**Relay Identification:**

|  |  |  |  |
| --- | --- | --- | --- |
| Panel Ref | : R02.2 | Panel Name | :  |
| Relay Ref | : F87T-2 | Model No | : 8IDVL4F2CSDF8QNL |
| Sr. No | :  |  |  |
| Manufacture | : ZIV | Frequency | : 60Hz |
| WINDING-1 Ratio | : 600/1 A | GND-1 Ratio | : 600/1 A  |
| WINDING-2 Ratio | : 3600/1 A | GND-2 Ratio | : 3600/1 A |
| SEF CT Ratio | : 800/1 A | PT ratio | : 132/13.8 KV |

1. **MECHANICAL CHECKS AND VISUAL INSPECTION:**

|  |  |  |
| --- | --- | --- |
| **S.N.** | **General Checks** | **Status** |
| **1** | Inspect for no physical damage. | OK |
| **2** | Verify the wiring connection as per approved drawing. | OK |
| **3** | Relay case connected to a local earth bar. | OK |
| **4** | Power up the relay circuit and check relay are healthy. | OK |
| **6** | Send the relay setting configuration file to relay through Port F. | OK |
| **7** | Check the watchdog contact (B10-B7 NC) (B10-B9 NO) | OK |

1. **ELECTRICAL TESTS:**

|  |  |  |
| --- | --- | --- |
| **ITEM** | **DESCRIPTION** | **CHECKED** |
| 1 | Case Earth checked | OK |
| 2 | Test switch checked for correct function. | OK |
| 3 | Human Machine Interface (HMI) checked | OK |
| 4 | Indications Checked | OK |
| 5 | Reset of indications checked. | OK |

1. **Secondary Injection Test for The Differential Relay:**

Transformer Voltage : 132/13.8kV

Transformer Capacity : 67 MVA

HV CT Ratio : 600/1 A

LV CT Ratio : 3600/1 A

 Star Point for Side 1 is : Earthed

 Star Point for Side 2 is : Earthed

Transformer Side 1 Connection : (Y) WYE

Transformer Side 2 Connection : (Y) WYE

Transformer Vector Group : YNyn0d1

1. VOLTAGE MEASUREMENTS:

|  |  |  |
| --- | --- | --- |
| **PHASES** | **Applied Sec Voltage (V)** | **Measured Primary Voltage (kV)** |
| A-N | 66.39 | 76.17 |
| B-N | 66.39 | 75.91 |
| C-N | 66.39 | 75.96 |
| A-B | 115 | 131.59 |
| B-C | 115 | 131.49 |
| A-C | 115 | 131.78 |

1. **MEASUREMENT CHECK:**
2. **HV Side:**

$$K=Transformer nominal sec. current \left(In\right)=\frac{Tran.MVA}{\sqrt{3} X Un X CTR\_{H.V} }= \frac{67MVA}{\sqrt{3} X 132kV\*600}=0.488$$

For Phase-neutral Fault $I\_{1}=\frac{I\_{inj}}{K \* KVG}=\frac{1}{0.488 \* 1.5}=1.366 A$ - Where KVG=1.5

For Phase-Phase or 3 PhaseFault $I\_{1}=\frac{I\_{inj}}{K\* KVG}=\frac{I\_{inj}}{0.488 \* 1}=2.049 A$ - Where KVG=1

$$I\_{differential}=| I\_{1}- I\_{2}|= I\_{1} in case of I\_{2}=0$$

$I\_{Restrain} =|I\_{1}+ I\_{2}|/2 = I\_{1}/2 in case of I\_{2}=0$

****

|  |  |  |  |
| --- | --- | --- | --- |
|  **Phase** | **I Inj. (A)** | **Calculated Value** | **Measurement Value** |
| **I prim (A)** | **I diff (PU)** | **I rest (PU)** | **I prim (A)** | **I diff (PU)** | **I rest (PU)** |
| R-N | 1 | 600 | 1.366 | 0.683 | 604 | 1.368 | 0.684 |
| Y-N | 1 | 600 | 1.366 | 0.683 | 601 | 1.361 | 0.681 |
| B-N | 1 | 600 | 1.366 | 0.683 | 602 | 1.363 | 0.862 |
| RY | 1 | 600 | 2.049 | 1.024 | 604 | 2.048 | 1.024 |
| YB | 1 | 600 | 2.049 | 1.024 | 602 | 2.043 | 1.022 |
| BR | 1 | 600 | 2.049 | 1.024 | 602 | 2.047 | 1.024 |
| RYB | 1 | 600 | 2.049 | 1.024 | 602 | 2.045 | 1.022 |

1. **LV Side:**

$$K=Transformer nominal sec. current \left(In\right)=\frac{Tran.MVA}{\sqrt{3} X Un X CTR\_{H.V}}= \frac{67MVA}{\sqrt{3} X 13.8 X 3600}=0.778$$

For Phase-neutral Fault $I\_{2}=\frac{I\_{inj}}{K \* KVG}=\frac{I\_{inj}}{0.778 \* 1.5}=0.854 A$ Where KVG=1.5

For Phase-Phase or 3 PhaseFault $I\_{1}=\frac{I\_{inj}}{K\* KVG}=\frac{I\_{inj}}{0.78 \* 1}=1.282 A$ - Where KVG=1

$$I\_{differential}=| I\_{1}- I\_{2}|= I\_{2} in case of I\_{1}=0$$

$I\_{Restrain} =|I\_{1}+ I\_{2}|/2 = I\_{2}/2 in case of I\_{1}=0$

|  |  |  |  |
| --- | --- | --- | --- |
|  **Phase** | **I Inj. (A)** | **Calculated Value** | **Measurement Value** |
| **I prim (KA)** | **I diff (PU)** | **I rest (PU)** | **I prim (KA)** | **I diff (PU)** | **I rest (PU)** |
| R-N | 1 | 3600 | 0.854 | 0.427 | 3.620 | 0.857 | 0.429 |
| Y-N | 1 | 3600 | 0.854 | 0.427 | 3.626 | 0.858 | 0.43 |
| B-N | 1 | 3600 | 0.854 | 0.427 | 3.629 | 0.859 | 0.43 |
| RY | 1 | 3600 | 1.282 | 0.641 | 3.629 | 1.286 | 0.644 |
| YB | 1 | 3600 | 1.282 | 0.641 | 3.629 | 1.288 | 0.645 |
| BR | 1 | 3600 | 1.282 | 0.641 | 3.626 | 1.288 | 0.645 |
| RYB | 1 | 3600 | 1.282 | 0.641 | 3.625 | 1.288 | 0.644 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  **Aux. Phase** | **I Inj. (A)** | **CT Ratio** | **Calculated Value (A)** | **Measurement Value (A)** |
| GND-1 | 1 | 600/1A | 600 | 598.21 |
| GND-2 | 1 | 3600/1A | 3600 | 3589 |
| SBEF | 1 | 800/1 A | 800 | 797.28 |

1. **Differential Low Set Test:**

**Calculated Values:**

Calculated Diff Current (Id) Value = K × (I Set Diff >) × KVG

 Where: - KVG (FACTOR) is according to transformer vector group as per following table:

 - PU /Trip/ drops off Values Calculation:

- Trip Value = K \* (I Set Diff >) \* KVG

I diff > set = 0.4

T diff > set = 0

1. **HV Side:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Fault****Type** | **Pickup Current = I d(A)** | **Drop off Current (A)** | **Trip time at****2\*I set (msec)** |
| **Calculated** | **Measured** |
| **R** | 0.292 | 0.292 | 0.236 | 31 |
| **Y** | 0.292 | 0.293 | 0.236 | 34 |
| **B** | 0.292 | 0.293 | 0.235 | 35 |
| **RY** | 0.195 | 0.195 | 0.156 | 26 |
| **YB** | 0.195 | 0.196 | 0.157 | 26 |
| **BR** | 0.195 | 0.196 | 0.157 | 26 |
| **RYB** | 0.195 | 0.195 | 0.157 | 26 |

 **Tolerance:** I diff = 3% or 50mA of set. Value, Operate. Time = 28 m Sec

1. **LV Side:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Fault****Type** | **Pickup Current = I d(A)** | **Drop off Current (A)** | **Trip time at****2\*I set (msec)** |
| **Calculated** | **Measured** |
| **R** | 0.466 | 0.466 | 0.374 | 33 |
| **Y** | 0.466 | 0.466 | 0.373 | 32 |
| **B** | 0.466 | 0.465 | 0.373 | 34 |
| **RY** | 0.311 | 0.311 | 0.249 | 26 |
| **YB** | 0.311 | 0.310 | 0.249 | 27 |
| **BR** | 0.311 | 0.310 | 0.249 | 27 |
| **RYB** | 0.311 | 0.310 | 0.248 | 28 |

 **Tolerance:** I diff = 3% or 50mA of set. Value, Operate. Time = 28 m Sec

1. **Differential High Set Test :**

 Diff >> set = 10 I/Ins

 T diff >> set = 0

1. **High Voltage Side:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Fault****Type** | **Pickup Current = I d(A)** | **Drop off Current (A)** | **Trip time at****2\*I set (mSec)** |
| **Calculated** | **Measured** |
| **R** | 7.32 | 7.305 | 6.95 | 26 |
| **Y** | 7.32 | 7.307 | 6.96 | 26 |
| **B** | 7.32 | 7.09 | 6.92 | 27 |
| **RY** | 4.88 | 4.87 | 4.64 | 24 |
| **YB** | 4.88 | 4.871 | 4.62 | 23 |
| **BR** | 4.88 | 4.869 | 4.62 | 23 |
| **RYB** | 4.88 | 4.869 | 4.62 | 22 |

 **Tolerance:** I diff = 3% or 50mA of set. Value, Operate. Time = 28 m Sec

1. **Low Voltage Side:**

|  |  |  |  |
| --- | --- | --- | --- |
| FaultType | Trip Value = I d (A) | Drop off Value (A) | Trip time at2\*Id (msec) |
| Calculated | Measured | Measured |
| **R** | 11.67 | 11.63 | 11.15 | 25 |
| **Y** | 11.67 | 11.62 | 11.09 | 24 |
| **B** | 11.67 | 11.62 | 11.08 | 23 |
| **RY** | 7.78 | 7.75 | 7.36 | 24 |
| **YB** | 7.78 | 7.75 | 7.33 | 24 |
| **BR** | 7.78 | 7.75 | 7.32 | 23 |
| **RYB** | 7.78 | 7.73 | 7.3 | 21 |

 **Tolerance:** I diff = 3% or 50mA of set. Value, Operate. Time = 28 m Sec

###### **DIFFERENTIAL STABILITY CHECK DURING NORMAL OPERATTION**

In this test will inject 3 phase current = 3 times rated current in the two sides of the transformer with angle difference = ∟180 ◦ IN external fault and without angle difference in internal fault and check that the relay is stable during external fault (IDIFF =0)

|  |  |  |  |
| --- | --- | --- | --- |
| **FAULT TYPE** | **PH** | **INJECTED CURRENT (A)**  | **MEAS. (PU)** |
| **I1** | **I2** | **I BIAS** | **I DIFF** |
| **EXTERNAL FAULT** | **RYB** | 1.464**∟0°** | 2.334**∟180°** | 3 | 0.01 |
| **INTERNAL FAULT** | **RYB** | 1.464**∟0°** | 2.334**∟0°** | 3.005 | 6.01 |

1. **Slope test between (HV Side & LV Side):**
* **Settings: -**

I diff > = 0.40

SLOPE 1 = 0.3

SLOPE 2 = 0.8

I diff >> = 10

Intersection 1 Irest IS1 = 0.25

Intersection 2 Irest IS2 = 2



* **Slope Calculation:**
1. **SLOPE-1:**

Idiff= Id+K1(Ir-IS1)

Fix Ir within IS1 AND IS2

Ir=1.5 ie 0.4+0.3\*(1.5-0.25)

Idiff=0.775

Normally Id=I1-I2

At this relay, Ib=(I1+I2)/2

SO Ib=1.5

I1+I2=3

I1-I2=0.775

I1=1.888 A

I2=1.112 A

**Inj Current at HV side = 0.775\*0.488\*1.5 =1.382**

**Inj Current at LV side = 0.775\*0.778\*1.5= 1.297**

**To Achieve this slope need to increase the HV current from lower than the calculated value. Note Id and Ir when the corresponding phase of the relay gives trip. And calculate the slope as tabled below.**

1. **Slope 1 check (at Irest= 1.5 A ) Id=0.775, Ires=1.5**

|  |  |  |
| --- | --- | --- |
| **Fault****Type** | **Injected Current pickup (A)** | **Measured Values** |
| **HV Side** | **LV Side** | **I diff** | **I rest** |
| **R-E** | 1.381 | 1.299 | 0.775 | 1.5 |
| **Y-E** | 1.382 | 1.289 | 0.772 | 1.482 |
| **B-E** | 1.381 | 1.291 | 0.773 | 1.495 |

1. **Slope 1 check: (at Irest= 1 A ) Id=0.625 , Ires=1**

|  |  |  |
| --- | --- | --- |
| **Fault****Type** | **Injected Current pickup (A)** | **Measured Values** |
| **HV Side** | **LV Side** | **I diff** | **I rest** |
| **R-E** | 0.960 | 0.803 | 0.624 | 1 |
| **Y-E** | 0.96 | 0.797 | 0.623 | 0.995 |
| **B-E** | 0.960 | 0.797 | 0.624 | 0.996 |

**Slope Summary**

|  |  |  |
| --- | --- | --- |
| **Ir at 1.A** | **Ir at 1.5 A** | **SLOPE %** **((Id2-Id1)/(Ir2-Ir1))\*100** |
| **Id1 Measured** | **Ir1** **Measured** | **Id2 Measured** | **Ir2** **Measured** |
| 0.624 | 1 | 0.775 | 1.5 | **30.2%** |
| 0.623 | 0.995 | 0.772 | 1.482 | **30.5%** |
| 0.624 | 0.996 | 0.773 | 1.495 | **29.8%** |

1. **SLOPE-2**

Idiff= Id+K1(IS2-IS1)+K2(Ib-IS2)

 **Apply the values to find the injecting current to achieve Slope 2. And repeat the same procedure.**

1. **Slope 2 check (at Irest= 2.2 A ) Id=1.085, Ires=2.2**

|  |  |  |
| --- | --- | --- |
| **Fault****Type** | **Injected Current pickup (A)** | **Measured Values** |
| **HV Side** | **LV Side** | **I diff** | **I rest** |
| **R-E** | 2.008 | 1.936 | 1.087 | 2.201 |
| **Y-E** | 2.008 | 1.928 | 1.078 | 2.192 |
| **B-E** | 2.008 | 1.929 | 1.081 | 2.195 |

1. **Slope 2 check: (at Irest= 2.5A ) Id=1.325, Ires=2.5**

|  |  |  |
| --- | --- | --- |
| **Fault****Type** | **Injected Current pickup (A)** | **Measured Values** |
| **HV Side** | **LV Side** | **I diff** | **I rest** |
| **R-E** | 2.314 | 2.145 | 1.326 | 2.499 |
| **Y-E** | 2.314 | 2.136 | 1.316 | 2.489 |
| **B-E** | 2.314 | 2.137 | 1.319 | 2.493 |

**Slope Summary**

|  |  |  |
| --- | --- | --- |
| **Ir at 2.2 A** | **Ir at 2.5 A** | **SLOPE %** **((Id2-Id1)/(Ir2-Ir1))\*100** |
| **Id1 Measured** | **Ir1** **Measured** | **Id2 Measured** | **Ir2** **Measured** |
| 1.087 | 2.201 | 1.326 | 2.499 | **80.2%** |
| 1.078 | 2.192 | 1.316 | 2.489 | **80.1%** |
| 1.081 | 2.195 | 1.319 | 2.493 | **79.8%** |

1. **Harmonic Test:**
2. **Second harmonic check:**

**SETTING**: 2nd Harmonic = 15%

|  |  |  |
| --- | --- | --- |
| **Fault****Type** | **HV Side** | **LV Side** |
| **Injected I> for relay**  | **120 HZ value** | **Injected I> for relay**  | **120 HZ value** |
| **Pickup (%)** | **Drop off (%)** | **Pickup (%)** | **Drop off (%)** |
| **R** | 1 A | 15.1 | 14.4 | 1 A | 14.8 | 14.4 |
| **Y** | 1 A | 15.1 | 14.3 | 1 A | 15.1 | 14.4 |
| **B** | 1 A | 15 | 114.4 | 1 A | 15.1 | 14.3 |

 Cross blocking of 2nd harmonic time setting = 50.0 msec

 Measured Trip time in cross blocking case = 62.9 msec

**NOTE :** IN CROSS BLOCKING WE INJECT 2 PHASES WITH ID> AND2nd harmonic AND THE LAST PHASE WITH ID> ONLY AND WITHOUT2nd harmonic

AT THIS CASE THE PHASE WITHOUT 2nd harmonic TRIPS AFTER BLOCKING TIME SETTING

1. **Fifth harmonic check:**

**SETTING**: 5th Harmonic (I 300 HZ / I 60 HZ) = 25 %

|  |  |  |
| --- | --- | --- |
| **Fault****Type** | **HV Side** | **LV Side** |
| **Injected I> for relay** | **300 HZ value** | **Injected I> for relay** | **300 HZ value** |
| **Pickup (%)** | **Drop off (%)** | **Pickup (%)** | **Drop off (%)** |
| **R** | 1 A | 23.8 | 23.6 | 1 A | 24.8 | 23.9 |
| **Y** | 1 A | 23.9 | 23.6 | 1 A | 24.8 | 23.8 |
| **B** | 1 A | 23.9 | 23.7 | 1 A | 4.8 | 23.9 |

 Cross blocking of 5th harmonic time setting = 50 msec

 Measured Trip time in cross blocking case = 63.4 msec

**NOTE :** IN CROSS BLOCKING WE INJECT 2 PHASES WITH ID> AND5th harmonic AND THE LAST PHASE WITH ID> ONLY AND WITHOUT5th harmonic

AT THIS CASE THE PHASE WITHOUT 5th harmonic TRIPS AFTER BLOCKING TIME SETTING

1. **Restricted Earth Fault:**

**I DIFFN = ( I A + I B + I C )/ I N + I G**

**I BIAS = MAX ( I A , I B , I C , I G )**

**REF PICKUP = 0.1**

**SLOPE = 0.6**

**REF DELAY = 0 S**

1. **For HV Side: (CH-1)**

Iref=0.1 A, T= 0.0 Sec

Injected current will be in neutral side only for pickup

|  |  |  |  |
| --- | --- | --- | --- |
| **Current****Setting****(A)** | **Trip = I REF(A)** | **Drop off (A)** | **Trip Time****@2\*IREF****(msec)** |
| **Calculated** | **Measured** |
| **0.1** | **0.1** | **0.099** | **0.077** | **38.2** |

**Tolerance:** IREF> = 3% or 10 mA of set. Value, Operate. Time = 30 m Sec

Slope for Increasing pick up value :

|  |  |  |  |
| --- | --- | --- | --- |
| SlopeSetting | Injected Current | Measured value (A) | Measured SlopeIref Op/Irest |
| Phases | CH-1 | Iref Op | Irest |
| 0.60 | 0.3 A ∟00 & 0.3 A ∟1800 | 0.177 ∟00 | 0.177 | 0.3 | 0.59 |

1. **For LV Side: (CH-2)**

I ref=0.1 A, T= 0.0 Sec

|  |  |  |  |
| --- | --- | --- | --- |
| **Current****Setting****(A)** | **Trip = I REF(A)** | **Drop off (A)** | **Trip Time****@2\*IREF****(msec)** |
| **Calculated** | **Measured** |
| **0.1** | **0.1** | **0.099** | **0.078** | **38** |

 **Tolerance:** IREF> = 3% or 10 mA of set. Value, Operate. Time = 30 m Sec

Slope for Increasing pick up value :

|  |  |  |  |
| --- | --- | --- | --- |
| SlopeSetting | Injected Current | Measured value (A) | Measured SlopeIref Op/Irest |
| Phases | CH-2 | Iref Op | Irest |
| 0.60 | 0.2 A ∟00 & 0.2 A ∟1800 | 0.117 ∟00 | 0.180 | 0.3 | 0.6 |

1. **HV WINDING 1 51/51N PROTECTION TEST:**
	1. **HV PHASE OVER CURRENT (51 UNIT 1):**

 **PHASE OVER CURRENT PICK UP / RESET / TIME RESULT:**

1.26

 CURVE: IEC INVERSE In=0.63 A TMS : 0.275

|  |  |  |  |
| --- | --- | --- | --- |
| **TIME CURVE** | **INJ. I (A)** | **CALC. (S)** | **MEAS. (S)** |
| **R** | **Y** | **B** |
| **IEC - NORMAL INVERSE** | **1.26** | **2.757** | **2.73** | **2.731** | **2.731** |

**Timing Is Measured at I = 2 x IN> Threshold**

 **Tolerance:** I >= 3% or 10 mA of set. Value,

 Operate. Time = 35 m Sec

* 1. **HV NEUTRAL OVER CURRENT (51N UNIT 1):**

 **NEUTRAL OVER CURRENT PICK UP / RESET / TIME RESULT:**

 CURVE: IEC INVERSE In=0.1 A TMS : 0.3

|  |  |  |  |
| --- | --- | --- | --- |
| **TIME CURVE** | **INJ. IN (A)** | **CALC. (S)** | **MEAS. (S)** |
| **IEC - NORMAL INVERSE** | **0.2** | **3.01** | **3.034** |

 **Timing Is Measured at I = 2 x IN> Threshold**

 **Tolerance:** I >= 3% or 10 mA of set. Value,

 Operate. Time = 35 m Sec

1. **LV WINDING 2 51/51N PROTECTION TEST:**
	1. **LV PHASE OVER CURRENT (51 UNIT 1):**

 **PHASE OVER CURRENT PICK UP / RESET / TIME RESULT:**

 CURVE: IEC INVERSE In=0.9 A TMS : 0.25

|  |  |  |  |
| --- | --- | --- | --- |
| **TIME CURVE** | **INJ. I (A)** | **CALC. (S)** | **MEAS. (S)** |
| **R** | **Y** | **B** |
| **IEC - NORMAL INVERSE** | **1.8** | **2.51** | **2.53** | **2.527** | **2.53** |

**Timing Is Measured at I = 2 x IN> Threshold**

 **Tolerance:** I >= 3% or 10 mA of set. Value,

 Operate. Time = 35 m Sec

* 1. **LV NEUTRAL OVER CURRENT (51N UNIT 1):**

 **NEUTRAL OVER CURRENT PICK UP / RESET / TIME RESULT:**

 CURVE: IEC INVERSE In=0.08 A TMS : 0.25

|  |  |  |  |
| --- | --- | --- | --- |
| **TIME CURVE** | **INJ. IN (A)** | **CALC. (S)** | **MEAS. (S)** |
| **IEC - NORMAL INVERSE** | **0.16** | **2.51** | **2.532** |

 **Timing Is Measured at I = 2 x IN> Threshold**

 **Tolerance:** I >= 3% or 10 mA of set. Value,

 Operate. Time = 35 m Sec

1. **GROUND CORE WINDING 3 (SBEF) 51N PROTECTION TEST:**
	1. **NEUTRAL OVER CURRENT (51N UNIT 1):**

 **NEUTRAL OVER CURRENT PICK UP / RESET / TIME RESULT:**



 IEC LONG TERM INVERSE TIME LIMIT Is =0.45 A TMS : 0.05

|  |  |  |  |
| --- | --- | --- | --- |
| **TIME CURVE** | **INJ. IN (A)** | **CALC. (S)** | **MEAS. (S)** |
| **IEC - NORMAL INVERSE** |  **0.9** |  **6** | **6.055** |

 **Timing Is Measured at I = 2 x IN> Threshold**

 **Tolerance:** I >= 3% or 10 mA of set. Value,

 Operate. Time = 35 m Sec

* 1. **NEUTRAL OVER CURRENT (51N UNIT 2):**
* IN> Threshold: 0.1 A
* T = 5 Seconds
* **NEUTRAL OVER CURRENT PICK UP / RESET / TIME RESULT:**

|  |  |  |  |
| --- | --- | --- | --- |
| **TESTED** | **PICKUP (A)** | **DROP OFF (A)** | **TIMING (S)** |
| **I-NP** | 0.083 | 0.075 | 5.009 |

 Timing Is Measured at I = 2 x IN> Threshold

1. **HV CBF:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Phase** | **Current (A)** | **Stage 1** | **HV LCM CBF** **( INITIATION + CB CLOSED )** |
| **Set** | **Pickup** | **Drop-off** | **Set** | **OPTD (mS)** | **OPTD (S)** |
| **RY** | 0.1 | 0.096 | 0.089 | 0.15 | 179 | 172 |
| **YB** | 0.096 | 0.090 | 175 |
| **BR** | 0.096 | 0.089 | 179 |
| **RYB** | 0.096 | 0.089 | 179.5 |
| **3I0** | 0.1 | 0.096 | 0.089 | 0.15 | 179 |

**Tolerance:** I >= 3% or 10 mA of set. Value, Operate. Time = 35 m Sec

1. **LV CBF:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Phase** | **Current (A)** | **Stage 1** | **LV LCM CBF** |
| **Set** | **Pickup** | **Drop-off** | **Set** | **OPTD (S)** | **OPTD (S)** |
| **RY** | 0.1 | 0.096 | 0.089 | 0.15 | 176 | 174 |
| **YB** | 0.096 | 0.089 | 175 |
| **BR** | 0.096 | 0.089 | 177 |
| **RYB** | 0.096 | 0.089 | 176 |
| **3I0** | 0.1 | 0.096 | 0.089 | 0.15 | 177 |

**Tolerance:** I >= 3% or 10 mA of set. Value, Operate. Time = 30 m Sec

1. **INPUTS, OUTPUTS AND LED CHECKS:**
2. Binary Inputs check:

|  |  |  |  |
| --- | --- | --- | --- |
| **Binary Inputs** | **Terminals** | **Description** | **Status** |
| BI-1 | H7-H8 | 94-2 TRIP OPTD | OK |
| BI-2 | H9-H10 | 86T-2 OPTD | OK |
| BI-3 | H9-I1 | RLY UNDER TEST | OK |
| BI-4 | H9-I2 | SPARE | OK |
| BI-5 | I3-I4 | PROTN OUT | OK |
| BI-6 | I3-I5 | IN/OUT DC SUPPLY FAIL | OK |
| BI-7 | I3-I6 | INDICATION DC SUPPLY FAIL | OK |
| BI-8 | I7-I8 | AC MCB TRIP | OK |
| BI-9 | I7-I9 | SPARE | OK |
| BI-10 | I7-I10 | SPARE | OK |
| BI-11 | K3-K4 | HV CBF INITIATION | OK |
| BI-12 | K3-K5 | LV CBF INITIATION | OK |
| BI-13 | K3-K6 | SPARE | OK |
| BI-14 | K7-K8 | HV LCM CBF INITIATION | OK |
| BI-15 | K7-K9 | LV LCM CBF INITIATION | OK |
| BI-16 | K7-K10 | SPARE | OK |
| BI-17 | L1-L2 | HV CB CLOSE | OK |
| BI-18 | L1-L3 | HV CB OPEN | OK |
| BI-19 | L1-L4 | LV CB CLOSE | OK |
| BI-20 | L5-L6 | LV CB OPEN | OK |
| BI-21 | L5-L7 | VT MCB FAIL | OK |
| BI-22 | L8-L9 | SPARE | OK |
| BI-23 | L8-L10 | SPARE | OK |
| BI-24 | M1-M2 | SPARE | OK |
| BI-25 | M1-M3 | SPARE | OK |
| BI-26 | M4-M5 | SPARE | OK |
| BI-27 | M4-M6 | SPARE | OK |
| BI-28 | D7-D8 | SPARE | OK |
| BI-29 | D7-D9 | SPARE | OK |
| BI-30 | D7-D10 | SPARE | OK |

1. Binary Outputs Check:

|  |  |  |  |
| --- | --- | --- | --- |
| **Binary Output** | **Terminals** | **Description** | **Remarks** |
| B0-1 | F7-F8 | 87T TRIP | OK |
| B0-2 | F9-F10 | 50/51 HV TRIP | OK |
| B0-3 | G1-G2 | 64REF HV TRIP | OK |
| B0-4 | G3-G4 | 64 REF LV TRIP | OK |
| B0-5 | G5-G6 | 51 LV TRIP | OK |
| B0-6 | G7-G8 | 51N LV TRIP | OK |
| B0-7 | G9-G10 | SPARE | OK |
| B0-8 | H1-H2 | SPARE | OK |
| B0-9 | H3-H4 | SPARE | OK |
| B0-10 | H5-H6 | SPARE | OK |
| B0-11 | J1-J2 | HV CBF OPTD | OK |
| B0-12 | J3-J4 | ACSE INITIATION | OK |
| B0-13 | J5-J6 | ACSE BLOCK | OK |
| B0-14 | J7-J8 | SPARE | OK |
| B0-15 | J9-J10 | SPARE | OK |
| B0-16 | K1-K2 | SPARE | OK |
| B0-17 | C1-C2 | SPARE | OK |
| B0-18 | C3-C4 | SPARE | OK |
| B0-19 | C5-C6 | SPARE | OK |
| B0-20 | C7-C8 | SPARE | OK |
| B0-21 | C9-C10 | SBEF OPTD | OK |
| B0-22 | D1-D2 | LV CBF OPTD | OK |
| B0-23 | D3-D4 | LV CBF OPTD | OK |
| B0-24 | D5-D6 | LV CBF OPTD | OK |

1. LEDs check:

|  |  |  |
| --- | --- | --- |
| LED Number | Configuration | Remarks |
| LED 01 | 87TDIFF TRIP | OK |
| LED 02 | HV 51-OC TRIP | OK |
| LED 03 | LV 51-OC TRIP | OK |
| LED 04 | HV 51N-OC TRIP | OK |
| LED 05 | LV 51N-OC TRIP | OK |
| LED 06 | 64NP REF TRIP | OK |
| LED 07 | 64NS REF TRIP | OK |
| LED 08 | 51 SBEF TRIP | OK |
| LED 09 | HV CBF INIT | OK |
| LED 10 | HV CBF LCM | OK |
| LED 11 | LV CBF INIT | OK |
| LED 12 | LV CBF LCM | OK |
| LED 13 | HV CBF OPD | OK |
| LED 14 | LV CBF OPD | OK |
| LED 15 | - | OK |
| LED 16 | ANY PICKUP | OK |
| LED-P1 | PHASE-A TRIP | OK |
| LED-P2 | PHASE-B TRIP | OK |
| LED-P3 | PHASE-C TRIP | OK |
| LED-P4 | HV/LV CBF LCM TRIP | OK |
| LED-P5 | INST. DIFF TRIP | OK |
| LED-P6 | TCS FAULTY | OK |

1. Binary Outputs contact resistance Check:

|  |  |  |  |
| --- | --- | --- | --- |
| **Binary Output** | **Terminals** | **Description** | **Resistance (Ω)** |
| B0-1 | F7-F8 | 87T TRIP |  |
| B0-2 | F9-F10 | 50/51 HV TRIP |  |
| B0-3 | G1-G2 | 64REF HV TRIP |  |
| B0-4 | G3-G4 | 64 REF LV TRIP |  |
| B0-5 | G5-G6 | 51 LV TRIP |  |
| B0-6 | G7-G8 | 51N LV TRIP |  |
| B0-7 | G9-G10 | SPARE |  |
| B0-8 | H1-H2 | SPARE |  |
| B0-9 | H3-H4 | SPARE |  |
| B0-10 | H5-H6 | SPARE |  |
| B0-11 | J1-J2 | HV CBF OPTD |  |
| B0-12 | J3-J4 | ACSE INITIATION |  |
| B0-13 | J5-J6 | ACSE BLOCK |  |
| B0-14 | J7-J8 | SPARE |  |
| B0-15 | J9-J10 | SPARE |  |
| B0-16 | K1-K2 | SPARE |  |
| B0-17 | C1-C2 | SPARE |  |
| B0-18 | C3-C4 | SPARE |  |
| B0-19 | C5-C6 | SPARE |  |
| B0-20 | C7-C8 | SPARE |  |
| B0-21 | C9-C10 | SBEF OPTD |  |
| B0-22 | D1-D2 | LV CBF OPTD |  |
| B0-23 | D3-D4 | LV CBF OPTD |  |
| B0-24 | D5-D6 | LV CBF OPTD |  |

1. **Test Equipments Used:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sl. No | Description | Manufacturer | Equipment Sl .No | Calibration Date | Calibration Due Date |
| 1 | FREJA 300 | PROGRAMMA | 1402754 | 30-04-2023 | 30-04-2025 |
| 2 | Multi-Meter | FLUKE | 97800156 | 03/03/2023 | 03/03/2025 |