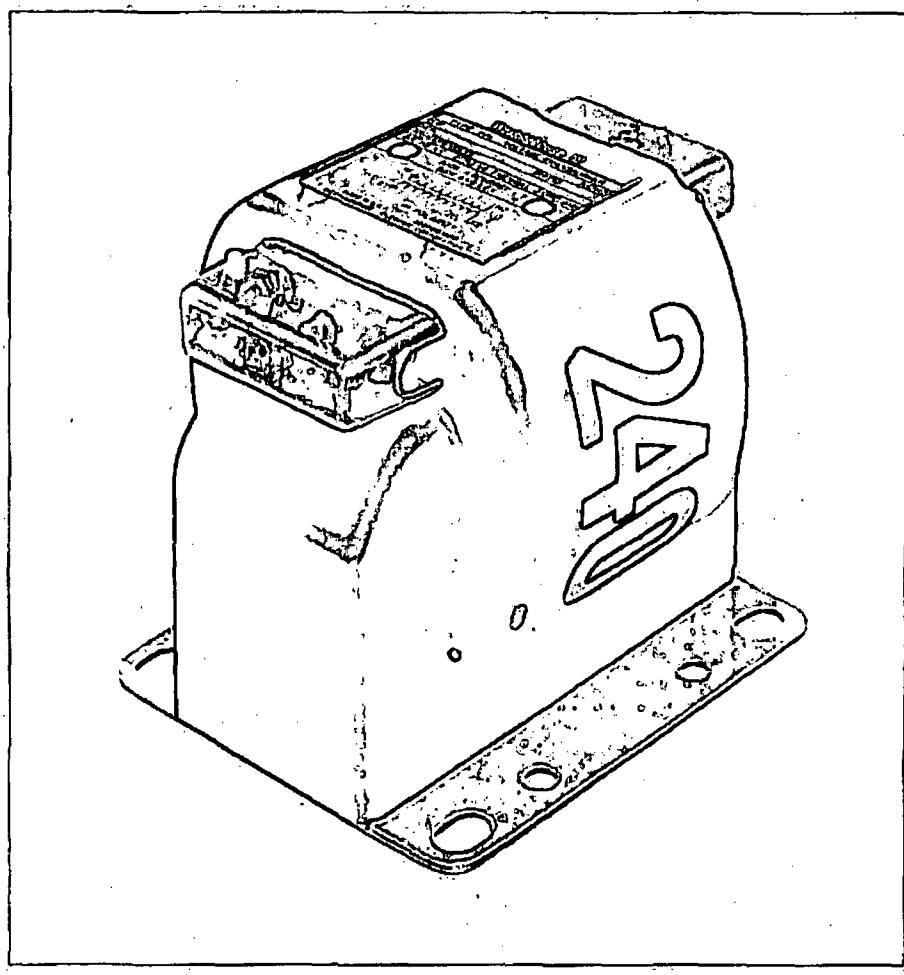
* *Utility Version Specified at Output Connectors*

Westinghouse Electric Corporation
Meter and LVIT Division
Raleigh, NC 27603

July 1979
New Information and
Supplements 44-200 D WE A
Pages 1 and 2, dated November 5, 1974
mail to,
E.D.C/2047/DB

600 Volts, 10Kv BIL
Primary Volts: 240 through 600
Indoor/Outdoor, 60 Hertz

Type PPI Voltage Transformers (Replaces EMP)



Application
The type PPI is a small light-weight molded voltage transformer specifically designed for light metering burdens in applications where size and weight are at a premium.

Accuracy
ANSI Metering Accuracy Class (60 Hz)
0.6 Class for W Burden
1.2 Class for X Burden
Type PPI will maintain 0.3 metering accuracy for most single meter applications.

Ratings
Thermal Rating
150 va at 30°C ambient
100 va at 55°C ambient

Temperature Rise
55°C at 30°C ambient
30°C at 55°C ambient

Construction Features
Core and Coils
Premolded forms are used for the winding spool and terminal brackets. A wound type core is assembled with the coil by banding the two securely into a cradle form. This rigid assembly is then completely enclosed in thermoplastic rubber.

Primary and Secondary Terminals
The terminals are stud type. Polarity markings and high and low voltage identification are molded in the body of the transformer. Sealable terminal covers can be supplied for high and low voltage.

Base Mounting
A detachable aluminum base comes with all ratings.

Further Information
Prices: Price List 44-019

Selector Guide

Primary Volts	Winding Ratio	Without Terminal Covers		With Terminal Covers	
		PPI Style Number	EMP Style Number	PPI Style Number	EMP Style Number
240/416Y	2:1	7526A01G01	254A476G01	7526A02G01	254A478G01
288/500Y	2.4:1	7526A01G02	254A476G02	7526A02G02	254A478G02
300/520Y	2.5:1	7526A01G03	254A476G05	7526A02G03	254A478G05
480/480Y	4:1	7526A01G04	254A476G03	7526A02G04	254A478G03
600/600Y	5:1	7526A01G05	254A476G04	7526A02G05	254A478G04