NRR-PMDAPEm Resource

From: Harding Jr, Thomas:(GenCo-Nuc) [thomas.hardingjr@exeloncorp.com]
Sent: Wednesday, June 03, 2015 12:48 PM
To: Mozafari, Brenda
Subject: Calculation DA-EE-93-006-08 Rev 2 Part 1
Attachments: DA-EE-93-006-08 r2 part 1.pdf

Attached is Part 1 of the calculation that the staff has requested. Due to the size of the pdf file I have to send it in 3 parts.

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Design Analysis

Ginna Station

Instrument Performance Evaluation and Setpoint Verification

Undervoltage Relays and Voltmeters on 480V Safeguards Buses

Rochester Gas and Electric Corporation
89 East Avenue
Rochester, New York 14649

DA-EE-93-006-08

Revision 2

3/1/02
Effective Date

Prepared by:	Brian F. Flynn Design Engineer	2/14/02 Date
Reviewed by:	[signature] Nuclear Safety & Licensing	2/15/02 Date
Reviewed by:	R W Eliasz Reactor Engineering & Analysis	3/1/2002 Date
Approved by:	[signature] Independent Review Engineer	3/1/2002 Date

TECHNICAL INPUT FORM				
EIN	27/14, 27B/14, 27/16, 27B/16, 27/17, 27B/17, 27/18, 27B/18, 27D/14, 27D/B/14, 27D/16, 27D/B/16, 27D/17, 27D/B/17, 27D/18, 27D/B/18, EI/PD, EI/NN, EI/NI, EI/ND			
KEYWORDS	Setpoint, 480, Uncertainty, Undervoltage, Relay, Trip			
CROSS REF	PR-1.1,PT-9.1.14,PT-9.1.16,PT-9.1.17,PT-9.1.18, SP-0078,SP-1398,SP-1369,SP-1370,SP-1371,SP-2241, SP-2308,SP-2309,SP-2311,SP-2312,SP-2313,SP-2315, SP-2324,SP-2325,SP-3364,SP-1806,SP-1802,SP-3392, SP-3393, SP-1795, R.1, R.11			
PSSL 62	EWR/ OTHER	PROPRIETARY	YES	NO X
COMMENT				
SUPERSEDES	N/A			

REVISION STATUS SHEET

Revision Number	Affected Sections	Description of Revision
0	all	Initial issue
1	all	Incorporates the requirements of the Improved Technical Specifications and accounts for potential transformer inaccuracy in determining relay setpoints. Relay voltage dropout and pickup setpoints were changed
2	all	Total re-write to incorporate procedure EP-3-S-0505 uncertainty methods and to include analysis of 480 V safeguards bus voltmeters.

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1.0 **Purpose:**

1.1 The following safeguards bus degraded voltage relays will be analyzed for relay performance and verification of voltage setpoints and time delay setpoints. These relays are ABB or ITE type 27.

BUS14 EINs	BUS16 EINs	BUS17 EINs	BUS18 EINs
27/14	27/16	27/17	27/18
27B/14	27B/16	27B/17	27B/18

1.2 The following safeguards bus loss-of-voltage relays will be analyzed for relay performance and verification of voltage setpoints and time delay setpoints, and coordination with the type 27 degraded voltage relays. These relays are ABB or ITE type 27N.

BUS14 EINs	BUS16 EINs	BUS17 EINs	BUS18 EINs
27D/14	27D/16	27D/17	27D/18
27D/B/14	27D/B/16	27D/B/17	27D/B/18

1.3 The following safeguards bus voltmeters will be analyzed. These voltmeters are Westinghouse type KA-241

BUS14 EINs	BUS16 EINs	BUS17 EINs	BUS18 EINs
EI/PD	EI/NN	EI/NI	EI/ND

1.4 For all components above:

1.4.1 The existing configuration will be evaluated against documented requirements.

1.4.2 Instrument uncertainties will be determined and relay setpoints will be evaluated, using the methodology of EP-3-S-0505.

2.0 **Conclusion:**

2.1 It has been determined that all Ginna Technical Specification and UFSAR requirements for the type 27 and 27N undervoltage relays have been satisfied by the existing nominal setpoints, which are consistent with this analysis. This is based on the evaluations and results listed below.

2.2 Evaluations are conducted in the following sections of this analysis:

Evaluations	27	27N	KA-241
voltage setpoint documentation	7.2	9.2	11.3
time delay setpoint documentation	8.2	10.2	N/A
voltage setpoint uncertainties	7.3	9.3	11.5
time delay setpoint uncertainties	8.3	10.3	N/A
voltage setpoint evaluations	7.4	9.4	11.6
time delay setpoint evaluations	8.4	10.4	N/A

2.3 Results of the evaluations are tabulated in the following sections of this analysis:

Results of Evaluations	27	27N	KA-241
setpoints	12.1	12.2	12.3
voltage setpoint uncertainties	7.3.9	9.3.9	11.5
time delay setpoint uncertainties	8.3.8	10.3.7	N/A
setpoint evaluations	12.4	12.5	12.6

3.0 Design Inputs:

3.1 Ginna Technical Specifications Setpoints:

3.1.1

Section	TSTAG	Setpoint	Value
SR 3.8.10.1	10001175	SP-0078	420 VAC
SR 3.8.10.1	10001097	"	"
SR 3.8.9.1	10001169	"	"
SR 3.8.9.1	10001093	"	"

3.1.2

Section	TSTAG	Setpoint	Value
SR 3.3.4.2	10000323	SP-2241	2.75 s
		SP-2308	368V
		SP-2309	372.8V
		SP-2311	2.4s ±0.12s
		SP-2312	414V
		SP-2313	419.2V
		SP-2315	1520s

3.1.3

Section	TSTAG	Setpoint	Value
B 3.3.4	10000434	SP-2324	2.75 s
		SP-2325	12.75 s

3.1.4

Section	TSTAG	Setpoint	Value
B3.8.6	10001139	SP-1795	108.6V
B3.8.4	10001127	SP-1795	108.6V
SR3.8.4.2	10001065	SP-1795	108.6V

3.2 COLR Accident Analysis Assumptions Setpoints:

Item	Setpoint	Value
11.3-1	SP-2241	2.75 s

3.3 EOP Setpoints:

EOP Setpoint	CMIS Setpoint	Value	EOP
R.11	SP-2312	414 v	AP-ELEC.2
R.1	SP-0078	420 v	AP-ELEC.1 AP-ELEC.2 AP-ELEC.3 AP-IA.1 AP-RCS.4 E-0 E-1 ES-0.1 ES-1.1 E-3 ES-1.2 ES-1.3 ECA-2.1 ECA-3.1 ECA-3.2 ECA-3.3

3.4 UFSAR Sections Describing safeguards bus undervoltage:

Section	UVTAG
3.1.1.3.5	00009536,00009339
7.3.3.2	00002014
8.3.1.1.4.2	00009553, 00009554
8.3.1.2.7	00002222
8.3.1.2.7.1	00002223
8.3.1.2.7.2	00002224
8.3.1.1.6.6	00009605, 00009606, 00009607, 00009608

3.5 UFSAR Table 3.11-1

3.6 Design Analyses

3.6.1 DA-EE-92-111-01, Diesel Generator A Dynamic Loading Analysis, Revision 1, 9/25/97.

3.6.2 DA-EE-92-112-01, Diesel Generator B Dynamic Loading Analysis, Revision 1, 9/27/97.

3.6.3 DA-EE-96-068-03, Offsite Power Load Flow Study, Revision 1, 9/3/99

3.7 EOP Setpoint Database:
EOP Setpoint R.1, 420 volts (SP-0078)
EOP Setpoint R.11, 414 volts (SP-2312)

4.0 Referenced Documents:

4.1 Procedures

4.1.1 Periodic Test Procedures

Procedure	Title
PT-9.1.14	Undervoltage Protection - 480 Volt Safeguard Bus 14
PT-9.1.16	Undervoltage Protection - 480 Volt Safeguard Bus 16
PT-9.1.17	Undervoltage Protection - 480 Volt Safeguard Bus 17
PT-9.1.18	Undervoltage Protection - 480 Volt Safeguard Bus 18

4.1.2 Protective Relay Procedures

PR-1.1, Protective Relay Calibration 480V undervoltage and Ground Alarm Scheme for Buses 14, 16, 17 and 18

4.1.3 Calibration Procedures

Procedure	Title
CP-501.3	Voltmeter (PD) and Ammeter (PC) Calibration for 480 V Circuit Bus 14 (Safeguard)
CP-501.4	Voltmeter (NI) and Ammeter (NH) Calibration for 480 V Circuit Bus 17 (Safeguard)
CP-501.5	Voltmeter (NN) and Ammeter (NM) Calibration for 480 V Circuit Bus 16 (Safeguard)
CP-501.6	Voltmeter (ND) and Ammeter (NC) Calibration for 480 V Circuit Bus 18 (Safeguard)

4.1.4 Engineering Procedures

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

4.1.5 Laboratory Test Procedures

LTP-2000, Doble F2000 Series Test Instrument Calibrations, Revision 1. (See Attached)

LTP-LS, Laboratory Inspection Services Test procedure for Category II Multifunction Meter.

4.2 Vendor Manuals

4.2.1 Westinghouse Application Data 43-200, Switchboard Instruments, March, 1977 (See attached)

4.2.2 Vendor Manual, Arbiter Model 1040C, Panel Meter Calibrator, dated 1991

4.2.3 Vendor Technical Documents:

VTD	Title
VTD-A0500-4201	Instructions single Phase Voltage Relays, Type 27N High Accuracy Undervoltage Relay.
VTD-A0500-4002	Instructions Single-Phase Voltage Relays, Undervoltage Relays and Overvoltage Relays (Type 27)
VTD-W0120-4769	Westinghouse I.L 43-241M, K-241 Line Switchboard Instruments.

4.3 R.E. Ginna Nuclear Power Plant Data Trending System Database

4.4 Drawings

Drawing	Title
10905-0054,3	480V Bus 14 - Unit 18A PT and UV Relays
10905-0055,3	480V Bus 16 - Unit 11A PT and UV Relays
10905-0056,3	480V Bus 17 - Unit 25A PT and UV Relays
10905-0057,3	480V Bus 18 - Unit 31A PT and UV Relays
11253-1,3	Relay Setting Schedule, Bus 14 & Bus 16
11253-1,4	Relay Setting Schedule, Bus 17 & Bus 18
11300-0416	Main Control Board Locator Number 35R Device Connection Diagram
11300-0425	Main Control Board Locator Number 35R Device Connection Diagram
11300-0430	Main Control Board Locator Number 35R Device Connection Diagram
11300-0435	Main Control Board Locator Number 35R Device Connection Diagram
21946-0054	480V Bus 14 - Unit 18A PT and UV Relays
21946-0055	480V Bus 16 - Unit 11A PT and UV Relays
21946-0056	480V Bus 17 - Unit 25A PT and UV Relays

	21946-0057	480V Bus 18 - Unit 31A PT and UV Relays
	33013-1736,8	Diesel Generator A and B Synch Switch Control Schematic

4.5 Standards

4.5.1 Electrical Metermen's Handbook, 7th edition, Edison Electric Institute. (See attachment 7)

4.5.2 National Electrical Code Handbook, 1996

4.5.3 ISA-RP67.04.02-2000, Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation, Approved January 2000.

4.5.4 ISA-dTR67.04.03, Indication Uncertainties And Their Relationship With Indicated Values, Draft Technical Report (Draft 4, April 1996).

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

5.0 Assumptions:

5.1 It is not necessary to demonstrate coordination between the type 27 inverse time undervoltage relays on Buses 13 and 15 (setpoint 82.0 volts), and the type 27N definite time undervoltage relays on Buses 14 and 16 (setpoint 92.0 volts). Basis: Buses 14 and 16 are designed to trip at a higher voltage than Buses 13 and 15. However, Buses 13 and 15 are not normally fed from buses 14 and 16, and the actual order of these trips is inconsequential.

5.2 The following inaccuracies for KA-241 voltmeters were assumed:

readability= ±.83% full scale
Parallax = Negligible

Basis: There is no vendor data available for readability and parallax. The readability assumption is based on ± 0.5 division for 60 divisions and 600 volts full scale (verified by 1/4/02 walkdown), and is calculated as follows:

$\pm 0.5/60 = \pm 0.83\%$

Parallax is assumed to be negligible because of the Westinghouse "full view" voltmeter design. Walkdown on 1/4/02 verified that 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.

5.3 Assume pressure, radiation, and humidity effects on equipment and cables are negligible. Basis: The following table summarizes the equipment and cable analyzed, its location, the accident environment from UFSAR Table 3.11-1, and the effects caused by the accident environment. All equipment and cable remains in normal environments during accidents, except equipment and cable located in the Auxiliary Building and Cable Tunnel.

Equipment	Locations	Accident Environment	Effects
Voltmeters, Cable	Control Room	0 psig negligible rad 60% humidity	none
Potential Transformers, Cable	Auxiliary Bldg	0.1 psig peak 900 rad total 100% humidity	See below
Potential Transformers, Cable	Screen House	0 psig negligible rad 60% humidity	none
Undervoltage Relays, Cable	Relay Room	0 psig negligible rad 60% humidity	none
Undervoltage Relays, Cable	Screen House	0 psig negligible rad 60% humidity	none
Cable	Cable Tunnel	0.25 psig peak negligible rad 100% humidity	See below
Cable	Underground Duct Bank	0 psig negligible rad 100% humidity	See below
Cable	Battery Rm, Air Handling Rm.	0 psig negligible rad 60% humidity	none

Accident Environment: In the table above, only potential transformers and cable are subject to the accident environments. With the exception of pressure, this accident environment is not present at the initiation of an event, when the undervoltage relays need to operate. Accident effects on potential transformers could affect the voltmeters analyzed in section 11.0. Potential transformers and cable are insensitive to pressure due to the lack of pressure-sensitive components.

100% humidity normal: In the table above, only cables in the underground duct bank to the Screen House are normally subject to 100% humidity. In accordance with assumption 5.8, the possible reduced insulation resistance of cables due to 100% humidity conditions has negligible effects on uncertainty calculations. **Conclusion:** Therefore, pressure, radiation and humidity effects are assumed negligible in this analysis.

5.4 Assume temperature affects are included in the accuracy class of the potential transformer. Basis: The accuracy class of a potential transformer includes operation up to the maximum burden at rated ambient temperature. For example, the undervoltage relay potential transformers are rated for 750 VA @ 30 degrees C, and 500VA @ 55 degrees C (See sections 7.3.5.1 and 9.3.5.1)

5.5 Assume meter drift for the KA-241 voltmeters is 1.0% for a 30 month frequency.
Basis: There is no vendor data available for drift. Indicator drift over a 30 month calibration cycle is assumed to be equal to the reference accuracy of the voltmeter, which is specified in VTD-W0120-4769 to be 1.0% full scale.

5.6 Assume seismic effects are not applicable.
Basis: The Ginna license does not require consideration of a Loss of Coolant Accident concurrent with a seismic event.

5.7 Assume the effects of repeatability, hysteresis and linearity are negligible in the total loop uncertainty calculation. Basis: 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.

5.8 Assume possible reduced insulation resistance of cables due to 100% humidity conditions has negligible effects on uncertainty calculations. Basis: The only potential effect of reduced insulation resistance on uncertainty is to increase the burden on a potential transformer enough to change its accuracy class, and the following calculations show that this is not realistic. The voltmeter potential transformers have the smallest rating for their accuracy class, at 12.5 VA, and are loaded to 7.4 VA per section 11.5. In order to load a voltmeter potential transformer to the limit of the accuracy rating applied in this analysis, the insulation resistance would have to be reduced to $(120\ \text{volts})^2/(12.5\text{-}7.4\ \text{VA}) = 2823$ Ohms. The undervoltage relay potential transformers are rated 75 VA, and are loaded to 1.7 VA per sections 7.3.5 and 9.3.5. In order to load an undervoltage relay potential transformer to the limit of the accuracy rating applied in this analysis, the insulation resistance would have to be reduced to $(120\ \text{volts})^2/(75\text{-}1.7\ \text{VA}) = 184$ Ohms. These low values of insulation resistance are not expected because of the heavy jacketed construction of 600 Volt rated cable tray control cable.

5.9 (deleted)

5.10 Assume that the existing undervoltage setpoints are adequate to prevent spurious undervoltage trip due to minor system disturbances. Basis: The worst-case "minor system disturbance" is the fault, which will clear in a matter of cycles. Since the minimum time delay analytical limit is 1.5 seconds, undervoltage trip will not result from minor system disturbances.

5.11 Assume that diesel generator load sequencing provides the worst-case bus voltages for this analysis. Basis: This will be demonstrated in the sections below by analyzing existing data to determine:

- Bus with lowest voltage during load sequencing (Bus 14)
- Voltage dips for individual motors on Bus 14
- Voltage dips for coincident motor starting on Bus 14

5.11.1 Determine bus with lowest voltage during normal offsite power load sequencing, from analysis DA-EE-96-068-03:

a. Offsite 34.5 KV circuits 751 or 767 can be aligned to feed either safety related 480 volt train. Both of these offsite power circuits have voltage regulators that are designed to maintain the voltages on these circuits even during maximum bus loading conditions. Although the circuits maintain the 34.5 KV voltages, there is a corresponding drop in voltages through downstream transformers and circuits that feed the 480 volt buses. A worst case scenario was analyzed in DA-EE-96-068-03 Case # 121, "0/100 After Voltage Regulator Responds During Large Break LOCA". The corresponding voltages on buses 14 and 16 are listed below, and it is seen that Bus 14 is the worst case. These voltages are lower than the Bus 17 and Bus 18 voltages due to the significantly higher loading on Buses 14 and 16.

Bus 14: (93.76%)(480V)=450.0V
Bus 16: (93.89%)(480V)=450.7V

5.11.2 Determine voltage dips △Vavg for individual motors on Bus 14, based on existing motor testing data.

ESFAS Load	**△Vavg (volts)**	**taccel (cycles)**	**taccel/60 =△t (sec)**
SAFWP1C	474-443=31 V	310-180=130	2.2 sec
CF1A	471-442=29 V	380-180=200	0.3 sec
CP1A	478-464=14 V	246-181=65	1.1 sec
RHRP1A	473-446=27 V	221-179=42	0.7 sec
MAFP1A	470-447=23 V	255-180=75	1.3 sec
ABEF1G	477-465=12 V	N/A(Chart is in seconds, not cycles)	2.75-0.25 =2.5 sec (from chart)
CF1D	478-446=32 V	N/A(Chart is in seconds, not cycles)	4.2-0.2 =4.0 sec (from chart)
CSP1A	474-449=25 V	250-180=70	1.2 sec
SIP1A	473-430=43 V	320-180=140	2.3 sec
SIP1C	473-435=38 V	320-180=140	2.3 sec

5.11.3 Determine voltage dips for coincident motor starting on Bus 14, from analysis DA-EE-92-111-01 and section 5.11.2 above.

DA-EE-92-111-01 reference	Coincident Motor Starts	Total Voltage Dip (From section 5.11.2)
7.5.1.2, Att J1	none	N/A
7.5.2.2, Att J2	none	N/A
7.5.3.2, Att J3	none	N/A
7.5.4.2, Att J4	SIP1C+CSP1A	38+25=63 volts
7.5.5.2, Att J4B	CF1A+CF1D	29+32=61 volts (not a probable combination)
7.5.6.2, Att J5	SIP1C+CSP1A	38+25=63 volts
7.5.7.2, Att J6	CF1D+CSP1A	32+25=57 volts
7.5.8.2, Att J7	none	N/A
7.5.9.2, Att J7B	CF1D+CSP1A	32+25=57volts
7.5.10.2, Att J8	none	
7.5.11.2, Att J9	CF1D+SIP1C+ CSP1A	32+38+25=95 volts (not a probable combination)

5.11.4 Determine the worst case combination of simultaneous motor starts, and demonstrate that the Bus 14 worst case bus voltage during diesel generator load sequencing is lower than it is during normal offsite power load sequencing:

a. Determine the Bus 14 worst case bus voltage during offsite power load sequencing:

From section 5.11.3, the worst case combination of simultaneous motor starts is CF1D and SIP1C and CSP1A, with a total voltage dip of 95 volts. (reference DA-EE-92-111-01 section 7.5.11.2) The Bus 14 worst case bus voltage is determined by subtracting the total voltage dip from the Bus 14 worst case voltage determined in section 5.11.1:

450.0 - 95 = **355 volts**

b. Determine the Bus 14 worst case bus voltage during diesel generator load sequencing:

From section 5.11.3, for the worst case combination of simultaneous motor starts, DA-EE-92-111-01 Attachment J9 is referenced. This attachment (reproduced as Attachment 2 of this analysis) provides the Bus 14 voltage profile during diesel generator load sequencing for this worst case. Attachment 2 shows that the voltage dips to 70% on Bus 14.

70% of 480V = **336 volts**

c. Compare a. and b. above:

The Bus 14 worst case bus voltage during diesel generator load sequencing (b. above) is lower than it is during normal offsite power load sequencing. However, these voltages are unrealistically low because they assume an <u>improbable</u> combination of three simultaneous motor starts.

5.11.5 Determine the worst case <u>probable</u> combination of simultaneous motor starts, and calculate the resulting Bus 14 worst case bus voltage during normal offsite power load sequencing:

From section 5.11.3, the worst case probable combination of simultaneous motor starts is SIP1C and CSP1A, with a total voltage dip of 63 volts. The Bus 14 worst case bus voltage is determined by subtracting the total voltage dip from the Bus 14 worst case voltage determined in section 5.11.1:

450.0 - 63 = **387 volts**

6.0 <u>Computer Codes:</u>

None

NOTE: This analysis is in 5 parts as follows:

Sect	Description	Component
7.0	Voltage Setpoint Analysis	Type 27 Relays
8.0	Time Delay Setpoint Analysis	Type 27 Relays
9.0	Voltage Setpoint Analysis	Type 27N Relays
10.0	Time Delay Setpoint Analysis	Type 27N Relays
11.0	Uncertainty Analysis	Type KA-241 Voltmeter

7.0 <u>Voltage Setpoint Analysis for Type 27 Relays</u>

7.1 Description of Configuration for the Type 27 Relay

7.1.1 The 480-V system is divided into six buses. Each bus is supplied by a separate 4160/480-V station service transformer. The safety related 480-V buses are supplied from the 4160-V buses as follows: buses 14 and 18 from 12A, 16 and 17 from 12B. Non-safety buses are supplied from the 4160-V buses as follows: 13 from 11A, and 15 from 11B. Tie breakers are provided between 480-V buses 14 and 13, buses 16 and 14, buses 16 and 15, and buses 17 and 18. The buses are comprised of Westinghouse load centers using DB type air circuit breakers. Discrete relaying is utilized for overcurrent and undervoltage protection as required. Number 11 Unit Auxiliary Transformer supplies Buses 11A and 11B from the main generator, which supplies all normal plant auxiliary loads. Station Auxiliary Transformers 12A and 12B, which are fed by offsite power, supply Buses 12A and 12B, which supply startup power and normal power to class 1E loads on the 480V safeguards system through four station service transformers.

7.1.2 The degraded voltage undervoltage relays for the 480 volt safeguards buses 14, 16, 17 and 18 are type 27. These relays protect safeguards bus loads from experiencing extended periods of degraded voltage conditions which could damage them. The relay has two adjustable characteristics: dropout (trip) voltage and time delay to dropout. The differential between the operate and reset voltage values is fixed at less than 0.5% (See section 7.4.8a)

7.1.3 The loss of voltage undervoltage relays for the safeguards buses are type 27N. These are evaluated in sections 9.0 and 10.0.

7.1.4 On each safeguards bus, a potential transformer supplies a type 27 relay and a type 27N relay, and a redundant potential transformer supplies a redundant type 27 relay and a redundant type 27N relay.

7.1.5 Each channel contains one loss of voltage relay and one degraded voltage relay. A one-out-of-two logic in both channels will cause the following actions on the associated safeguards bus:

a. trip of the normal feed breaker from offsite power;

b. trip of the bus-tie breaker to the opposite electrical train (if closed);

c. shed of all bus loads except the CS pump, component cooling water pump (if no safety injection signal is present), and safety related motor control centers; and

d. start of the associated diesel generator.

7.2 Evaluation of Configuration Against Documented Requirements for the Type 27 Relay

7.2.1 Analytical Limit (AL) for Type 27 Relays

a. COLR Accident Analysis Assumptions Setpoints includes no analytical limit for the type 27 relays.

b. Ginna Technical Specification SR3.3.4.2 lists the degraded voltage "allowable value" as ≥**414 volts** (CMIS setpoint **SP-2312**). This is actually the safeguards bus degraded voltage minimum analytical limit. At the 120 volt side of the 480/120 potential transformer this is **103.5 volts.**

c. The Safeguards bus degraded voltage maximum analytical limit for the type 27 degraded voltage relay is established in this analysis as **108.0 volts**, and the corresponding time delay minimum analytical limit is established in sections 8.2.1d and 8.2.1e. Basis: The worst-case voltage dips on the safeguards buses will result from diesel generator load sequencing (see assumption 5.11). The combination of the degraded voltage maximum analytical limit and the time delay minimum analytical limit shall ensure that the type 27 relay will not trip during diesel generator load sequencing. The actual value of the degraded voltage maximum analytical limit is selected as a readable voltage on Attachments 2 and 3 which is in or below the range of the voltage dips during diesel generator load sequencing. It is also required to be greater than the loss of voltage analytical limit from sections 9.2.1c and 9.2.1d, and large enough to result in a positive value for the upper margin, which will be calculated in section 7.4.4a. Looking at Attachments 2 and 3, the degraded voltage maximum analytical limit is selected as 90% of 480 volts, or 432 volts bus voltage. The corresponding voltage at the low side of the potential transformer is 432/4 = **108 volts.** The voltage dip that is less than this analytical limit for the largest time interval will be the basis for the time delay minimum analytical limit. (See sections 8.2.1d and 8.2.1e). Therefore, the combination of the degraded voltage maximum analytical limit and the time delay minimum analytical limit ensures that the type 27 relay will not trip during diesel generator load sequencing.

NOTE: Diesel generator (D/G) dynamic loading analyses DA-EE-92-111-01 and DA-EE-92-112-01 each have an attachment J which contains plots of bus voltage profiles. Attachments 2 and 3 are worst-case plots, from Attachment J9 of each analysis. These plots are the most severe voltage profiles in the D/G dynamic analyses, LOOP-LOCA: CS, SI C and 2nd CF coincident start for Bus 14 and Bus 16. The following tables determine that Attachment J9 in each analysis has the worst-case voltage dip time of all the Attachment J plots. Dip times are determined by scaling the plots.
(% division x 4 seconds/division = seconds)

D/G A DA-EE-92-111-01 Attach, Page #	Minimum Voltage Dip (% of 480 Volts)	Worst-Case Dip Time (Seconds) between trip (90%V) and reset (90.5%V)
J1 Page 1	83.97	0.22 div x 4=0.9
J2 Page 1	80.36	0.38 div x 4=1.5
J3 Page 1	75.79	0.31 div x 4=1.2
J4 Page 1	77.70	0.31 div x 4=1.2
J4B Page 1	69.95	0.38 div x 4=1.5
J5 Page 1	77.70	0.31 div x 4=1.2
J6 Page 1	80.32	0.31 div x 4=1.2
J7 Page 1	74.66	0.31 div x 4=1.2
J7B Page 1	79.2	0.41 div x 4=1.6
J8 Page 1	75.87	0.30 div x 4=1.2
J9 Page 1	70.39	0.47 div x 4=1.9 **Worst Case Train A**

D/G B DA-EE-92-112-01 Attach, Page #	Minimum Voltage Dip (% of 480 Volts)	Worst-Case Dip Time (Seconds) between trip (90%V) and reset (90.5%V)
J1 Page 1	81.12	0.13 div x 4=0.5
J2 Page 1	76.20	0.22 div x 4=0.9
J3 Page 1	72.52	0.25 div x 4=1.0
J4 Page 1	72.90	0.25 div x 4=1.0
J4B Page 1	66.28	0.31 div x 4=1.2
J5 Page 1	75.31	0.22 div x 4=0.9
J6 Page 1	76.49	0.28 div x 4=1.1
J7 Page 1	76.14	0.37 div x 4=1.5
J8 Page 1	72.52	0.27 div x 4=1.1
J9 Page 1	69.71	0.42 div x 4=1.7 **Worst Case Train B**

7.2.2 Nominal Setpoint and Calibration Tolerance for Type 27 Relays

a. Calibration procedure PR-1.1 dropout test nominal setpoint and as-left tolerance: 105.2 volt nominal setpoint, tolerance of 105.2 to 105.7 volts. This is **105.2 volts** (+0.5,-0.0 volts). At the high side of the 480/120 potential transformer this is 420.8 (+2.0,-0.0 volts) or 420.8 to 422.8 volts.

b. Ginna Technical Specification SR3.3.4.2 lists the degraded voltage trip setpoint as ≥**419.2** volts (CMIS setpoint **SP-2313**). This Technical Specification requirement is met by the 420.8 volt setpoint discussed in (a.) above.

c. Drawing 11253-1 sheets 3 and 4 shows that these relays have a **105.2 volt** dropout and time lever setting of 6.

7.2.3 Allowable Value (AVt) for Type 27 Relays

a. Calibration procedure PR-1.1 dropout test as-found tolerance: ± 1.0 volt of previous As-Left Test.

b. Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17, PT-9.1.18 dropout test as-found acceptance criteria: **104.2 to 106.6 volts** (CMIS setpoint **SP-1368**).

7.2.4 Reset Nominal Setpoint (NSr) for Type 27 Relays

a. Calibration procedure PR-1.1 pickup test as-left pickup voltage nominal value: Not specified because this setpoint is not adjustable.

b. Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17, PT-9.1.18 pickup test as-found pickup voltage nominal value: Not specified, because this setpoint is not adjustable.

7.2.5 Reset Calibration Tolerance for Type 27 Relays

a. Calibration procedure PR-1.1 pickup test as-left pickup voltage tolerance: Not specified because this setpoint is not adjustable.

7.2.6 Reset As-Found Tolerance for Type 27 Relays

a. Calibration procedure PR-1.1 pickup test as-found pickup voltage tolerance: Not specified because this setpoint is not adjustable.

b. The Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17 and PT-9.1.18 pickup test as-found acceptance criteria: **104.2 to 107.6** volts.

7.2.7 Identify Performance Related Design Bases Associated with the Type 27 relays:

SC-3 — Safety Classification (SR/SS/NS) as documented in the Ginna Q-List.

NO — NUREG 0737/RG 1.97 as documented in Table 7.5-1 of the Ginna UFSAR.

NO — EQ (Per the 10CFR 50.49 list)

NS — Seismic Category (Seismic Class I/ Structural Integrity Only/ NS).

YES — Ginna Technical Specifications

YES — UFSAR

YES — EOP Setpoint
The minimum analytical limit of **414 volts** (CMIS setpoint **SP-2312**) corresponds with EOP setpoint **R.11**. See section 11.0 for an analysis of the **R.11** setpoint.

7.3 Evaluation of Instrument Uncertainties

NOTE: This section documents the components of Total Loop Uncertainty (TLU):

7.3.1 Relay Uncertainty (Ru) for Type 27 Relays

VTD-A0500-4002 does not specify a relay accuracy at constant temperature and constant control voltage. It would be reasonable to assume that the relay accuracy is comprised entirely of the Temperature Uncertainty and Control Voltage Uncertainties listed below. However, for conservatism, a relay accuracy of half the Temperature Uncertainty will be applied in this analysis. (Compare the type 27N relay, sections 9.3.1, 9.3.2) Therefore, the relay uncertainty (accuracy) will be considered half of the Temperature Uncertainty from section 7.3.2, or **± 0.21%** of a 120 volt span.

7.3.2 Temperature Uncertainty (Tu) for Type 27 Relays

VTD-A0500-4002 lists 0.5 volts variation in operating voltage over the temperature range 20-40 deg. C. This is **0.42%** of a 120 volt span. The relay temperature uncertainty is therefore **± 0.42%** of a 120 volt span.

7.3.3 Control Voltage Uncertainty (CVu) for Type 27 Relays

VTD-A0500-4002 lists 0.2 volts variation in operating voltage for a 10 volt variation in control voltage. Control voltage is normally **133.5 ± 0.5 volts** (CMIS Setpoint **SP-1806**), and equalizing voltage is **139.8 volts** (CMIS Setpoint **SP-1802**). The total variation in control voltage is therefore 139.8-133=6.8V, so the corresponding variation in operating voltage is (6.8/10)(0.2 volts)=0.136 volts. A variation of 0.136 volts is **0.11%** of a 120 volt span. The relay control voltage uncertainty is therefore **± 0.11%** of a 120 volt span.

NOTE: The vital battery minimum voltage of **108.6 volts** (CMIS Setpoint **SP-1795**) is not applicable because it assumes a long term loss of AC power.

7.3.4 Drift Uncertainty (Du) for Type 27 Relays

An IHPA computer run dated 12/14/01 (See Attachment 6 page entitled "Ks Results Summary") calculated a drift of **± 0.83%** of a 120 volt span for the Type 27 relay. The drift uncertainty is therefore **± 0.83%** of a 120 volt span.

7.3.5 Potential Transformer Uncertainty (PTu) for Type 27 Relays

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

(Westinghouse 480/120V 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 @ 30 degrees C, 500VA @ 55 degrees C.

7.3.5.2 Attachment 4 (Westinghouse bulletin 44-204) shows that the type EMPL potential transformer has an accuracy rating of **± 0.3%** for burdens up to 75 VA and 85% pf (for W, X, and Y burdens).

Based on drawings 10905-0054,3, 10905-0055,3, 10905-0056,3 and 10905-0057,3 The total burden on a PT consists of a type 27 and a type 27N relay. Based on Attachment 5 pages 2 and 3, the burdens for these relays are 1.2 VA and 0.5 VA respectively, for a total burden of 1.7 VA.

The total burden of 1.7 VA is less than 75 VA. Therefore the potential transformer uncertainty is **± 0.3%** of a 120 volt span.

7.3.5.3 Using other references, the same potential transformer accuracy is shown: The nameplate references Westinghouse I.L. 44-060-2 line 7. Attachment 6 Table 1 Line 7 shows **± 0.3%** accuracy for W, X, and Y burdens. The Electrical Metermen's Handbook (Attachment 5 page 1 Table 11-13) shows that the highest of these burdens (Y) corresponds to 75VA.

7.3.6 M&TE Uncertainty (MTEu) for Type 27 Relays

a. A review of work orders determined that Doble F2000 series M&TE was used to calibrate the relays. Per the Doble Operating Manual, Doble F2000 series M&TE has an AC voltage output accurate to ± 0.25% of setting typical, and ± 0.5% of setting maximum. Laboratory Test Procedure LTP-2000 Table 5.2 shows that the Doble 150 volt range has the following calibration tolerances greater than and less than the setpoint of 90.0 volts:

Value	Minimum	Maximum	Tolerance
75.0 volts	74.62 volts	75.38 volts	± 0.51%
150.0 volts	149.2 volts	150.8 volts	± 0.53%

b. Since the tolerance of 0.53% is greater than the 0.25% accuracy, the 0.53% tolerance will be applied in this analysis. The M&TE uncertainty for a 120 volt span is therefore **± 0.53%** of a 120 volt span.

7.3.7 Calibration Uncertainty (Cu) for Type 27 Relays

Section 7.2.2a shows the relay setting as 105.2 volts with a calibration tolerance of (+0.5,-0.0 volts) The 0.5 volts is 0.42% of 120 volts. The Calibration Uncertainty is therefore a bias of **+ 0.42%** of a 120 volt span.

NOTE: The net positive calibration tolerance is a biasing effect similar to raising the nominal setpoint of the relay, and will be considered a positive bias. This positive bias has the effect of decreasing the margin between the nominal setpoint and the maximum calculated setpoint, and increasing the margin between the nominal setpoint and the minimum calculated setpoint.

7.3.8 Voltage Drop Uncertainty (VDu) for Type 27 Relays

A review of drawings 21946-0054, 0055, 0056, and 0057 and the circuit schedules shown on these drawings shows that circuit L683 is the worst case. It is 520 feet long, #14 AWG wire run in conduit.

The total burden on a PT is 1.7 VA.
(Based on sections 7.3.5.2, 9.3.5.2)
I = (1.7 VA burden)/(120 V) = 0.014 amps
R = Impedance of 1040' of #14AWG wire routed in steel conduit: $1.04(3.1^2 + 0.073^2)^{1/2} = 3.22$ Ohms
(Impedance is from NEC Handbook Chapter 9 Table 9)
Voltage drop = IR = 0.045 volts
(0.04% of a 120 volt span)

The voltage drop uncertainty is therefore a bias of **+0.04%** of a 120 volt span.

NOTE: Voltage drop to the relay is a biasing effect similar to raising the nominal setpoint of the relay, and will be considered a positive bias. This positive bias has the effect of decreasing the margin between the the nominal setpoint and the maximum calculated setpoint, and increasing the margin between the nominal setpoint and the minimum calculated setpoint.

7.3.9 Summary of Uncertainties for Type 27 Relays

Parameter	Uncertainty	Section
Relay Uncertainty (Ru)	± 0.21%	7.3.1
Temperature Uncertainty (Tu)	± 0.42%	7.3.2
Control Voltage Uncertainty (CVu)	± 0.11%	7.3.3
Drift Uncertainty (Du)	± 0.83%	7.3.4
P.T. Uncertainty (PTu)	± 0.3%	7.3.5
M&TE Uncertainty (MTEu)	± 0.53%	7.3.6
Calibration Uncertainty (Cu)	+ 0.42% bias	7.3.7
Voltage Drop Uncertainty (VDu)	+ 0.04% bias	7.3.8

7.4 Setpoint Evaluations

7.4.1 Determining the Upper TLU for Type 27 Relays

The Upper Total Loop Uncertainty TLU_{UPPER} will be subtracted from the Maximum Analytical Limit to determine the Maximum Calculated Setpoint. The uncertainties of the relays and test equipment listed in the table above are assumed to be independent, random, linear, and approximately normally distributed; with the exception of the biased uncertainties. The Upper Total Loop Uncertainty TLU_{UPPER} is calculated by adding the biased uncertainties to the square root of the sum of the squares of the random uncertainties (See note below, and see section 7.3.9 for uncertainty values).

$$TLU_{UPPER} = (Ru^2+Tu^2+CVu^{2+}Du^2+PTu^2+MTEu^2)^{1/2} + Cu + VDu$$

$$TLU_{UPPER} = 1.14\% + 0.42\% + 0.04\% = 1.60\%$$

TLU_{UPPER} = 0.016 x 120 = **1.9 volts**

NOTE: The sum of the biased uncertainties Cu and VDu is positive, which increases the magnitude of TLU_{UPPER}, lessens the Maximum Calculated Setpoint, and reduces the Upper Margin to the Nominal Setpoint.

7.4.2 Determining the Lower TLU for Type 27 Relays

The Lower Total Loop Uncertainty TLU_{LOWER} will be added to the Minimum Analytical Limit to determine the Minimum Calculated Setpoint. The uncertainties of the relays and test equipment listed in the table above are assumed to be independent, random, linear, and approximately normally distributed; with the exception of the biased uncertainties. The Lower Total Loop Uncertainty TLU_{LOWER} could be calculated by subtracting the net positive biased uncertainties from the square root of the sum of the squares of the random uncertainties. However, in this analysis, the net positive uncertainties will be neglected for conservatism. (See note below, and see section 7.3.9 for uncertainty values).

$$TLU_{LOWER} = (Ru^2+Tu^2+CVu^{2+}Du^2+PTu^2+MTEu^2)^{1/2} = 1.14\%$$

TLU_{LOWER} = 0.0114 x 120 = **1.4 volts**

NOTE: Subtracting the net positive biased uncertainties Cu and VDu from TLU_{LOWER} would decrease the magnitude of TLU_{LOWER}, decrease the Minimum Calculated Setpoint, and increase the Lower Margin to the Nominal Setpoint. However, the net positive biased uncertainties are neglected when calculating TLU_{LOWER} so that the Lower Margin between the Minimum Calculated Setpoint and the nominal setpoint will remain conservatively small.

7.4.3 Determining the Maximum and Minimum Calculated Setpoints for Type 27 Relays:

a. To ensure that undervoltage trip actually occurs at or less than the Maximum Analytical Limit AL_{MAX}, the Maximum Calculated Setpoint CS_{MAX} is required to be less than AL_{MAX} by the magnitude of the upper Total Loop Uncertainty TLU_{UPPER}. AL_{MAX} is established in section 7.2.1c.

$CS_{MAX} = AL_{MAX} - TLU_{UPPER}$

CS_{MAX} = 108.0 volts - 1.9 volts = **106.1 volts**

(106.1 x 4 = 424.4 volts at the bus)

NOTE: The net positive sum of the biased uncertainties has been included in TLU_{UPPER}, so the magnitude of CS_{MAX} has been decreased by this amount. (See section 7.4.1)

b. To ensure that undervoltage trip actually occurs at or greater than the Minimum Analytical Limit AL_{MIN}, the Minimum Calculated Setpoint CS_{MIN} is required to be greater than AL_{MIN} by the magnitude of the Lower Total Loop Uncertainty TLU_{LOWER}. AL_{MIN} is established in section 7.2.1.b.

$CS_{MIN} = AL_{MIN} + TLU_{LOWER}$

CS_{MIN} = 103.5 volts + 1.4 volts = **104.9 volts**

(104.9 x 4 = 419.6 volts at the bus)

NOTE: The biased uncertainties have been neglected in TLU_{LOWER}, so the magnitude of CS_{MIN} is not affected by the biased uncertainties. (See section 7.4.2)

7.4.4 Determining Upper and Lower Margins, using the Nominal Setpoint from Section 7.2.2a for Type 27 Relays:

a. Upper Margin = CS_{MAX} - NS

Upper Margin = 106.1 - 105.2 = **0.9 Volts**

NOTE: CS_{MAX} has been decreased by the net positive sum of the biased uncertainties (See section 7.4.3a). Therefore, the upper margin has been decreased by the same amount.

b. Lower Margin = NS - CS_{MIN}

Lower Margin = 105.2 - 104.9 = **0.3 Volts**

NOTE: The lower margin is not affected by the biased uncertainties because the CS_{MIN} is not affected by the biased uncertainties. (See section 7.4.3b)

7.4.5 Determining the Upper and Lower Channel Operability Test Values for Type 27 Relays:
(See section 7.3.9 for uncertainty values)

NOTE: The Upper COT is applied to calculate the Maximum Allowable Value. The Lower COT is applied to calculate the Minimum Allowable Value. PTu and VDu are process uncertainties that are not applicable to the COT calculation. M&TEu is also not applicable.

a. $COT_{UPPER} = (Ru^2 + Tu^2 + CVu^2 + Du^2)^{½} + Cu$

COT_{UPPER} = 0.96% + 0.42% = 1.38%

COT_{UPPER} = .0138 x 120 = **1.7 volts**

b. $COT_{LOWER} = (Ru^2 + Tu^2 + CVu^2 + Du^2)^{½}$ = 0.96%

COT_{LOWER} = .0096 x 120 = **1.2 volts**

7.4.6 Determining the Total Instrument Uncertainty for Type 27 Relays:
(See section 7.3.9 for uncertainty values)

NOTE: PTu and VDu are process uncertainties that are not applicable to the TIU calculation.

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

TIU = ±1.10% +0.42% = **(+1.52,-0.68)%**

TIU x 120 = ±1.32 +0.50 = **(+1.82,-0.82)volts**

7.4.7 Determining the Maximum and Minimum Allowable Values for Type 27 Relays:

a. $AV_{MAX} = CS_{MAX} + COT_{UPPER}$

AV_{MAX} = 106.1 + 1.7 = **107.8 volts**

(107.8 x 4 = 431.2 volts at the bus)

b. $AV_{MIN} = CS_{MIN} - COT_{LOWER}$

AV_{MIN} = 104.9 - 1.2 = **103.7 volts**

(103.7 x 4 = 414.8 volts at the bus)

c. Compare calibration procedure PR-1.1 dropout test as-found tolerance: ± 1.0 volt of previous As-Left Test.(see section 7.2.3.a) The as-left tolerance is 105.2 to 105.7 volts (section 7.2.2.a). The as-found tolerance is therefore ± 1.0 volt from the As-Left tolerance, or 104.2 to 106.7 volts. This is acceptable because it is within the range of allowable values AV_{MIN} to AV_{MAX} in (b) and (a) above.

d. Compare Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17, PT-9.1.18 dropout test as-found acceptance criteria: 104.2 to 106.6 volts (see section 7.2.3.b). This is acceptable because it is within the range of allowable values AV_{MIN} to AV_{MAX} in (b) and (a) above.

7.4.8 Determining the Reset Nominal Setpoint (NSr) for Type 27 Relays:

a. VTD-A0500-4002 states that "on these models there is no adjustment for the differential between the operate and reset voltage values". It also states that the differential between operate and reset voltages is less than 0.5%. For a Nominal Setpoint voltage of 105.2 volts (from section 7.2.2), this is (0.5%)(105.2 volts) = 0.53 volts.

NSr = NS + 0.53

NSr = 105.2 + 0.53 = **105.7 volts**

b. Compare calibration procedure PR-1.1 pickup test as-left pickup voltage nominal value: Not specified because this setpoint is not adjustable. (See section 7.2.4a)

7.4.9 Determining the Reset Calibration Tolerance (CTr) for Type 27 Relays:

a. The Calibration Tolerance from section 7.2.2a will be applied to the reset Nominal Setpoint from section 7.4.8a to determine a reset calibration tolerance CTr:

CTr = CT + NSr

CTr = (+0.5,-0.0) + 105.7 = **105.7 to 106.2 volts**

NOTE: From section 7.2.2a the dropout test as-left calibration tolerance is 105.2 to 105.7 volts. Therefore, there is no overlap between dropout and reset calibration tolerances.

b. Compare calibration procedure PR-1.1 pickup test as-left pickup voltage tolerance: Not specified because this setpoint is not adjustable. (see section 7.2.5a)

7.4.10 Determining the Reset As-Found Tolerance (AFTr) for Type 27 Relays:

a. Based on section 7.4.8a, the differential between the operate and reset voltage values will not exceed 0.5%. The Reset As-Found Tolerance will be determined from the Allowable Values in section 7.4.7 as follows: (The maximum tolerance is 0.5% greater than the maximum allowable value; the minimum tolerance is 0.0% greater than the minimum allowable value.)

$AFTr_{MAX} = AV_{MAX}$ (1.005)

$AFTr_{MAX}$ = 107.8 (1.005) = **108.3 volts**

$AFTr_{MIN} = AV_{MIN}$ (1.000)

$AFTr_{MIN}$ = 103.7 (1.000) = **103.7 volts**

b. Compare calibration procedure PR-1.1 pickup test as-found pickup voltage tolerance: Not specified because this setpoint is not adjustable. (See section 7.2.6a)

c. Compare Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17, and PT-9.1.18 pickup test as-found acceptance criteria: 104.2 to 107.6 volts (see section 7.2.6.b). This range is acceptable because it is within the As-Found tolerance range specified in a. above.

8.0 <u>Time Delay Setpoint Analysis for Type 27 Relays</u>

8.1 Description of the Type 27 Relay Time Delay

8.1.1 The Type 27 relays exhibit an inverse operating characteristic, i.e. the less the bus voltage, the faster the operating time. The relays have selectable inverse time curves as shown in VTD-A0500-4002. Per procedure PR-1.1, and drawing 11253-1 sheets 3 and 4, the relays are set at their maximum time dial setting of 6. This gives the longest possible time delays for this relay type.

8.2 Evaluation of the Existing Type 27 Relay Time Delay Against Documented Requirements

8.2.1 Time Delay Analytical Limit (ALt)

a. COLR Accident Analysis Assumptions Setpoints includes no time delay analytical limit for the type 27 relay.

b. NRC SER (CMIS record id# RG003135.00C) Figure 1 and section 3.3.1(1) show the time delay maximum analytical limit as **1600 seconds** at 414 volts bus voltage. (At the low side of the potential transformer, 414/4=103.5 volts) (CMIS setpoint **SP-3392**)

NOTE: The **1600 second** maximum analytical limit at 103.5 volts, **SP-3392**, and the **1520 second** maximum allowable value at 103.5 volts **(SP-2315)** may be conservatively applied to higher voltage testpoints, such as the 104.2 volt test point. This is justified as follows: The inverse time characteristic curve for the Type 27 relay creates a fixed relationship between the time delay at higher voltages and the time delay at 103.5 volts: The relay time delay decreases as operating voltage decreases. The time delay at the 103.5 volt test point will be less than the time delay at higher voltages. Therefore, applying the 1600 second maximum analytical limit at higher voltages or applying the 1520 second maximum allowable value at higher voltages means that less than the maximum analytical limit is being applied at 103.5 volts, where this analytical limit was established.

c. NRC SER (CMIS record id# RG003135.00C) Figure 1 shows the time delay maximum analytical limit as **500 seconds** (CMIS Setpoint **SP-3393**) at 368 volts bus voltage. (At the low side of the potential transformer, 368/4=92.0 volts)(CMIS setpoint **SP-3393**)

d. The worst-case voltage dips on the safeguards buses result from diesel generator load sequencing (See assumption 5.11). The time delay minimum analytical limit will be established as the maximum time that voltage dip could be between the degraded voltage maximum analytical limit (432 volts, see section 7.2.1c) and a relay reset value that is 0.5% higher than this (2.2 volts). The combination of the degraded voltage maximum analytical limit and the time delay minimum analytical limit will ensure that the type 27 relay will not trip during diesel generator load sequencing.

e. Although the section 7.2.1c tables shows that 1.9 seconds is the maximum voltage dip time for diesel generator load sequencing, this is not the worst case because offsite power is not as responsive as the voltage regulation of the diesel generators. As a result, the lower voltages result in longer motor acceleration times when fed from offsite power. In accordance with design analysis DA-EE-92-111-01, motor acceleration times can approach up to 5 seconds during reduced voltage conditions. The containment recirculation fans are the worst case and approach 5 seconds. During SI sequencing motors are started at 5 second intervals. A conservative worst case scenario assuming the SI sequencer timer relay drifts and degraded voltages could result in a Service Water motor, two Containment Recirculation Fans and an Auxiliary Feedwater motor all starting sequentially and maintaining voltages below the degraded voltages setpoints during the starting of these four motors. In design analysis DA-EE-92-111-01, it is demonstrated that the maximum acceleration times for the service water motors are less than 1.5 seconds and the auxiliary feedwater pumps are less than 2 seconds, even at voltage as low as 352 volts (80% of 440 VAC). Therefore, the maximum expected low voltages for starting these 4 motors sequentially is 13.5 seconds (1.5 sec + 5 sec + 5 sec + 2 sec). However for conservatism a minimal analytical limit of 20 seconds at 432 volts will be utilized. The time delay minimum analytical limit is therefore **20 seconds** at 432 volts. (At the low side of the potential transformer, 432/4=108 volts)

NOTE: The **20 second** minimum analytical limit at 108.0 volts may be conservatively applied at lower voltage test points, such as the 92 volt and 104.2 volt test points. This is justified as follows: The inverse time characteristic curve for the Type 27 relay creates fixed relationships between the time delay at 108.0 volts and the time delays at lower voltages: The relay time delay increases as operating voltage increases. The time delay at the 108.0 volt analytical limit will be greater than time delays at lower voltages. Therefore, applying the 20 second minimum analytical limit at lower voltage test points means that more than the minimum analytical limit is being applied at 108.0 volts, where this analytical limit was established.

8.2.2 Time Delay Allowable Value (AVt)

a. Ginna Technical Specification SR3.3.4.2 lists the degraded voltage time delay allowable value as **1520 seconds** at 414 volts bus voltage (At the low side of the potential transformer, 414/4=103.5 volts)(CMIS setpoint **SP-2315**). 1520 seconds is the 1600 second Analytical Limit minus a 5% tolerance for protective relaying actuation. The source document for this setpoint is an NRC SER (CMIS record id# RG003135.00C) which states that the 5% tolerance band defines the maximum allowable time delay before protective relaying actuation is initiated, and that this tolerance band was determined by all the accuracies of the relay test instrumentation.

b. Based on Figure 1 of the NRC SER (CMIS record id# RG003135.00C), the allowable value at 368 volts is equal to the **500 second** analytical limit (CMIS setpoint **SP-3393**) minus the 5% tolerance band, or **475 seconds** at 368 volts. (At the low side of the potential transformer, 368/4=92.0 volts)

c. Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17, PT-9.1.18 dropout time test as-found acceptance criteria: **35 to 45 seconds** at 92 volts (CMIS setpoint **SP-1369**).

d. Ginna Technical Specification SR3.3.4.2 lists the degraded voltage time delay setpoint as ≤**1520 seconds** at 104.8 volts (419.2 volts bus voltage) (CMIS setpoint **SP-2315**).

e. Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17, PT-9.1.18 dropout time test as-found acceptance criteria: **<1520 seconds** at 104.2 volts (CMIS setpoint **SP-2315**). However, it is recommended that the following administrative criteria be added: 45 to 125 seconds. See section 8.4.9 for basis.

f. Calibration procedure PR-1.1 dropout time test as-found tolerance: 35.0 to 45.0 seconds at 92 volts. This is 40.0 ± 5 seconds at 92 volts.

g. Calibration procedure PR-1.1 dropout time test as-left acceptance criteria: 0 to 300 seconds at 104.2 volts. However, it is recommended that this range be changed to a range of 45 to 125 seconds. See section 8.4.10 for basis.

8.2.3 Time Delay Nominal Setpoint and Calibration Tolerance

a. Calibration procedure PR-1.1 dropout time test nominal setpoint and as-left tolerance: 40 seconds setpoint at 92 volts, tolerance 39.0 to 41.0 seconds at 92 volts. This is **40.0 ± 1 second** @ 92 volts (CMIS setpoint **SP-3364**).

NOTE: The relay is calibrated at 92 volts (a. above). However, the actual time delay is tested at 92 volts (See section 8.2.2c) and 104.2 volts (See section 8.2.2e).

b. The nominal time delay setpoint at 104.2 volts is 80 seconds ±14.4 seconds. See section 8.3.4.d.

NOTE: The nominal trip setpoint is 105.2 volts (See section 7.2.2a) The 104.2 volt test point is the lowest acceptable trip setpoint value.

c. Drawing 11253-1 sheets 3 and 4 shows that these relays have a **40 second** dropout and time lever setting of 6.

8.3 Evaluation of Time Delay Instrument Uncertainties for Type 27 Relay

NOTE: A 150 second span is applied below. Basis: A review of relay test data from 1991 to 2001 showed that this time delay never exceeded 94.3 seconds at 104.2 volts. (see section 8.3.4) A 125 second upper limit for as-left and as-found acceptance values is recommended in sections 8.2.2e and 8.2.2g. The span is conservatively set at 150 seconds, which is larger than the time delay range that the relay is expected to be capable of at 104.2 volts.

8.3.1 Relay Time Delay Uncertainty (Rut)

VTD-A0500-4002 states that "by using the calibration procedures given later in this book, the relay may be set precisely to the desired value of operating voltage and delay with excellent repeatability". Since VTD-A0500-4002 does not specify a delay time accuracy at constant temperature and constant control voltage, it will be conservatively assumed the same as the relay uncertainty from section 7.3.1. Therefore, the time delay uncertainty is **± 0.21%** of a 150 second span.

8.3.2 Time Delay Temperature Uncertainty (Tut)

Since VTD-A0500-4002 does not specify a delay time accuracy for variations in temperature, it will be conservatively assumed the same as the Temperature Uncertainty from section 7.3.2. Therefore the time delay temperature uncertainty is **± 0.42%** of a 150 second span.

8.3.3 Time Delay Control Voltage Uncertainty (CVut)

Since VTD-A0500-4002 does not specify a delay time accuracy for variations in control voltage, it will be conservatively assumed the same as the Control Voltage Uncertainty from section 7.3.3. Therefore the time delay control voltage uncertainty is **± 0.11%** of a 150 second span.

8.3.4 Time Delay Drift Uncertainty (Dut)

a. Drift uncertainties will be calculated for the 104.2 volt test point and the 92 volt test point. Conservatively high drift uncertainties will be estimated in this analysis due to the large margins between the analytical limits (see section 8.2.1) and the nominal setpoints (see section 8.2.3). The drift uncertainty will be estimated as the worst case total drift for any Type 27 relay over the 5 year interval from January 1997 to December 2001.

b. 104.2 volt test point: A review of relay test data from 1/97 to 12/01 shows the following actual data:

Relay EIN	Actual Minimum	Actual Maximum	Range (seconds)
27/14	70.14	88.5	79.3 ±9.2
27/16	74.80	91.0	82.9 ±8.1
27/17	78.83	94.3	86.6 ±7.7
27/18	73.65	92.36	**83.0 ±9.4 Worst Case**
27B/14	73.74	88.0	80.9 ±7.1
27B/16	76.82	87.1	82.0 ±5.1
27B/17	73.56	80.9	77.2 ±3.67
27B/18	71.00	81.8	76.4 ±5.4

c. In the above actual test data, the worst case 104.2 volt time delay range over 5 years is ± 9.4 seconds. The time delay drift uncertainty is therefore conservatively estimated as 9.4 seconds. 9.4 seconds is 6.3% of a 150 second span. Therefore the 104.2 volt time delay Drift uncertainty is **± 6.3%** of a 150 second span.

d. Also based on the above test data, the nominal setpoint at 104.2 volts is estimated as 80 seconds

e. 92 volt test point: A review of relay test data from 1/97 to 12/01 shows the following actual data:

Relay EIN	Actual Minimum	Actual Maximum	Range (Seconds)
27/14	40.8	42.12	41.5 ±0.7
27/16	40.0	42.45	41.2 ±1.3
27/17	41.39	43.8	**42.6 ±1.2 Worst Case**
27/18	41.9	43.6	42.8 ±0.9
27B/14	41.0	42.7	41.9 ±0.9
27B/16	41.23	42.4	41.8 ±0.6
27B/17	41.6	43.66	42.6 ±1.03
27B/18	42.0	44.2	43.1 ±1.1

f. In the above actual test data, the worst case 92 volt time delay range over 5 years is ± 1.2 seconds. The time delay drift uncertainty is therefore conservatively estimated as 1.2 seconds. 1.2 seconds is 0.8% of a 150 second span. Therefore the 92 volt time delay Drift uncertainty is **± 0.8%** of a 150 second span.

8.3.5 Time Delay Potential Transformer Uncertainty (PTut)

From section 8.2.3.a, the nominal time delay at 92 volts is **40 seconds (SP-3364)**. For a 150 second span, a conservatively high average change in time delay for a given change in operating voltage is determined as follows: (150-40 seconds)/(104.2-92 volts)=9.0 sec/volt. For a potential transformer accuracy of ±0.3% and a span of 120 volts, this results in a time delay uncertainty of (9.0 seconds/volt)(0.3%)(120 volts)=±3.2 seconds. 3.2 seconds is ±2.1% of a 150 second span. Therefore the time delay potential transformer uncertainty is **± 2.1%** of a 150 second span.

8.3.6 Time Delay M&TE Uncertainty (MTEut)

Per Attachment 5 pages 4-6, the Dranetz 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. For a 150 second span, measurement accuracy is therefore ±(0.003%*150 sec + .01 sec) = ±0.015 second. This is equal to **± 0.015%** of a 150 second span. Therefore the time delay M&TE uncertainty is **± 0.015%** of a 150 second span.

8.3.7 Time Delay Calibration Uncertainty (Cut)

Section 8.2.3a shows the relay setting as 40 seconds with a calibration tolerance of (±1 second). This is **± 2.5%** of 40 seconds. Therefore the time delay calibration uncertainty is **± 2.5%** of a 150 second span.

8.3.8 Summary of Time Delay Uncertainties

Parameter	Uncertainty	Section
Relay Uncertainty (Rut)	± 0.21%	8.3.1
Temperature Uncertainty (Tut)	± 0.42%	8.3.2
Control Voltage Uncertainty (CVut)	± 0.11%	8.3.3
Drift Uncertainty (Dut)	± 6.3% @104.2V ± 0.8% @92V	8.3.4c 8.3.4f
P.T. Uncertainty (PTut)	± 2.1%	8.3.5
M&TE Uncertainty (MTEut)	± 0.015%	8.3.6
Calibration Uncertainty (Cut)	± 2.5%	8.3.7

8.4 Setpoint Evaluation for Type 27 Relay Time Delay

8.4.1 In lieu of performing a formal uncertainty analysis, it will be demonstrated that the actual relay time delays at the 92 volt and 104.2 volt test points are between the analytical limits by margins that are larger than the total uncertainty.

8.4.2 The uncertainties listed in section 8.3.8 above were calculated for a 100 second span, and therefore may be conservatively applied to the time delays at both the 92 volt test point with a nominal 40 second delay and the 104.2 volt test point with a nominal 80 second time delay).

8.4.3 Total Loop Uncertainties (TLUt) will be calculated for the 104.2 volt test point and the 92 volt test point. The uncertainties of the relays and test equipment listed in the table above are assumed to be independent, random, linear, and approximately normally distributed. The Total Loop Uncertainty (TLUt) is therefore calculated by the square root of the sum of the squares: (See section 8.3.8 for uncertainty values:

$TLUt_{104.2}=\pm(Rut^2+Tut^{2+}CVut^2+Dut^2+PTut^2+MTEut^2+Cut^2)^{½}$ = $\pm$**7.11**%

$TLUt_{104.2}$ = $\pm$ 0.0711 x 150 seconds = **$\pm$ 10.7 seconds**

$TLUt_{92}=\pm(Rut^2+Tut^{2+}CVut^2+Dut^2+PTut^2+MTEut^2+Cut^2)^{½}$ = $\pm$**3.40**%

$TLUt_{92}$ = $\pm$ 0.0340 x 150 seconds = **$\pm$ 5.1 seconds**

8.4.4 Determining Maximum and Minimum Time Delay Calculated Setpoints at 104.2 Volts, and Acceptability of the 80 Second Test Point at 104.2 Volts (low side of PT):

a. To ensure that undervoltage trip actually occurs at or less than the Maximum Analytical Limit ALt_{MAX}, the Maximum Calculated Setpoint CSt_{MAX} is required to be less than the ALt_{MAX} by the magnitude of the Total Loop Uncertainty TLUt. ALt_{MAX} is established in section 8.2.1b as 1600 seconds.

$CSt_{MAX} = ALt_{MAX} - TLUt$

CSt_{MAX} = 1600 - 10.7 seconds = **1589 seconds**

The 80 second test point is acceptably less than CSt_{MAX}, by a large margin:

Upper Margin = 1589 - 80 = **1509 seconds**

NOTE: The note after Section 8.2.1b discusses how the 1600 second maximum analytical limit and 1520 second maximum allowable value are conservatively applied to the 80 second test point at 104.2 volts.

b. To ensure that undervoltage trip actually occurs at or greater than the Minimum Analytical Limit ALt_{MIN}, the Minimum Calculated Setpoint CSt_{MIN} is required to be greater than ALt_{MIN} by the Total Loop Uncertainty TLUt. ALt_{MIN} is established in sections 8.2.1d and 8.2.1e.

$CSt_{MIN} = ALt_{MIN} + TLUt$

CSt_{MIN} = 20 seconds + 10.7 seconds = **30.7 seconds**

The 80 second test point is acceptably greater than CSt_{MIN}, by a large margin:

Lower Margin = 80 - 30.7 = **49.3 seconds**

NOTE: The note after Section 8.2.1e discusses how the 20 second minimum analytical limit is conservatively applied to the 80 second test point at 104.2 volts.

8.4.5 Determining Maximum and Minimum Time Delay Calculated Limits at 92 Volts, and Acceptability of the 40 Second Test Point at 92 Volts, (low side of PT):

a. To ensure that undervoltage trip actually occurs at or less than the Maximum Analytical Limit ALt_{MAX}, the Maximum Calculated Setpoint CSt_{MAX} is required to be less than the ALt_{MAX} by the magnitude of the Total Loop Uncertainty TLUt. ALt_{MAX} is established in section 8.2.1c.

$CSt_{MAX} = ALt_{MAX} - TLUt$

CSt_{MAX} = 500 - 5.1 seconds = **494.9 seconds**

The 40 second test point is acceptably less than CSt_{MAX}, by a large margin:

Upper Margin = 494.9 - 40 = **454.9 seconds**

NOTE: The 500 second maximum analytical limit and 475 second maximum allowable value were established at 92 volts (sections 8.2.1c and 8.2.2b), and therefore are applicable to the 92 volt test point.

b. To ensure that undervoltage trip actually occurs at or greater than the Minimum Analytical Limit ALt_{MIN}, the Minimum Calculated Setpoint CSt_{MIN} is required to be greater than ALt_{MIN} by the Total Loop Uncertainty TLUt. ALt_{MIN} is established in sections 8.2.1d and 8.2.1e.

$CSt_{MIN} = ALt_{MIN} + TLUt$

CSt_{MIN} = 20 seconds + 5.1 seconds = **25.1 seconds**

The 40 second test point is acceptably greater than CSt_{MIN}, by a large margin:

Lower Margin = 40 - 25.1 = **14.9 seconds**

NOTE: The note after Section 8.2.1e discusses how the 20 second minimum analytical limit is conservatively applied to the 92 volt test point.

8.4.6 Determining the Maximum and Minimum Time Delay Allowable Values for Type 27 Relays:

a. Maximum and Minimum Allowable Values at 104.2 volts:

For conservatism, the minimum allowable value is set equal to the minimum calculated setpoint from section 8.4.4b:

$AVt_{MIN} = CSt_{MIN} =$ **30.7 seconds**

It would be conservative to set the maximum allowable value equal to the maximum calculated setpoint from section 8.4.4a. (1589 seconds) However, it is more conservative to set the allowable value equal to the Tech Spec allowable value from section 8.2.2a:

$AVt_{MAX} =$ **1520 seconds (SP-2315)**

b. Maximum and Minimum Allowable Values at 92 volts:

For conservatism, the minimum allowable value is set equal to the minimum calculated setpoint from section 8.4.5b:

$AVt_{MIN} = CSt_{MIN} =$ **25.1 seconds**

It would be conservative to set the maximum allowable value equal to the maximum calculated setpoint from section 8.4.5a. (494.9 seconds) However, it is more conservative to set the allowable value equal to the allowable value from section 8.2.2b:

$AVt_{MAX} =$ **475 seconds**

8.4.7 Compare calibration procedure PR-1.1 dropout time test as-found tolerance: 35.0 to 45.0 seconds at 92 volts (see section 8.2.2f). This is acceptable because it is within the range of allowable values AVt_{MIN} to AVt_{MAX} in section 8.4.6b above.

8.4.8 Compare Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17, PT-9.1.18 dropout time test as-found acceptance criteria: 35 to 45 seconds at 92 volts (see section 8.2.2c). This is acceptable because it is within the range of allowable values AVt_{MIN} to AVt_{MAX} in section 8.4.6b above.

8.4.9 Compare Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17, PT-9.1.18 dropout time test as-found acceptance criteria: less than 1520 seconds at 104.2 volts (see section 8.2.2e). This upper limit is acceptable because it is within the range of allowable values in section 8.4.6a above. However, it is recommended in section 8.2.2e that the administrative limit of 45 to 125 seconds be added. This is acceptable because it is within the range of allowable values in section 8.4.6a above. This range provides the following margins from the range of actual test values in section 8.3.4b:

a. Maximum Administrative Limit - Maximum Test Value:

125 - 94.3 = **30.7 seconds**

b. Minimum Test Value - Minimum Administrative Limit

70.14 - 45 = **25.1 seconds**

8.4.10 Compare Calibration procedure PR-1.1 dropout time test as-left acceptance criteria: 0 to 300 seconds at 104.2 volts (see section 8.2.2g). The lower limit of 0 seconds is not acceptable because it is not within the range of allowable values in section 8.4.6a above. Therefore, it is recommended in section 8.2.2g that this range be changed to a range of 45 to 125 seconds. See section 8.4.9 for basis.

9.0 Voltage Setpoint Analysis for Type 27N Relays

9.1 Description of Configuration for the Type 27N Relay

9.1.1 The 480-V system is described in section 7.1.1.

9.1.2 The degraded voltage undervoltage relays for the safeguards buses are type 27. These are evaluated in sections 7.0 and 8.0.

9.1.3 The loss of voltage undervoltage relays for the 480 volt safeguards buses 14, 16, 17 and 18 are type 27N. These relays protect safeguards bus loads from experiencing very low voltage conditions which could damage them. The relay has three adjustable characteristics: dropout (trip) voltage, pickup (reset) voltage, and time delay to dropout.

9.1.4 On each safeguards bus, a potential transformer supplies a type 27 relay and a type 27N relay, and a redundant potential transformer supplies a redundant type 27 relay and a redundant type 27N relay.

9.1.5 Each channel contains one loss of voltage relay and one degraded voltage relay. A one-out-of-two logic in both channels will cause the following actions on the associated safeguards bus:

a. trip of the normal feed breaker from offsite power;

b. trip of the bus-tie breaker to the opposite electrical train (if closed);

c. shed of all bus loads except the CS pump, component cooling water pump (if no safety injection signal is present), and safety related motor control centers; and

d. start of the associated diesel generator.

9.2 Evaluation of Configuration Against Documented Requirements for the Type 27N Relay

9.2.1 Analytical Limit (AL_{MIN}) and (AL_{MAX}) for Type 27N Relays

a. COLR Accident Analysis Assumptions Setpoints includes no analytical limit for the type 27N relays.

b. Ginna Technical Specification SR3.3.4.2 lists the loss of voltage "allowable value" as **≥368 volts** (CMIS setpoint **SP-2308**). This is actually the safeguards bus loss of voltage minimum Analytical Limit. At the low side of the 480/120 potential transformer this is 92.0 volts. The minimum Analytical Limit (AL_{MIN}) is therefore **92.0 volts.**

c. The Safeguards bus loss of voltage maximum analytical limit for the type 27N loss of voltage relay is established in this analysis as **96.0 volts**, and the corresponding time delay minimum analytical limit is established in section 10.2.1c. Basis: The worst-case voltage dips on the safeguards buses result from diesel generator load sequencing (See assumption 5.11).

NOTE: It is shown in section 5.11.5 that the worst case bus 14 voltage during normal offsite power load sequencing is 387 volts for the worst case probable combination of simultaneous motor starts. The bus voltage of 387 volts is higher than the maximum analytical limit of 384 volts. Therefore, normal offsite power load sequencing can not cause operation of the type 27N relay.

d. The combination of the loss of voltage maximum analytical limit and the time delay minimum analytical limit shall ensure that the type 27N relay will not trip during diesel generator load sequencing. The actual value of the loss of voltage maximum analytical limit is selected as a readable voltage on Attachments 2 and 3 which is in or below the range of the voltage dips during diesel generator load sequencing. It is also required to be less than the degraded voltage analytical limit from section 7.2.1c, but large enough to result in a positive value for the upper margin, which will be calculated in section 9.4.4a. Looking at Attachments 2 and 3, the degraded voltage maximum analytical limit is selected as 80% of 480 volts, or 384 volts bus voltage. The corresponding voltage at the low side of the potential transformer is 384/4 = **96.0 volts**. The voltage dip that is less than this analytical limit for the largest time interval will be the basis for the time delay minimum analytical limit. (See section 10.2.1c). Therefore, the combination of the loss of voltage maximum analytical limit and the time delay minimum analytical limit ensures that the type 27N relay will not trip during diesel generator load sequencing.

NOTE: Diesel generator (D/G) dynamic loading analyses DA-EE-92-111-01 and DA-EE-92-112-01 each have an attachment J which contains plots of bus voltage profiles. Attachments 2 and 3 are worst-case plots, from Attachment J9 of each analysis. These plots are the most severe voltage profiles in the D/G dynamic analyses, LOOP-LOCA: CS, SI C and 2nd CF coincident start for Bus 14 and Bus 16. The following tables determine that Attachment J9 in each analysis has the worst-case voltage dip time of all the Attachment J plots. Dip times are determined by scaling the plots. (% division x 4 seconds/division = seconds)

D/G A DA-EE-92-111-01 Attach, Page #	Minimum Voltage Dip (% of 480 Volts)	Worst-Case Dip Time (Seconds)between trip (80%V) and reset (80.5%V)
J1 Page 1	83.97	0.00 div x 4=0.0
J2 Page 1	80.36	0.00 div x 4=0.0
J3 Page 1	75.79	0.16 div x 4=0.6

J4 Page 1	77.70	0.09 div x 4=0.4
J4B Page 1	69.95	0.25 div x 4=1.0
J5 Page 1	77.70	0.13 div x 4=0.5
J6 Page 1	80.32	0.00 div x 4=0.0
J7 Page 1	74.66	0.22 div x 4=0.9
J7B Page 1	79.2	0.13 div x 4=0.5
J8 Page 1	75.87	0.17 div x 4=0.7
J9 Page 1	70.39	0.27 div x 4=1.1 **Worst Case Train A**

D/G B DA-EE-92-112-01 Attach, Page #	Minimum Voltage Dip (% of 480 Volts)	Worst-Case Dip Time (Seconds) between trip (80%V) and reset (80.5%V)
J1 Page 1	81.12	0.00 div x 4=0.0
J2 Page 1	76.20	0.10 div x 4=0.4
J3 Page 1	72.52	0.17 div x 4=0.7
J4 Page 1	72.90	0.20 div x 4=0.8
J4B Page 1	66.28	0.27 div x 4=1.1
J5 Page 1	75.31	0.17 div x 4=0.7
J6 Page 1	76.49	0.17 div x 4=0.7
J7 Page 1	76.14	0.20 div x 4=0.8
J8 Page 1	72.52	0.20 div x 4=0.8
J9 Page 1	69.71	0.27 div x 4=1.1 **Worst Case Train B**

9.2.2 Nominal Setpoint and Calibration Tolerance for Type 27N Relays

a. Calibration procedure PR-1.1 dropout test nominal setpoint and as-left tolerance: **93.2 volts** (+0.5,-0.0 volts) or 93.2 to 93.7 volts. At the high side of the 480/120 potential transformer this is **372.8 volts** (CMIS setpoint **SP-2309)**, (+2.0,-0.0 volts), or 372.8 to 374.8 volts.

b. Ginna Technical Specification SR3.3.4.2 lists the loss of voltage trip setpoint as ≥**372.8 volts** (CMIS setpoint **SP-2309**). This Technical Specification requirement is met by the 372.8 volt setpoint discussed in (a.) above.

c. Drawing 11253-1 sheets 3 and 4 shows that these relays have a **93.2 volt** dropout and time lever setting of 2.

9.2.3 Trip Allowable Values (AVt) for Type 27N Relays

a. Calibration procedure PR-1.1 dropout test as-found tolerance: ± 0.6 volt of previous as-left Test.

b. Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17, PT-9.1.18 dropout test as-found acceptance criteria: **92.6 to 94.3 volts** (CMIS setpoint **SP-1370**). Since the nominal setpoint is 93.2 volts (see section 9.2.2a), this equates to 93.2 (+1.1,-0.6) volts.

9.2.4 Reset Nominal Setpoint (NSr) for Type 27N Relays

a. Calibration procedure PR-1.1 pickup test nominal setpoint: 93.7 volts

b. Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17, PT-9.1.18 pickup test as-found pickup voltage nominal value: Not specified.

9.2.5 Reset Calibration Tolerance for Type 27N Relays

Calibration procedure PR-1.1 as-left pickup test tolerance: 93.7 to 94.2 volts, as close to 93.7 volts as practical. This is the 93.7 volt nominal setpoint (+0.5,-0.0) volts.

9.2.6 Reset As-Found Tolerance for Type 27N Relays

a. Calibration procedure PR-1.1 as-found pickup test tolerance: ± 1.0 volts from the previous as-left test.

b. The Periodic Test procedure PT-9.1.14, PT-9.1.16, PT-9.1.17 and PT-9.1.18 pickup test as-found acceptance criteria specify a range of 92.6 to 94.8 volts. Since the nominal reset setpoint is 93.7 volts (see 9.2.4a), this equates to 93.7 ± 1.1 volts.

9.2.7 Identify Performance Related Design Bases Associated with the Type 27N relays:

SC-3 — Safety Classification (SR/SS/NS) as documented in the Ginna Q-List.

NO — NUREG 0737/RG 1.97 as documented in Table 7.5-1 of the Ginna UFSAR.

NO — EQ (Per the 10CFR 50.49 list)

NS — Seismic Category (Seismic Class I/ Structural Integrity Only/ NS).

YES — Ginna Technical Specifications

YES — UFSAR

NO — EOP Setpoint
Per a review of the Emergency Operating Procedures Setpoint Database, there are no EOP setpoints associated with the 27N relays on Buses 11A/11B.

9.3 Evaluation of Instrument Uncertainties for the Type 27N Relay

NOTE: This section Documents the components of Total Loop Uncertainty (TLU):

9.3.1 Relay Uncertainty (Ru) for Type 27N Relays

VTD-A0500-4201 lists **0.1%** variation in operating voltage at constant temperature and control voltage. The relay uncertainty is therefore **± 0.1%** of a 120 volt span.

9.3.2 Temperature Uncertainty (Tu) for Type 27N Relays

VTD-A0500-4201 lists **0.4%** variation in operating voltage over the temperature range 10 to 40 deg. C, for the Harmonic Filter models which are installed at Ginna. The Temperature Uncertainty is therefore **± 0.4%** of a 120 volt span.