1. **GENERAL INFORMATION:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Make |  |  | Panel Ref: |  |
| Model |  |  | Designation. |  |
| Sr. No. |  |  | Drawing & Sh. No. |  |
| Version |  |  | Aux. Voltage |  |
| Order No. |  |  | Rated Frequency |  |
| Software |  |  | Rated Current |  |

1. **MECHANICAL CHECK AND VISUAL INSPECTION (TICK IF VERIFIED)**

 As Per TCS –P–105 Rev -1, Item no 4.1

|  |  |  |
| --- | --- | --- |
| item | Description | Remarks |
| 1 | Check tightness of all connections | ❑ Yes | ❑ N/A |
| 2 | Inspect for physical damage / defects | ❑ Yes | ❑ N/A |
| 3 | CT shorting checked | ❑ Yes | ❑ N/A |
| 4 | Indications checked | ❑ Yes | ❑ N/A |
| 5 | Contact resistance of tripping and alarm checked | ❑ Yes | ❑ N/A |
| 6 | Check the ferrules as per specification | ❑ Yes | ❑ N/A |
| 7 | Panel Earthing checked | ❑ Yes | ❑ N/A |
| 8 | Check case cover and gasket for proper seal against dust. | ❑ Yes | ❑ N/A |
| 9 | Check all installed equipment nameplate information for compliance to approved drawings and equipment /material lists.  | ❑ Yes | ❑ N/A |
| 10 | For all internal and external panel wiring, confirm that all screw terminations are tight and that crimp connectors are firmly secured to the wire and to the termination point. Ensure that no part of the wire is bent at the termination point.  | ❑ Yes | ❑ N/A |
| 11 | Check that panel equipment is mounted securely and protected against mal operation due to vibration, shock, etc | ❑ Yes | ❑ N/A |
| 12 | Use of ring type terminals for wire termination for current circuit wires. | ❑ Yes | ❑ N/A |
| 13 | Relay terminal is isolated from the system terminal CTs | ❑ Yes | ❑ N/A |
| 14 | Relay trips and alarms have all been isolated | ❑ Yes | ❑ N/A |

1. **ELECTRICAL TESTS:**

As per TCS –P–105 Rev -1, Item no 4.2

* 1. **FUNCTION Test:**

|  |  |  |
| --- | --- | --- |
| Item | Description | Remarks |
| 1 | Human Machine Interface (HMI) Checked. | ❑ Yes | ❑ N/A |
| 2 | Case Earthing checked. | ❑ Yes | ❑ N/A |
| 3 | LED’s Function Checked. | ❑ Yes | ❑ N/A |
| 4 | Trip Contacts Checked. | ❑ Yes | ❑ N/A |
| 5 | Reset Function Checked | ❑ Yes | ❑ N/A |
| 6 | Group active Functions Checked | ❑ Yes | ❑ N/A |
| 7 | Binary inputs checked. | ❑ Yes | ❑ N/A |
| 8 | Output Relays Checked | ❑ Yes | ❑ N/A |
| 9 | Event Display on HMI Screen Checked | ❑ Yes | ❑ N/A |
| 10 | Test switch / plug checked for correct function. | ❑ Yes | ❑ N/A |
| 11 | Watchdog contacts checked | ❑ Yes | ❑ N/A |

* 1. **ANALOG INPUT MEASUREMENTS**

Main CT Ratio: ------ A Main VT Ratio: ---------- V

Neutral VT Ratio: --------- V

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel | Duty | Injected Values | Calculated Values | Measured Values |
| Secondary | Primary | Primary |
|  |  |  |  |  |  |
| IAW-Z01:02 | CT - Phase A |  |  |  |  |
| IBW-Z03:04 | CT - Phase B |  |  |  |  |
| ICW-Z05:06 | CT - Phase B |  |  |  |  |
|  |  |  |  |  |  |
| IAX-Z07:08 | CT - Spare |  |  |  |  |
| IBX-Z09:10 | CT - Neutral |  |  |  |  |
| ICX-Z11:12 | CT - Spare |  |  |  |  |
|  |  |  |  |  |  |
| VAY-Z13:14 | VT - Phase A |  |  |  |  |
| VBY-Z15:16 | VT - Phase B |  |  |  |  |
| VCY-Z17:18 | VT - Phase B |  |  |  |  |
|  |  |  |  |  |  |
| VAZ-Z19:20 | Neutral VT |  |  |  |  |
| VBZ-Z21:22 | VT - Spare |  |  |  |  |
| VCZ-Z23:24 | VT - Spare |  |  |  |  |
|  |  |  |  |  |  |
| V AB | Phase A to Phase B |  |  |  |  |
| V BC | Phase B to Phase C |  |  |  |  |
| V CA | Phase C to Phase A |  |  |  |  |
|  |  |  |  |  |  |
| Frequency | - |  |  |  |  |
|  |  |  |  |  |  |
| Active Power | - |  |  |  |  |
|  |

* 1. **CHECKING OF BINARY OUTPUTS, INPUTS AND LED’S**

Slot A- Main Board

|  |  |  |  |
| --- | --- | --- | --- |
| Slot No. | B I/O No. | Relay Terminals | Checked |
| A | BO. 101 | A01:A02 (NO) | ❑ Yes | ❑ N/A |
| A | BO. 102 | A03:A04 (NO) | ❑ Yes | ❑ N/A |
| A | BO. 103 | A05:A06 (NO) | ❑ Yes | ❑ N/A |
| A | BO. 104 | A07:A08 (NO) | ❑ Yes | ❑ N/A |
| A | BO. 105 | A09:A10 (NO) | ❑ Yes | ❑ N/A |
| A | BO. 106 | A12:A11 (NC) | ❑ Yes | ❑ N/A |
| A12:A13 (NO) | ❑ Yes | ❑ N/A |
| A | BO. 107 | A15:A14 (NC) | ❑ Yes | ❑ N/A |
| A15:A16 (NO) | ❑ Yes | ❑ N/A |
| A | BO. 108 (Watchdog) | A18:A17 (NC) | ❑ Yes | ❑ N/A |
| A18:A19 (NO) | ❑ Yes | ❑ N/A |
|  |  |  |  |  |
| A | BI. 01 | A20:A21 | ❑ Yes | ❑ N/A |
| A | BI. 02 | A22:A23 | ❑ Yes | ❑ N/A |
| A | BI. 03 | A24:A25 | ❑ Yes | ❑ N/A |
| A | BI. 04 | A26:A27 | ❑ Yes | ❑ N/A |
| A | BI. 05 | A28:A29 | ❑ Yes | ❑ N/A |
| A | BI. 06 | A30:A31 | ❑ Yes | ❑ N/A |
| A | BI. 07 | A32:A33 | ❑ Yes | ❑ N/A |

Slot B- Interface Board

|  |  |  |  |
| --- | --- | --- | --- |
| Slot No. | B I/O No. | Relay Terminals | Checked |
| B | BO. 201 | B01:B02 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 202 | B03:B04 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 203 | B05:B06 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 204 | B07:B08 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 205 | B09:B10 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 206 | B11:B12 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 207 | B13:B14 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 208 | B15:B16 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 209 | B17:B18 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 210 | B19:B20 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 211 | B21:B22 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 212 | B23:B24 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 213 | B25:B26 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 214 | B28:B27 (NC) | ❑ Yes | ❑ N/A |
| B28:B29 (NO) | ❑ Yes | ❑ N/A |
| B | BO. 215 | B31:B30 (NC) | ❑ Yes | ❑ N/A |
| B31:B32 (NO) | ❑ Yes | ❑ N/A |
| B | BI. 01 | B33:B34 | ❑ Yes | ❑ N/A |
| B | BI. 02 | B35:B36 | ❑ Yes | ❑ N/A |
| B | BI. 03 | B37:B38 | ❑ Yes | ❑ N/A |
| B | BI. 04 | B39:B40 | ❑ Yes | ❑ N/A |
| B | BI. 05 | B41:B42 | ❑ Yes | ❑ N/A |
| B | BI. 06 | B43:B44 | ❑ Yes | ❑ N/A |
| B | BI. 07 | B45:B46 | ❑ Yes | ❑ N/A |
| B | BI. 08 | B47:B48 | ❑ Yes | ❑ N/A |

LED’s Function Test

|  |  |  |
| --- | --- | --- |
| LED No. | Color | Checked |
| 1 | Red | ❑ Yes | ❑ N/A |
| 2 | Red | ❑ Yes | ❑ N/A |
| 3 | Red | ❑ Yes | ❑ N/A |
| 4 | Red | ❑ Yes | ❑ N/A |
| 5 | Red | ❑ Yes | ❑ N/A |
| 6 | Red | ❑ Yes | ❑ N/A |
| 7 | Red | ❑ Yes | ❑ N/A |
| 8 | Red | ❑ Yes | ❑ N/A |
| 9 | Red | ❑ Yes | ❑ N/A |
| 10 | Red | ❑ Yes | ❑ N/A |
| 11 | Red | ❑ Yes | ❑ N/A |
| 12 | Red | ❑ Yes | ❑ N/A |
| 13 | Red | ❑ Yes | ❑ N/A |
| 14 | Red | ❑ Yes | ❑ N/A |
| 15 | Red | ❑ Yes | ❑ N/A |
| 16 | Red | ❑ Yes | ❑ N/A |

Push Button LED’s Function Test

|  |  |  |
| --- | --- | --- |
| LED No. | Color | Checked |
| 1 | Yellow | ❑ Yes | ❑ N/A |
| 2 | Yellow | ❑ Yes | ❑ N/A |
| 3 | Yellow | ❑ Yes | ❑ N/A |
| 4 | Yellow | ❑ Yes | ❑ N/A |
| 5 | Yellow | ❑ Yes | ❑ N/A |
| 6 | Yellow | ❑ Yes | ❑ N/A |
| 7 | Yellow | ❑ Yes | ❑ N/A |
| 8 | Yellow | ❑ Yes | ❑ N/A |

1. **GROUND OVERCURRENT PROTECTION (50G):**

Stage1:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Phase | Set Current (A) | Pickup (A) | Drop off (A) | Set Time (sec) | Injected Current ( 2 \* Is) | measured Time (sec) |
| N |  |  |  |  |  |  |
|  |  |  |  |  |  |

Stage2:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Phase | Set Current (A) | Pickup (A) | Drop off (A) | Set Time (sec) | Injected Current ( 2 \* Is) | measured Time (sec) |
| N |  |  |  |  |  |  |
|  |  |  |  |  |  |

1. **DIRECTIONAL PHASE TIME OVERCURRENT PROTECTION**

Over Current Pick & Drop Off Checking

Set E32 = N

* 1. Phase Instantaneous Over Current Element (E50P):

|  |  |  |  |
| --- | --- | --- | --- |
| Phase | 50P1P Settings | Pick Up | Drop Off |
| R |  |  |  |
|  |  |  |
| Y |  |  |  |
|  |  |  |
| B |  |  |  |
|  |  |  |

* + 1. **TIME DELAY OVER CURRENT ELEMENT (67PD):**
* Inject current = 2 \* setting current

|  |  |  |
| --- | --- | --- |
| Phase | 67P1D Settings | Measured Time |
| R |  |  |
|  |  |
| Y |  |  |
|  |  |
| B |  |  |
|  |  |

* + 1. **IEC STANDARD INVERSE CURVE**

Settings: 51s1o = imaxl, 51s1p = a, 51s1c = c1, 51s1td = , 51s1tc =

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Current (A) | Curve | Injected Current  ( 2 \* Is) | Calculated Time (sec) | Measured Time (sec) |
| R |  | C1 |  |  |  |
| Y |  | C1 |  |  |  |
| B |  | C1 |  |  |  |

* + 1. **IEC VERY INVERSE CURVE**

Settings: 51s1o = imaxl, 51s1p = , 51s1c = c2, 51s1td = , 51s1tc =

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Current (A) | Curve | Injected Current ( 2 \* Is) | Calculated Trip Time (sec) | Measured Time (sec) |
| R |  | C2 |  |  |  |
| Y |  | C2 |  |  |  |
| B |  | C2 |  |  |  |

* + 1. **IEC SHORT TIME INVERSE CURVE**

Settings: 51s1o = imaxl, 51s1p = a, 51s1c = c5, 51s1td = , 51s1tc =

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Current (A) | Curve | Injected Current ( 2 \* Is) | Calculated Trip Time (sec) | Measured Time (sec) |
| R |  | C5 |  |  |  |
| Y |  | C5 |  |  |  |
| B |  | C5 |  |  |  |

* 1. **CHECKING THE DIRECTIONAL ELEMENT E32**

Set directional over current as a definite time

Set 67P1D = MINIMUM SETTING 2 CYCLE

Set E32 = Y

Check setting of output contact for testing directional element.

Set 50P1P =

Calculation:

Z2C= Re {V2 \* 1∟Z1\* I2} / (I2)2 = [|V2| / |I2|] \* COS (∟V2 – ∟Z1 - ∟I2)

I2 = V2 / Z2

|ITEST| =|3I2| =|3V2|/ |Z2F|

CT RW = , CTRX= , PTRY= , VNOMY = , PTRZ = , VNOMZ =

Z1MAG= , Z1ANG=

Current test 50FP and 50RP test

Fix the settings of Z2F= Ω, Z2R = Ω, a2= , K2=

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PHASE | 50FP | PICK UP | DROP OFF | 50RP | PICK UP | DROP OFF |
| R-N |  |  |  |  |  |  |
|  |  |  |  |  |  |
| Y-N |  |  |  |  |  |  |
|  |  |  |  |  |  |
| B-N |  |  |  |  |  |  |
|  |  |  |  |  |  |

* + 1. **IMPEDANCE Z2F TEST**

 Fix Settings of 50FP= A, 50RP= A, a2= , K2=

Applied Impedance Angle = Z1ANG

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Settings Of Z2F  | Applied Voltage  | \*\*Injected Current= Applied Voltage / (Z2F)  | Pick Up Current | Calculated Pick Up Z2F |
| R-N |  |  |  |  |  |
|  |  |  |  |  |
| Y-N |  |  |  |  |  |
|  |  |  |  |  |
| B-N |  |  |  |  |  |
|  |  |  |  |  |
| R-Y-B |  |  |  |  |  |
|  |  |  |  |  |

\*\* The injected current must be >= 50FP

* + 1. **IMPEDANCE Z2R TEST**

Fix Settings of 50FP= A, 50RP= A, a2= , K2=

APPLIED IMPEDANCE ANGLE = Z1ANG

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| PHASE | SETTINGS OF Z2R | APPLIED VOLTAGE  | \*\*INJECTED CURRENT= APPLIED VOLTAGE / (Z2R)  | PICK UP CURRENT | CALCULATED PICK UP Z2R |
| R-N |  |  |  |  |  |
|  |  |  |  |  |
| Y-N |  |  |  |  |  |
|  |  |  |  |  |
| B-N |  |  |  |  |  |
|  |  |  |  |  |
| R-Y-B |  |  |  |  |  |
|  |  |  |  |  |

\*\* The injected current must be >= 50FP

* + 1. **OPERATIONAL AREA TESTING**

Z1MAG= , Z2F= Ω, Z2R = Ω, a2= , K2= , 50Q3P = ,

DIRECTION SETTING DIR3 =

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | Settings of Z1ANG | Applied VOLTAGE  | Injected current | Phase Angle |
| R-N |  |  |  |  |
|  |  |  |  |
| Y-N |  |  |  |  |
|  |  |  |  |
| B-N |  |  |  |  |
|  |  |  |  |
| R-Y-B |  |  |  |  |
|  |  |  |  |

* + 1. **CHECKING OF A2 AND K2**

Z1MAG= , Z1ANG= , Z2F= Ω, Z2R = Ω, a2= , K2= , 50P1P = ,

DIRECTION SETTING DIR3 =

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Phase | Settings of a2 and k2 | Applied Voltage | Pick Up Injected Current I2 | Phase Angle IN Operating Area | a2 | k2 |
| R-N |  |  |  |  |  |  |
|  |  |  |  |  |  |
| Y-N |  |  |  |  |  |  |
|  |  |  |  |  |  |
| B-N |  |  |  |  |  |  |
|  |  |  |  |  |  |
| R-Y-B |  |  |  |  |  |  |
|  |  |  |  |  |  |

1. **NEGATIVE SEQUENCE DIRECTIONAL OVER CURRENT PROTECTION (67Q).**
	1. **CHECKING THE NEGATIVE-SEQUENCE**

Instantaneous Over current Element, E50Q1

Set 67Q3D = MINIMUM SETTING 2 CYCLE

Set E32 = N

Check setting of output contact for testing.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | 50Q3P Setting | Calculated Expected Current | Pick Up | Drop Off |
| R-N |  | 3\* 50Q3P |  |  |
|  | 3\* 50Q3P |  |  |
| Y-N |  | 3\* 50Q3P |  |  |
|  | 3\* 50Q3P |  |  |
| B-N |  | 3\* 50Q3P |  |  |
|  | 3\* 50Q3P |  |  |
| R-Y |  | √3 \* 50Q3P |  |  |
|  | √3 \* 50Q3P |  |  |
| Y-B |  | √3 \* 50Q3P |  |  |
|  | √3 \* 50Q3P |  |  |
| B-R |  | √3 \* 50Q3P |  |  |
|  | √3 \* 50Q3P |  |  |

* 1. **CHECKING THE DIRECTIONAL ELEMENT E32**

Set 67Q3D = Minimum Setting 2 Cycle

Set E32 = Y

Check setting of output contact for testing directional element.

Set 50Q3P =

Calculation:

Z2C= Re {V2 \* 1∟Z1\* I2} / (I2)2 = [|V2| / |I2|] \* COS (∟V2 – ∟Z1 - ∟I2)

I2 = V2 / Z2

|ITEST| =|3I2| =|3V2|/ |Z2F|

CT RW = , CTRX= , PTRY= , VNOMY = , PTRZ = , VNOMZ =

Z1MAG= , Z1ANG=

* + 1. **CURRENT TEST 50FP AND 50RP TEST**

Fix the settings of Z2F= Ω, Z2R = Ω, a2= , K2=

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PHASE | 50FP | PICK UP | DROP OFF | 50RP | PICK UP | DROP OFF |
| R-N |  |  |  |  |  |  |
|  |  |  |  |  |  |
| Y-N |  |  |  |  |  |  |
|  |  |  |  |  |  |
| B-N |  |  |  |  |  |  |
|  |  |  |  |  |  |

* + 1. **IMPEDANCES Z2F TEST**

Fix Settings of 50FP= A, 50RP= A, a2= , K2=

APPLIED IMPEADANCE ANGLE = Z1ANG

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Settings of Z2F | Applied Voltage | \*\*Injected Current= Applied Voltage / (Z2F) | Pick Up Current | Calculated Pick Up Z2F |
| R-N |  |  |  |  |  |
|  |  |  |  |  |
| Y-N |  |  |  |  |  |
|  |  |  |  |  |
| B-N |  |  |  |  |  |
|  |  |  |  |  |
| R-Y-B |  |  |  |  |  |
|  |  |  |  |  |

\*\* The injected current must be >= 50FP

* + 1. **IMPEDANCES Z2R TEST:**

Fix Settings of 50FP= A, 50RP= A, a2= , K2=

Applied Impeadance Angle = Z1ANG

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Settings of Z2R | Applied Voltage  | \*\*Injected Current= Applied Voltage / (Z2R)  | Pick Up Current | Calculated Pick Up Z2R |
| R-N |  |  |  |  |  |
|  |  |  |  |  |
| Y-N |  |  |  |  |  |
|  |  |  |  |  |
| B-N |  |  |  |  |  |
|  |  |  |  |  |
| R-Y-B |  |  |  |  |  |
|  |  |  |  |  |

\*\* The injected current must be >= 50FP

* + 1. **OPERATIONAL AREA TESTING**

Z1MAG= , Z2F= Ω, Z2R = Ω, a2= , K2= , 50Q3P = ,

DIRECTION SETTING DIR3 =

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | Settings of Z1ANG | Applied Voltage  | Injected current | Phase Angle |
| R-N |  |  |  |  |
|  |  |  |  |
| Y-N |  |  |  |  |
|  |  |  |  |
| B-N |  |  |  |  |
|  |  |  |  |
| R-Y-B |  |  |  |  |
|  |  |  |  |

* + 1. **CHECKING OF A2 AND K2**

Z1MAG= , Z1ANG= , Z2F= Ω, Z2R = Ω, a2= , K2= , 50Q3P = ,

Direction Setting DIR3 =

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Phase | Setting of a2 and k2 | Applied Voltage | Pick up Injected current I2 | Phase Angle in Operating Area | a2 | k2 |
| R-N |  |  |  |  |  |  |
|  |  |  |  |  |  |
| Y-N |  |  |  |  |  |  |
|  |  |  |  |  |  |
| B-N |  |  |  |  |  |  |
|  |  |  |  |  |  |
| R-Y-B |  |  |  |  |  |  |
|  |  |  |  |  |  |

1. **UNDER VOLTAGE PROTECTION (27):**

Stage1:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Voltage (V) | Pickup (V) | Drop off (V) | Set Time (sec) | Actual Trip Time (sec) |
| R |  |  |  |  |  |
| Y |  |  |  |  |  |
| B |  |  |  |  |  |
| R-Y-B |  |  |  |  |  |

Stage2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Voltage (V) | Pickup (V) | Drop off (V) | Set Time (sec) | Actual Trip Time (sec) |
| R |  |  |  |  |  |
| Y |  |  |  |  |  |
| B |  |  |  |  |  |
| R-Y-B |  |  |  |  |  |

1. **OVER VOLTAGE PROTECTION (59):**

Stage1:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Voltage (V) | Pickup (V) | Drop off (V) | Set Time (sec) | Actual Trip Time (sec) |
| R |  |  |  |  |  |
| Y |  |  |  |  |  |
| B |  |  |  |  |  |
| R-Y-B |  |  |  |  |  |

Stage2:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Voltage (V) | Pickup (V) | Drop off (V) | Set Time (sec) | Actual Trip Time (sec) |
| R |  |  |  |  |  |
| Y |  |  |  |  |  |
| B |  |  |  |  |  |
| R-Y-B |  |  |  |  |  |

1. **BREAKER FAILURE PROTECTION (50BF):**

Stage1

Settings: 50FP1 = A, Retrip Time Delay = 8CYCLES, BFI3P1= TRIP

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Current (A) | Pickup (A) | Drop off (A) | Set Time (sec) | Actual Trip Time (sec) |
| R |  |  |  |  |  |
| Y |  |  |  |  |  |
| B |  |  |  |  |  |

Stage2

Settings: 50FP1 = A, Breaker Failure Time Delay = CYCLES, BFI3P1= TRIP

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Current (A) | Pickup (A) | Drop off (A) | Set Time (sec) | Actual Trip Time (sec) |
| R |  |  |  |  |  |
| Y |  |  |  |  |  |
| B |  |  |  |  |  |

1. **FINAL SETTING:**
	1. **DIRECTIONAL PHASE TIME OVERCURRENT PROTECTION :**

IEC Standard Inverse Curve

Settings: 51s1o = imaxl, 51s1p = a, 51s1c = c1, 51s1td = , 51s1tc =

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Current (A) | Curve | Injected Current ( 2 \* Is) | Calculated Time (sec) | Measured Time (sec) |
| R |  | C1 |  |  |  |
| Y |  | C1 |  |  |  |
| B |  | C1 |  |  |  |

* 1. **CHECKING THE DIRECTIONAL ELEMENT E32**

Checking Z2F (According To Direction Setting)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | Applied Voltage  | \*\*Injected Current= Applied Voltage / (Z2F)  | Pick Up Current | Calculated Pick Up Z2F |
| R-N |  |  |  |  |
| Y-N |  |  |  |  |
| B-N |  |  |  |  |
| R-Y-B |  |  |  |  |

**CHECKING Z2R (ACCORDING TO DIRECTION SETTING)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | Applied Voltage  | \*\*Injected Current= Applied Voltage / (Z2F)  | Pick Up Current | Calculated Pick Up Z2F |
| R-N |  |  |  |  |
| Y-N |  |  |  |  |
| B-N |  |  |  |  |
| R-Y-B |  |  |  |  |

**OPERATIONAL AREA TESTING:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | Settings of Z1ANG | Applied Voltage  | Injected Current | Phase Angle |
| R-N |  |  |  |  |
| Y-N |  |  |  |  |
| B-N |  |  |  |  |
| R-Y-B |  |  |  |  |

* 1. **GROUND OVERCURRENT PROTECTION (50G)**

Stage1:

Settings: 50g1P = , Delay Time = , 67g1tc =

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Phase | Set Current (A) | Pickup (A) | Drop off (A) | Set Time (sec) | Injected Current ( 2 \* Is) | Measured Time (sec) |
| N |  |  |  |  |  |  |

Stage2:

Settings: 50g2P = 0.5 A, Delay Time = 5sec, 67g2tc = 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | Pickup (A) | Drop off (A) | Injected Current ( 2 \* Is) | Measured Time (sec) |
| N |  |  |  |  |

* 1. **NEGATIVE SEQUENCE DIRECTIONAL OVER CURRENT PROTECTION (67Q)**

Settings: CTRW = , PTRW , VNOM = , Z1MAG= , Z1ANG= , Z0MAG= , Z0ANG= , E32 = , DIR3 = , Order Ground Dir.Elment Priority = ,

50FP = A, 50RP = A, Z2F = Ohms, Z2R = Ohms, a2 = , k2 = , 50Q3P=

* + 1. **INSTANTANEOUS NEGATIVE SEQUENCE OVER CURRENT ELEMENT, E50Q1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | 50q3p  | Calculated Expected Current | Pick Up | Drop Off |
| R-N |  | 3\* 50Q3P |  |  |
| Y-N |  | 3\* 50Q3P |  |  |
| B-N |  | 3\* 50Q3P |  |  |
| R-Y |  | √3 \* 50Q3P |  |  |
| Y-B |  | √3 \* 50Q3P |  |  |
| B-R |  | √3 \* 50Q3P |  |  |

* + 1. **CHECKING THE DIRECTIONAL ELEMENT E32**
			- 1. Checking Z2F (According To Direction Setting)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | Applied Voltage  | \*\*Injected Current= Applied Voltage / (Z2F)  | Pick Up Current | Calculated Pick Up Z2F |
| R-N |  |  |  |  |
| Y-N |  |  |  |  |
| B-N |  |  |  |  |
| R-Y-B |  |  |  |  |

* + - * 1. Checking Z2R (According To Direction Setting)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | Applied Voltage  | \*\*Injected Current= Applied Voltage / (Z2F)  | Pick Up Current | Calculated Pick Up Z2F |
| R-N |  |  |  |  |
| Y-N |  |  |  |  |
| B-N |  |  |  |  |
| R-Y-B |  |  |  |  |

* + - * 1. Operational area testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | Settings Of Z1ang | Applied Voltage  | Injected Current | Phase Angle |
| R-N |  |  |  |  |
| Y-N |  |  |  |  |
| B-N |  |  |  |  |
| R-Y-B |  |  |  |  |

* 1. **UNDER VOLTAGE PROTECTION (27):**

Stage1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Voltage (V) | Pickup (V) | Drop off (V) | Set Time (sec) | Actual Trip Time (sec) |
| R |  |  |  |  |  |
| Y |  |  |  |  |  |
| B |  |  |  |  |  |
| R-Y-B |  |  |  |  |  |

Stage2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Voltage (V) | Pickup (V) | Drop off (V) | Set Time (sec) | Actual Trip Time (sec) |
| R |  |  |  |  |  |
| Y |  |  |  |  |  |
| B |  |  |  |  |  |
| R-Y-B |  |  |  |  |  |

* 1. **OVER VOLTAGE PROTECTION (59):**

Stage1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Voltage (V) | Pickup (V) | Drop off (V) | Set Time (sec) | Measured Time (sec) |
| R |  |  |  |  |  |
| Y |  |  |  |  |  |
| B |  |  |  |  |  |
| R-Y-B |  |  |  |  |  |

Stage2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Voltage (V) | Pickup (V) | Drop off (V) | Set Time (sec) | Measured Time (sec) |
| R |  |  |  |  |  |
| Y |  |  |  |  |  |
| B |  |  |  |  |  |
| R-Y-B |  |  |  |  |  |

* 1. **BREAKER FAILURE PROTECTION (50BF):**

Stage1

Settings: 50FP1 = A, Retrip Time Delay = CYCLES , BFI3P1= TRIP

|  |  |  |  |
| --- | --- | --- | --- |
| Phase | Pickup (A) | Drop off (A) | Measured Time (SEC) |
| R |  |  |  |
| Y |  |  |  |
| B |  |  |  |

Stage2

Settings: 50FP1 = A, Breaker Failure Time Delay = CYCLES,

BFI3P1= TRIP

|  |  |  |  |
| --- | --- | --- | --- |
| Phase | Pickup (A) | Drop off (A) | Measured Time (SEC) |
| R |  |  |  |
| Y |  |  |  |
| B |  |  |  |