☐ ANO-1	☐ ANO-2	☐ GGNS	☐ IP-2	☐ IP-3	☐ PLP
☐ JAF	☐ PNPS	☒ RBS	☐ VY	☐ W3	
☐ NP-GGNS-3	☐ NP-RBS-3				

CALCULATION COVER PAGE	(1) **EC #** 27437	(2) **Page 1 of** 22

(3) Design Basis Calc. ☒ YES ☐ NO

(4) ☒ CALCULATION ☐ EC Markup

(5) **Calculation No: G13.18.6.2-ENS*004**

(6) **Revision: 1**

(7) **Title:** Loop Uncertainty Determination for DIV III Loss of Voltage Relays – GE Model NGV Undervoltage Relay

(8) **Editorial** ☐ YES ☒ NO

(9) **System(s): 302**

(10) **Review Org (Department):** NSBE3 (I&C Design)

(11) **Safety Class:**

☒ **Safety / Quality Related**
☐ **Augmented Quality Program**
☐ **Non-Safety Related**

(12) **Component/Equipment/Structure Type/Number:**

E22-S004-27N1	E22-S004-27N2

(13) **Document Type:** F43.02

(14) **Keywords (Description/Topical Codes):**

uncertainty, calculation

REVIEWS

(15) Name/Signature/Date	(16) Name/Signature/Date	(17) Name/Signature/Date
Chuck Mohr (see EC 11753 for signature)	Justin Waters (see EC 11753 for signature)	Paul Matzke (see EC 11753 for signature)
Responsible Engineer	☒ **Design Verifier** ☐ **Reviewer** ☒ Comments Attached	**Supervisor/Approval** ☒ Comments Attached

CALCULATION REFERENCE SHEET	CALCULATION NO: G.13.18.6.2-ENS*004 REVISION: 1

I. EC Markups Incorporated (N/A to NP calculations) None

II. Relationships:	Sht	Rev	Input Doc	Output Doc	Impact Y/N	Tracking No.
1. EN-DC-126	--	002	☑	☐	N	
2. EN-IC-S-007-R	--	000	☑	☐	N	
3. 7224.300-000-001B	--	300	☑	☐	N	
4. 201.130-186	--	000	☑	☐	N	
5. 215.150	--	006	☑	☐	N	
6. G080-1344	--	000	☑	☐	N	
7. 6221.418-000-001A	--	300	☑	☐	N	
8. F137-0100	--	000	☑	☐	N	
9. 0221.418-000-008	--	300	☑	☐	N	
10. EE-001M	--	009	☑	☐	N	
11. GE-828E537AA	003	028	☑	☐	N	
12. GE-828E537AA	007	030	☑	☐	N	
13. GE-828E537AA	008	028	☑	☐	N	
14. GE-828E537AA	011	029	☑	☐	N	
15. STP-302-1604	--	018	☑	☐	N	
16. GE-152D8167	005	004	☑	☐	N	
17. G13.18.6.3-012	--	000	☑	☐	N	
18. EDP-AN-02	--	300	☑	☐	N	
19. G13.18.3.1*002	--	004	☐	☑	Y	EC11753
20. GE-152D8167	003	006	☑	☐	N	
21. GE-152D8167	003A	006	☑	☐	N	
22. GE-152D8167	004	007	☑	☐	N	
23. BE-230D	--	010	☑	☐	N	
24. 0221.418-000-049	--	300	☑	☐	N	

III. CROSS REFERENCES:

1. Indus Asset Suite Equipment Data Base (EDB)
2. Technical Specifications section B3.3.8.1
3. ANSI Standards C57.13 (1993), C37.90 (1989)
4. Multi-Amp Instruction Book EPOCH-10
5. USAR Figures 3.11-1 through 5

IV. SOFTWARE USED: N/A

Title:____________ Version/Release:__________ Disk/CD No._______

V. DISK/CDS INCLUDED: N/A

Title:____________ Version/Release__________ Disk/CD No._______

VI. OTHER CHANGES: The following related references have been removed:

3221.418-000-003U, 0221.415-000-122, GE-828E537AA #006, GE-DL828E537AA, STP-302-0102

Revision	Record of Revision
0	Initial issue to support determination of loss of voltage relay setpoints by Electrical Engineering
1	Incorporated new drift value and extended calibration period to 30 months per EC 11753.

TABLE OF CONTENTS

1.0 Purpose and Description

1.1. Purpose

The purpose of this calculation is to determine the uncertainty associated with the existing Division III, Safety-Related, 4.16 kV Loss of Voltage relays E22-27N1 and 27N2. Nominal trip Setpoints and Allowable values will be determined by the Electrical Engineering group in calculation G13.18.3.1*002 and documented on the applicable BE drawing.

1.2. Loop Descriptions

The DIV. III incoming Normal Supply power is monitored by two undervoltage relays (27N1 and 27N2) whose outputs are arranged in a one-out-of-two logic configuration (Reference 3.10.3). The channels include electronic equipment (e.g., trip units) that compare measured input signals with pre-established setpoints. When the setpoint is exceeded, the channel output relay actuates, opens the DIV III Normal Supply source breaker.

The Division III 4.16 kV emergency bus has its own independent Loss of Voltage instrumentation and associated trip logic. The DIV III emergency bus is monitored by undervoltage relays 27S1 through 27S4) whose outputs are arranged in a one-out-of-two, twice logic configuration (Reference 3.10.3).

1.3. Design Bases/Design Bases Event

Per Bases B 3.3.8.1, Reference 3.7.3, "successful operation of the required safety functions of the Emergency Core Cooling Systems (ECCS) is dependent upon the availability of adequate power sources for energizing the various components such as pump motors, motor operated valves, and the associated control components. The LOP instrumentation monitors the 4.16 kV emergency buses. Offsite power is the preferred source of power for the 4.16 kV emergency buses. If the monitors determine that insufficient power is available, the buses are disconnected from the offsite power sources and connected to the onsite diesel generator (DG) power sources."

1.4. Degree of Accuracy/Limits of Applicability

The results of this calculation are based on the statistical methods of at least 95% probability of occurrence for a one sided probability of distribution in accordance with "General Electric Instrument Setpoint Methodology," (Reference 3.3) and EN-IC-S-007-R, "Instrument Loop Uncertainty & Setpoint Calculations", (Reference 3.2).

The results of this calculation are valid under the Assumptions stated in Section 7.0 of this calculation. The appropriate use of this calculation to support design or station activities, other than those specified in Section 1.1 of this calculation, is the responsibility of the user.

1.5. Applicability

A data analysis has been performed in order to determine which, if any, redundant instrument loops are bounded by the results of this calculation. This calculation is applicable to the Loops associated with the primary elements stated in Section 2.1. The results of this calculation are bounding for the applicable instrument loops, based on such factors as instrument manufacturer and model number, instrument location/environmental parameters, actual installation and use of the instrument in process measurements.

2.0 Results/Conclusion

2.1. Results

The Loop Uncertainty and Total Loop Uncertainty for the Loss of Voltage and Loss of Voltage relays were calculated in Section 8.0. These values and other associated values such as loop drift are presented in table 2.1-1.

Table 2.1-1
Model NGV Loss of Voltage Relay – Voltage Trip

System(s)	Loop Identification	Loop Uncertainty (LU) VAC	Channel Drift (D_L) VAC	Total Loop Uncertainty (TLU) VAC	M&TE Loop Accuracy Requirements (MTE_L) VAC	Maximum Loop Setting Tol. (PALB) VAC
302	E22-S004-27N1 E22-S004-27N2	± 3.678 *± 128.73	± 5.823	± 5.31 *± 185.85	± 0.375	± 2.61

*** Value adjusted to reflect uncertainty applied to the primary of the potential transformer.**

2.2. Conclusions

The calculated Loop Uncertainty and Total Loop Uncertainty presented in table 2.1-1 are bounding for the relays and circuits listed in Section 2.1.

3.0 **References**

3.1. EN-DC-126, "Engineering Calculation Process"

3.2. EN-IC-S-007-R, "Instrument Loop Uncertainty & Setpoint Calculations"

3.3. 7224.300-000-001B, NEDC-31336P-A, General Electric Instrument Setpoint Methodology

3.4. Indus Asset Suite Equipment Data Base (EDB)

3.5. 201.130-186, "Peak Spreading of ARS Curves for the Control Building"

3.6. Environmental Design Criteria, Spec 215.150, including USAR figures 3.11-1 through 5 as outlined in EDP-AN-02 section 6.3.1

3.7. RBS Operating License

3.7.1. Not used

3.7.2. Not used

3.7.3. Bases Sections B3.3.8.1

3.8. RBS USAR

None

3.9. Vendor Manuals/Documents

3.9.1. G080-1344, General Electric Instructions Undervoltage Relays

3.9.2. F137-0100, Fluke 45 Dual Display Multimeter Users Manual

3.9.3. Multi-Amp Instructions for the EPOCH-10, Microprocessor-Enhanced Protective Relay Test Set, (maintained by the Standards Laboratory)

3.9.4. 6221.418-000-001A, High Pressure Core Spray System Power Supply Unit, NEDO-10905

3.9.5. 0221.418-000-008, Purchase Specification Data Sheet 21A9300AU, High Pressure Core Spray System

3.10. Electrical Schematics

3.10.1. EE-001M, 4160V One Line Diagram Standby Bus E22-S004

3.10.2. GE-828E537AA#003, Elementary Diagram HPCS Power Supply System

3.10.3. GE-828E537AA#007, Elementary Diagram HPCS Power Supply System

3.10.4. GE-828E537AA#008, Elementary Diagram HPCS Power Supply System

3.10.5. GE-828E537AA#011, Elementary Diagram HPCS Power Supply System

3.11. Surveillance Test Procedures:

3.11.1. STP-302-1604, HPCS Loss of Voltage Channel Calibration And Logic System Functional Test

3.11.2. Not used

3.12. Logic Diagrams

3.12.1. GE-152D8167#003, Functional Control Diagram, High Pressure Core Spray Power Supply

3.12.2. GE-152D8167#003A, Functional Control Diagram, High Pressure Core Spray Power Supply

3.12.3. GE-152D8167#004, Functional Control Diagram, High Pressure Core Spray Power Supply

3.12.4. GE-152D8167#005, Functional Control Diagram, High Pressure Core Spray Power Supply

3.13. Standards

3.13.1. ANSI Standard C57.13, Requirements for Instrument Transformers

3.13.2. ANSI Standard C37.90, Relays and Relay Systems Associated with Electric Power Apparatus

3.14. E-mail message from General Electric Power Management to George Boles, Attachment 1

3.15. G13.18.6.3-012, Rev.0, General Electric Model NGV13B Relay Drift Analysis

3.16. BE-230D, 4.16kV Bus 1E22-S004 Relay Settings

3.17. 0221.418-000-049, 1E22-S004 Equipment Summary

4.0 **Design Input**

4.1. **Loop Input**

4.1.1. Loop Data:

Form 1: Loop/Process Data Sheet		
Description	**Data**	**Reference**
Loop Sensor(s)	E22-S004 PT-Line	3.10.4
Location	E22-S004	3.10.4
Output Range	0 – 120 VAC	3.10.4
Input Range	0 – 4200 VAC	3.10.4

4.1.2. Special Considerations:

4.1.2.1. Calibration shall be performed using the following instruments:

- Multi-Amp EPOCH-10 relay tester set to Oscillator mode (Reference 3.9.3)
- Fluke Model 45 Digital Multimeter set to medium resolution (Reference 3.9.2)

4.1.2.2. A minimum of 1 hour warm up time at the location where the M&TE will be used shall be allowed for the Fluke Model 45 Multimeter.

4.2. **Loop Instrumentation**

Form 2: Instrument Data Sheet Calc. Device Number 1		
Description	**Data**	**Reference**
Component Number(s)	E22-S004-PT-Bus	3.4
Manufacturer	GE	3.17
Model(s)	JVM	3.17
Location(s)	CB. 116'EL/E22-S004	3.4
Service Description	Transformer	3.4
Instrument Range	0 – 4200 VAC	3.10.4
Instrument Span	120 VAC	3.10.4
Output Range	0 – 120 VAC	3.10.4
Calibration Interval Evaluated	N/A	Note
Device Setting Tolerance	N/A	Note

Note: Potential transformers for instrument service cannot be calibrated or adjusted. Therefore there is no device setting tolerance or calibration interval.

Form 2: Instrument Data Sheet Calc. Device Number 2		
Description	**Data**	**Reference**
Component Number(s)	E22-S004-27N1 E22-S004-27N2	3.4
Manufacturer	General Electric	3.16
Model	12NGV	3.16
Location(s)	CB. 116'EL/E22-S004	3.4
Service Description	Relay	3.4
Input Range	0 – 120 VAC	3.9.1
Output	Contact Action	3.10, 3.12
Calibration Interval Evaluated	30 Mo. (24 Mo. + 25%)	3.2

4.3. **Loop Device Data**

Form 3: Instrument Accuracy Data Sheet Calc. Device Number 1 General Electric JVM		
Description	**Data**	**Reference**
Reference Accuracy (RA_T)	0.3% of setting 2σ	3.9.4, 8.2.1 7.1.2
Seismic Effects (SE_T)	N/A	7.1.4
Temperature Effects (TE_T)	N/A	7.1.12
Insulation Resistance Effects (IR_T)	N/A	7.1.10
Temperature Drift Effect (TD_T)	N/A	7.1.13
Drift (DR_T)	N/A	7.1.14

Form 3: Instrument Accuracy Data Sheet Calc. Device Number 2 General Electric NGV		
Description	**Data**	**Reference**
Reference Accuracy (RA_R)	± 1% of setting 2σ	3.14, Attachment 1 7.1.2
Seismic Effects (SE_R)	0	7.1.4
Temperature Effects (TE_R)	2% of setting (68°F – 104°F)	7.1.12
Insulation Resistance Effects (IR_R)	N/A	7.1.10
Temperature Drift Effect (TD_R)	N/A	7.1.13
Drift (DR_R)	± 5.823 VAC 2σ	3.15
Power Supply Effect (PS_R)	N/A	7.1.6
Reset Differential	10% of Setting 2σ	3.9.1 3.11.1, 7.1.2

4.4. **Environmental Information**

Form 4: Environmental Conditions Data Sheet		
Zone: CB-116-2		
Description	**Data**	**Reference**
Location		
Building/Elevation	CB-116	3.4
Room/Area	Switchgear Room	3.4
Normal		
Temperature Range, °F	40 - 104	3.6, 7.1.12
Humidity Range, %RH	20 - 90	3.6, 7.1.9
Radiation 40 Year Total Integrated Dose, Rads	800	3.6
Pressure Range	Atmos	3.6
Accident (Loss of Offsite Power)		
Temperature Range, °F	Same as Normal	3.6
Humidity Range, %RH	Same as Normal	3.6
Radiation, Total Integrated Dose, Rads	Same as Normal	3.6
Pressure Range	Same as Normal	3.6
Seismic		
Accelerations, g	< 3	3.5

5.0 Nomenclature

The terms and abbreviations that are not defined in this section are defined in Reference 3.3, Reference 3.2 or within the text of this calculation.

6.0 Calculation Methodology

This calculation is prepared in accordance with the EN-IC-S-007-R, "Instrument Loop Uncertainty & Setpoint Calculations" (Reference 3.2), EN-DC-126, "Engineering Calculation Process" (Reference 3.1) and 7224.300-000-001B, "General Electric Instrument Setpoint Methodology" (Reference 3.3).

7.0 Assumptions

7.1. Assumptions that do not require confirmation

7.1.1. Miscellaneous Allowance (ML)

A miscellaneous allowance has not been applied to the uncertainty of the devices evaluated by this calculation. By assuming all vendor supplied data is a 2σ value and with intermediate rounding of values, sufficient conservatism has been introduced.

7.1.2. Vendor 2σ Data

For conservatism, all uncertainties given in vendor data specifications are assumed to be 2σ unless otherwise specified.

7.1.3. Zero Effect

Not applicable

7.1.4. Seismic Effects (SE)

Seismic effects are assumed to be negligible for the NGV relay, per Reference 3.9.5. Seismic effects are not applicable to potential transformers.

7.1.5. Radiation Effects (RE) & Radiation Drift Effect (RD)

Are not applicable to the relays and transformers evaluated by this calculation, as they are located in a mild environment (Reference 3.6).

7.1.6. Power Supply Effects (PS)

Power supply effects are not applicable to type NGV relays as the relay does not utilize a control power source separate from the sensed voltage.

Power supply effects are not applicable to transformers.

7.1.7. Process Measurement Uncertainty (PM)

Not Applicable

7.1.8. Static Pressure Effects (SP)

Not Applicable

7.1.9. Humidity Effects (HE)

The relays were specified by the HPCS manufacturer and are assumed to be designed to with stand the environmental effects in the mounting location. The HPCS Design Specification, Section 4.6.1 (reference 3.9.5) states that the design conditions for the switchgear and its sub-components are 20-90% Relative Humidity. Per Reference 3.6, the humidity range for environmental zone CB-116-2 is 20 to 90% RH. Reference 3.6 also identifies that 1% of the calendar year (30 hours) the humidity could be 5 % higher. This is considered negligible.Therefore, it is assumed that Humidity Effects are negligible.

7.1.10. Insulation Resistance Effects (IR)

(IR) effects, which may result in degradation of circuit insulation, are not applicable to the devices and circuits addressed by this calculation.

7.1.11. Voltage Drop

Voltage drop due to long wiring lengths between source and load are assumed to be negligible as the potential transformers and the under-voltage relays evaluated by this calculation are located in the same switch gear compartment.

7.1.12. Temperature Effects (TE)

There is no temperature effect data available from the manufacturer for the Type NGV relay. Therefore for conservatism, temperature effects are assumed to be equal to the repeatability value (± 2% of setting) given in Attachment 1. Reference 3.6 also identifies that 1% of the calendar year (30 hours) the temperature could be 5°F higher. This is considered negligible.

Temperature effects are not applicable to transformers. Temperatures above the rated value would tend to produce total failure of the transformer, rather than an error in output.

7.1.13. Temperature Drift Effects (TD)

The drift analysis performed in Reference 3.15 is assumed to encompass all components of drift and drift effects except for temperature drift effects which are assumed to be included in the Reference Accuracy of the device.

Temperature drift effects are not applicable to transformers.

7.1.14. Instrument Drift

The drift analysis can be found in Reference 3.15.

Drift is not applicable to transformers.

7.2. **Assumptions that require confirmation**

None

8.0 Calculation

This section includes the following subsections used in performance of this calculation:

8.1) Calculation of Miscellaneous Uncertainties

8.2) Calculation of Individual Device Reference Accuracy (RA) and Determination of Appropriate Device Uncertainty

8.3) Calculation of Individual Device Uncertainties

8.4) Calculation of Loop Calibration Accuracy (C_L)

8.5) Calculation of Insulation Resistance Effects (IR)

8.6) Calculation of Loop Uncertainty (LU)

8.7) Calculation of the Loop Drift (D_L)

8.8) Calculation of Total Loop Uncertainty (TLU)

8.9) Calculation of Reset Differential (RD)

8.1. Calculation of Miscellaneous Uncertainties

8.1.1. Calculation of Transformer Burden and Determination of Reference Accuracy

Per Reference 3.9.4, page 5-10, section 5.3, the Type JVM potential transformer has a 1.2% ratio error for a combined relaying and metering burden of greater than 75 VA. However, a burden below 75VA yields a transformer accuracy of ± 0.3% of setting. As shown below, the devices fed by the PT Line transformer do not meet the 75 VA burden threshold.

2 Model NGV Undervoltage Relays @ 4.2 VA each	=	8.4
2 Model 27N Undervoltage Relays @ 0.5 VA each	=	1.0
1 Synchronizing Relay @ 2.0 VA	=	2.0
2 Volt Meter, GE AB40 @ 0.32 VA each	=	0.64
1 Synchronizing Scope @ 5.2 VA	=	5.2
Control Relays/Meters not listed, Assumed Value	=	10.0
		25.24 VA

Therefore, PT Reference Accuracy shall be 0.3% of setting (87 VAC per Ref. 3.11.1) or 0.261 VAC for this calculation.

8.1.2. Calculation of Relay Temperature Effects (TE_R) (Assumption 7.1.12)

TE_R = ± 1% Setting
= ± 0.01 x 87 VAC
= ± 0.87 VAC

8.2. Calculation of Individual Device Reference Accuracy (RA) & Determination of Appropriate Device Uncertainty

8.2.1. Transformer Reference Accuracy (RA_T)

RA_T = ± 0.3% of Setting
= ± 0.003 * 87 VAC
= ± 0.261 VAC (2σ Value)

8.2.2. Undervoltage Relay Reference Accuracy for Voltage Setting (RA_R)

RA_R = ± 1% of Setting
= ± 0.01 * 87 VAC
= ± 0.87 VAC (2σ Value)

8.2.3. Loop Reference Accuracy (RA_L)

(Reference 3.2)

$RA_L = \pm [(RA_T)^2 + (RA_R)^2]^{1/2}$
$= \pm [(0.261)^2 * (0.87)^2]^{1/2}$
= ± 0.908 VAC (2σ Value)

Per Reference 3.11.1 the Loop Calibration Tolerance (CT_L – Procedural As Left Band) for Loss of Voltage is ± 2.61 VAC. As the CT_L value is greater than the associated Loop Reference Accuracy, the individual device Reference Accuracies are set to zero for the remainder of this calculation (Reference 3.2).

8.3. Calculation of Individual Device Uncertainties (Reference 3.2)

8.3.1. Device Uncertainty Transformer (A_T) (Sections 4.3 and 8.2.1)

$A_T = \pm [(RA_T)^2]^{1/2}$
$= \pm [(0)^2]1/2$
= + 0 VAC (2σ Value)

8.3.2. Device Uncertainty Relay Voltage Setting (A_R)

$A_R = \pm [(RA_R)^2 + (PS_R)^2 + (TE_R)^2]^{1/2}$
$= \pm [(0)^2 + (0)^2 + (0.87)^2]^{1/2}$
= ± 0.87 VAC (2σ Value)

8.4. Calculation of Loop Calibration Accuracy (C_L)

Per reference 3.2 and 3.3 Loop Calibration uncertainty (C_L) is defined as:

$C_L = \pm [(MTE_L)^2 + (CT_L)^2]^{1/2}$
$= \pm [0.375^2 + 2.61^2]^{1/2}$ VAC
= ± 2.64 VAC (2σ Value)

8.4.1. Measuring and Test Equipment Effects – Relay (MTE_L)

Measurement & Test Equipment (MTE_L) effects are defined from Reference 3.2 as:

$MTE_L = \pm [(MTE_{RAT})^2 + (MTE_{RIT})^2 + (MTE_{TET})^2 + (MTE_{CST})^2]^{1/2}$

Where:

MTE_{RAT} = Reference accuracy of the M&TE used for calibration. Assumed equal to the Reference Accuracy of the primary element in the loop, 0.261 VAC (Reference 3.2).

MTE_{RIT} = Readability of the M&TE used, assumed to be 0 as all M&TE used are digital with at least 2 digits of resolution. (Reference 3.2)

MTE_{TET} = Effects of temperature changes on the M&TE between the calibration laboratory and the area where the M&TE is used, Assumed equal to the Reference accuracy of the primary element in the loop, 0.261 VAC (Reference 3.2).

MTE_{CST} = The accuracy of the calibration standard used to calibrate the M&TE, assumed equal to 1/4 the Reference accuracy of the primary element in the loop, 0.065 VAC (Reference 3.2).

$$\begin{aligned} MTE_L &= \pm [(MTE_{RAT})^2 + (MTE_{RIT})^2 + (MTE_{TET})^2 + (MTE_{CST})^2]^{1/2} \\ &= \pm [(0.261)^2 + (0)^2 + (0.261)^2 + (0.065)^2]^{1/2} \\ &= \pm 0.375 \text{ VAC} \qquad (2\sigma \text{ Value}) \end{aligned}$$

8.4.2. Calculation of Calibration Effects (CT)
Calibration Effects (CT_L) are defined from Reference 3.2 as:

CT_L = Square Root Sum of the Squares (SRSS) of the calibration effects which are uncertainties due to "as Left" loop accuracy.

$CT_L = \pm 2.61$ VAC (2σ value)

8.5. Calculation of Insulation Resistance Effects (IR)

0 per Assumption 7.1.10

8.6. Calculation of Loop Uncertainty (LU)

$$\begin{aligned} LU &= \pm (m/n)[(A_T)^2 + (A_R)^2 + (C_L)^2]^{1/2} \pm M \text{ (margin)} \\ &= \pm (1.645/2)[(0)^2 + (0.87)^2 + (2.64)^2]^{1/2} \pm 1.392 \\ &= \pm 3.678 \text{ VAC} \end{aligned}$$

Adjusted to reflect primary voltage to the PT

= ± 3.678 x PT Ratio (Primary Voltage/Secondary Voltage)

= ± 3.678 x 35 VAC

= ± 128.73 VAC

8.7. **Calculation of Loop Drift (D_L)**

8.7.1. Transformer Temperature Drift Effects (TD_T)

0 for per Assumption 7.1.13

8.7.2. Relay Temperature Drift Effects (TDR)

0 per assumption 7.1.13

8.7.3. Relay Drift (DR_R):

Assumption 7.1.14

$DR_R = \pm 5.823$ VAC (2σ Value)

As the only component of loop drift is the relay drift determined in reference 3.15, Loop Drift (DR_L) is equal to Relay Drift (DR_R).

$D_L = \pm 5.823$ VAC (2σ Value)

8.8. **Calculation of Total Loop Uncertainty (TLU) Calculation:**

$$
\begin{aligned}
TLU &= \pm (m/n)[(A_T)^2 + (A_R)^2 + (C_L)^2 + (DR_L)^2]^{1/2} \\
&= \pm (1.645/2)[(0)^2 + (0.87)^2 + (2.64) + (5.823)^2]^{1/2} \\
&= \pm 5.31 \text{ VAC}
\end{aligned}
$$

Adjusted to reflect primary voltage to the PT:

$$
\begin{aligned}
&= \pm 5.31 \text{ x PT Ratio (Primary Voltage/Secondary Voltage)} \\
&= \pm 5.31 \text{ x } 35 \text{ VAC} \\
&= \pm 185.85 \text{ VAC}
\end{aligned}
$$

8.9. **Calculation of Reset Differential**

The reset differential is applied to the voltage setting and is specified to be ± 10% of setting per References 3.9.1 and 3.11.1. This value will be used in the calculation.

$$
\begin{aligned}
RR &= \pm 0.1 * \text{setting VAC} \\
&= \pm 0.1*87 \\
&= \pm 8.70 \text{ VAC}
\end{aligned}
$$

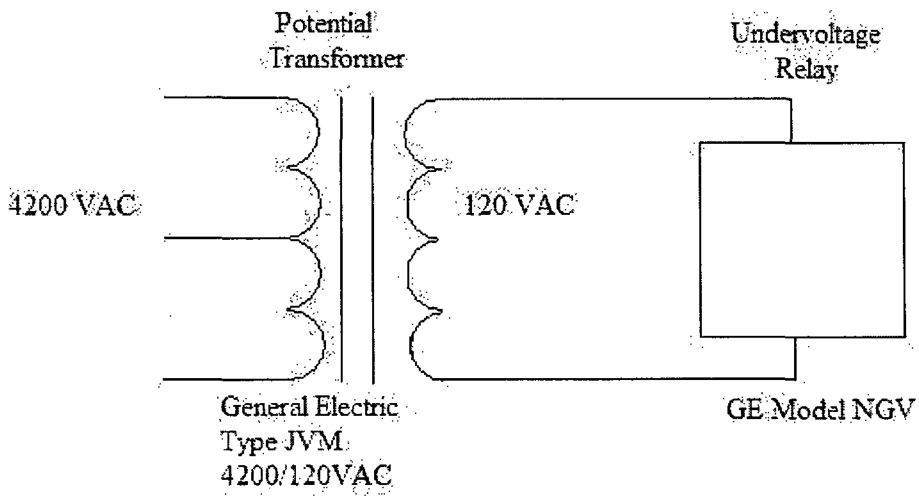
Adjusted to reflected primary (bus) voltage at the PT:

$$
\begin{aligned}
&= \text{RR x PT Ratio (primary voltage/secondary voltage)} \\
&= \pm 8.7 \text{ x } 35 \text{ VAC} \\
&= \pm 304.5 \text{ VAC}
\end{aligned}
$$

Calculated uncertainties are applicable to reset.

Summary of Calculation Data						
	Transformer Device 1			**Undervoltage Relay Device 2**		
	Values	**σ**	**Ref**	**Values**	**σ**	**Ref**
Input Range	0 – 42 kV	–	3.13	0 – 120	–	3.13
Process Units	**VAC**	–	3.13	**VAC**	–	3.13
Reference Accuracy (RA)	0.3% of Setting	2	8.2.1	1% of Setting	2	8.2.2
Temperature Effect (TE)	N/A	–	7.1.12	± 0.87	2	7.1.12
Seismic Effects (SE)	N/A	–	7.1.4	N/A	–	7.1.4
Radiation Effect (RE)	N/A	–	7.1.5	N/A	–	7.1.5
Instrument Drift (DR)	N/A	–	7.1.14	± 5.823	2	3.15
Temperature Drift Effect (TD)	N/A	–	7.1.13	N/A	–	7.1.13
Radiation Drift Effect (RD)	N/A	–	7.1.5	N/A	–	7.1.5
Power Supply Effect (PS)	N/A	–	7.1.6	N/A	–	7.1.6
Humidity Effects (HE)	N/A	–	7.1.9	N/A	–	7.1.9
Static Pressure Effect (SP)	N/A	–	7.1.8	N/A	–	7.1.8
Process Measurement Effect (PM)	N/A	–	7.1.7	N/A	–	7.1.7
Insulation Resistance Effect (IR)	N/A	–	7.1.10	N/A	–	7.1.10
Zero Effect (ZE)	N/A	–	7.1.3	N/A	–	7.1.3

9.0 **Simplified Block Diagram**



From: "EmailClerk (IndSys,IM)" <emailclerk@indsys.ge.com>
To: <georgeboles@dpengineering.com>
Subject: Email out for Case C01-39202
Date: Thursday, April 19, 2001 7:14 AM

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Please do not modify the subject line or processing of this e-mail may be delayed.

Case C01-39202
Subject NGV Dropout Range

George,

The dropout range for the NGV11 relay is "Once the voltage dropout level has been adjusted to a value within the range of Dropout Adjustment as in Table C of the Instruction Book then on any dropout operation, the voltage range from the beginning of the action to its completion is about one percent of rated voltage"

g GE Power Management

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DESIGN VERIFICATION COVER PAGE

☐ ANO-1	☐ ANO-2	☐ IP-2	☐ IP-3	☐ JAF	☐ PLP
☐ PNPS	☐ VY	☐ GGNS	☒ RBS	☐ W3	☐ NP

Document No. **G13.18.6.2.ENS*004**	Revision No. **1**	Page 1 of 4

Title: **Loop Uncertainty Determination for Div III Loss of Voltage Relays – GE Model NGV Undervoltage Relay**

☒ Quality Related ☐ Augmented Quality Related

DV Method: ☒ Design Review ☐ Alternate Calculation ☐ Qualification Testing

VERIFICATION REQUIRED	DISCIPLINE	VERIFICATION COMPLETE AND COMMENTS RESOLVED (DV print, sign, and date)
☐	Electrical	
☐	Mechanical	
☒	Instrument and Control	**Justin Waters** Justin Waters 2/24/09
☐	Civil/Structural	
☐	Nuclear	
☐		
☐		

Originator:	**Charles Mohr** Charles Mohr 2/24/09 Print/Sign/Date After Comments Have Been Resolved

IDENTIFICATION:				DISCIPLINE:
Document Title: **Loop Uncertainty Determination for Div III Loss of Voltage Relays – GE Model NGV Undervoltage Relay**				☐ Civil/Structural ☐ Electrical
Doc. No.:	**G13.18.6.2.ENS*004**	Rev. 1	QA Cat.: SR	☒ I & C
Verifier:	Justin Waters Print	Justin Waters Sign	2/24/09 Date	☐ Mechanical ☐ Nuclear
Manager authorization for supervisor performing Verification. ☐ N/A	Print	Sign	Date	☐ Other
METHOD OF VERIFICATION: Design Review ☒	Alternate Calculations ☐		Qualification Test ☐	

The following basic questions are addressed as applicable, during the performance of any design verification. [ANSI N45.2.11 – 1974] [NP] [QAPD, Part II, Section 3] [NQA-1-1994, Part II, BR 3, Supplement 3s-1].

NOTE The reviewer can use the "Comments/Continuation sheet" at the end for entering any comment/resolution along with the appropriate question number. Additional items with new question numbers can also be entered.

1. Design Inputs – Were the inputs correctly selected and incorporated into the design?

   (Design inputs include design bases, plant operational conditions, performance requirements, regulatory requirements and commitments, codes, standards, field data, etc. All information used as design inputs should have been reviewed and approved by the responsible design organization, as applicable.

   All inputs need to be retrievable or excerpts of documents used should be attached.

   See site specific design input procedures for guidance in identifying inputs.)

   Yes ☒ No ☐ N/A ☐

2. Assumptions – Are assumptions necessary to perform the design activity adequately described and reasonable? Where necessary, are assumptions identified for subsequent re-verification when the detailed activities are completed? *Are the latest applicable revisions of design documents utilized?*

   Yes ☒ No ☐ N/A ☐

3. Quality Assurance – Are the appropriate quality and quality assurance requirements specified?

   Yes ☒ No ☐ N/A ☐

4. Codes, Standards and Regulatory Requirements – Are the applicable codes, standards and regulatory requirements, including issue and addenda properly identified and are their requirements for design met?
Yes ☒ No ☐ N/A ☐

5. Construction and Operating Experience – Have applicable construction and operating experience been considered?
Yes ☐ No ☐ N/A ☒

6. Interfaces – Have the design interface requirements been satisfied and documented?
Yes ☐ No ☐ N/A ☒

7. Methods – Was an appropriate design or analytical (for calculations) method used?
Yes ☒ No ☐ N/A ☐

8. Design Outputs – Is the output reasonable compared to the inputs?
Yes ☒ No ☐ N/A ☐

9. Parts, Equipment and Processes – Are the specified parts, equipment, and processes suitable for the required application?
Yes ☐ No ☐ N/A ☒

10. Materials Compatibility – Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?
Yes ☐ No ☐ N/A ☒

11. Maintenance requirements – Have adequate maintenance features and requirements been specified?
Yes ☐ No ☐ N/A ☒

12. Accessibility for Maintenance – Are accessibility and other design provisions adequate for performance of needed maintenance and repair?
Yes ☐ No ☐ N/A ☒

13. Accessibility for In-service Inspection – Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?
Yes ☐ No ☐ N/A ☒

14. Radiation Exposure – Has the design properly considered radiation exposure to the public and plant personnel?
Yes ☐ No ☐ N/A ☒

15. Acceptance Criteria – Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?
Yes ☒ No ☐ N/A ☐

16. Test Requirements – Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?
Yes ☐ No ☐ N/A ☒

17. Handling, Storage, Cleaning and Shipping – Are adequate handling, storage, cleaning and shipping requirements specified?
Yes ☐ No ☐ N/A ☒

18. Identification Requirements – Are adequate identification requirements specified?
Yes ☐ No ☐ N/A ☒

19. Records and Documentation – Are requirements for record preparation, review, approval, retention, etc., adequately specified? Are all documents prepared in a clear legible manner suitable for microfilming and/or other documentation storage method? Have all impacted documents been identified for update as necessary?
Yes ☒ No ☐ N/A ☐

20. Software Quality Assurance- ENN sites: For a calculation that utilized software applications (e.g., GOTHIC, SYMCORD), was it properly verified and validated in accordance with EN- IT-104 or previous site SQA Program?
ENS sites: This is an EN-IT-104 task. However, per ENS-DC-126, for exempt software, was it verified in the calculation?
Yes ☐ No ☐ N/A ☒

21. Has adverse impact on peripheral components and systems, outside the boundary of the document being verified, been considered?
Yes ☐ No ☐ N/A ☒

Comments / Continuation Sheet

Question #	Comments	Resolution	Initial/Date
1	Comments provided by markup for calculation G.13.18.6.2-ENS*004.	Comments resolved to the satisfaction of the reviewer.	JW 2/24/09

Calculation G13.18.6.2-ENS*004, Rev. 001 (EOI Review Comments)

Comments / Continuation Sheet

Question #	Comments	Resolution	Initial/Date
1	Calc number should be G13.18.6.2-ENS*004	Corrected	
2	Calc ref sheet does list the following references from the original calc. Should they be listed in Section VI of the form as being removed? 0221.415-000-122 3221.418-000-003U STP-302-0102	Agreed, those are not used.	
3	Should a reference be added to show where the Setting value of 87 VAC is derived in Section 8.1.1?	I think that's a good idea – the setting doesn't appear to be referenced anywhere. Added reference to STP in Section 8.1.1	
4	Use Ref. 3.11.1 for the STP in Section 8.9 instead of directly referring to it like was done in Section 8.2.3.	Agreed, although this paragraph will be removed per comment below.	
5	Your change in the first paragraph to Section 8.9 now references the STP As-Left reset tolerance. However, the original paragraph pertained to the reset differential value itself, not its tolerance. The current STP revision shows the Reset Differential as 95.70 VAC or 10% of setting. This is stated in the second paragraph of Section 8.9. Based on this I don't believe the first paragraph is required anymore since the rest is now the same whether the relay is calibrated or not calibrated during performance of the STP.	Agreed – first paragraph serves no purpose. Removed. (changes page count)	
		Note: Per discussion, margin was added to the LU to bring it up to previous value. No margin added to TLU. See Section 8.6 and 2.1.	