Note:

* The approved updated final settings should be applied and printed out from the relay by using the software of the relay.
* The approved final setting and the printout final setting should be attached with this test format.
* The print out final setting should be signed by SEC AND Contractor.
* The following test format contains minimum required tests and some of settings are mentioned as an example and not as limitation.
1. **GENERAL DATA & INFORMATION**

|  |  |  |  |
| --- | --- | --- | --- |
| Panel No.  |  | CT Ratio : \_\_\_\_\_\_ |  |
| Relay Type  |  | In |  |
| Manufacturer |  | VT Ratio  |  |
| SERIAL NO |  | Vn |  |
| No. of contacts:  |  | Draw. & Sh No. : |  |
| Order - No. |  | Conn.Diag.No. |  |
| Software Version |  | DC. Auxiliary. Voltage  |  |
| Opto-coupler supply: |  | Frequency Fn  | 60 Hz |

1. **MECHANICAL CHECKS AND VISUAL INSPECTION**

As per TCS –P–105 Rev -1, Item no 4.1& 4.12.1.1

|  |  |  |
| --- | --- | --- |
| Item | Description | Remarks |
|  | Inspect for any physical damage or defects. | ❑ Yes | ❑ N/A |
|  | Verify connections and ferrules as per approved drawings | ❑ Yes | ❑ N/A |
|  | Check tightness of all the connections. | ❑ Yes | ❑ N/A |
|  | Check Apparatus List | ❑ Yes | ❑ N/A |
|  | Check relay version and switching elements on printed circuit board | ❑ Yes | ❑ N/A |

1. **ELECTRICAL TESTS**

 As per TCS –P–105 Rev -1, Item no 4.2& 4.12.1.2

* 1. **FUNCTION TEST**

|  |  |  |
| --- | --- | --- |
| Item | Description | Remarks |
|  | Human Machine Interface (HMI) Checked. | ❑Yes  | ❑N/A  |
|  | Case Earthing checked. | ❑Yes  | ❑N/A  |
|  | LED’s Function Checked. | ❑Yes  | ❑N/A  |
|  | Trip Contacts Checked. | ❑Yes  | ❑N/A  |
|  | Reset Function Checked | ❑Yes  | ❑N/A  |
|  | Group active Functions Checked | ❑Yes  | ❑N/A  |
|  | Binary inputs checked. | ❑Yes  | ❑N/A  |
|  | Output Relays Checked | ❑Yes  | ❑N/A  |
|  | Event Display on HMI Screen Checked | ❑Yes  | ❑N/A  |
|  | Test switch / plug checked for correct function. | ❑Yes  | ❑N/A  |
|  | Watchdog contacts checked | ❑Yes  | ❑N/A  |
|  | Current shorting facility. | ❑Yes  | ❑N/A  |

* 1. **RELAY BURDEN**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | DC Voltage (V) | Current (mA) | VA |
|  | Normal Condition | 125 |  |  |
|  | Fault Condition | 125 |  |  |

As per manual page No. burden =12 VA

* 1. **WATCHDOG CONTACT TEST**

Check status of watchdog contacts as below.

Note:

* Open HMI view after connecting to the relay.
* Click “STATUS” view and save the snapshot in to annexure word document.

|  |  |  |
| --- | --- | --- |
| OUTPUT | Contact Status | Remarks |
| Relay De- energized | Relay Energized |
|  K3 , K4 | Closed ( ) | Open ( ) |  |

* 1. **TIME AND DATE CHECK:-**

To check time & date go to main menu on the display for 7SD522 then open system time and adjust time & date.

To test keeping time and date setting this, remove the auxiliary supply from the relay for approximately ( ) seconds, then restoring the auxiliary supply, the time and date setting should not be lost.

Result: \_\_\_\_\_\_\_\_\_\_\_\_

* 1. **SETTING ADOPTED:**

Refer enclosed setting printout

* 1. **SECONDARY INJECTION TEST:**
		1. **MEASUREMENTS**

Open Degsi 4 Measurement primary value operational value primary after connecting to the relay & observe the reading, in primary values.

Voltage applied current injected

PTR: CTR:

Current Inputs Check

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Input CT | Applied Value (A) | CT Ratio Applied (A) | Displayed Secondary Value (A) | Displayed Primary Value (A) |
| IR | 1.0 |  |  |  |
| IY | 1.0 |  |  |  |
| IB | 1.0 |  |  |  |
| IN | 0 |  |  |  |

To get the value of IN we will inject only one phase by 1A

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Input CT | Applied Value (A) | CT Ratio Applied (A) | Displayed Secondary Value(A) | Displayed Primary Value(A) |
| IN | 1.0 |  |  |  |

Voltage Inputs Check:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Input PT | Applied Value | PT Ratio Applied | Displayed Secondary Value (V) | Displayed Primary Value (KV) |
| VRY |  |  |  |  |
| VYB |  |  |  |  |
| VBR |  |  |  |  |
| VRN |  |  |  |  |
| VYN |  |  |  |  |
| VBN |  |  |  |  |

Active, Reactive and Apparent Power Check:

- Injected 66.4V/phase and 1.0A with 0 ۫, 45° lagging &90۫.

- To check the values go to measurement.

- P= √3 \* V \* I \* COS (ӨL) and Q= √3 \* V \* I \* SIN (ӨL)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PHASE ANGLE | Calculated(P) MW | Measured(P) MW | Calculated(Q) MVAR | Measured(Q) MVAR | Calculated(S) MVA | Measured(S) MVA |
| AT 0 ۫ |  |  |  |  |  |  |
| AT 45 ۫ |  |  |  |  |  |  |
| AT 90 ۫ |  |  |  |  |  |  |

* 1. **DIFFERENTIAL PROTECTION (87L):**



*NOTE:* The Sensitivity and timing tests are conduct with

|  |
| --- |
| DIFF.TEST Mode: OFF |

-From HMI Display go to control menu. Tagging/ Diff test

Mode: OFF or by Digsi.

-Connect fiber between the two relays

I-DIFF> …add (1210)

 Equation for Pickup Current:

Irest/INB =set Idiff>/INB + permissible local CT error \*I / IN1 + permissible remote CT error \*I / IN2 + System errorI0

I = Actual current flowing

INB = the nominal operational current as parameterized

IN1 = the primary nominal current of the local current transformer

IN2 = the primary nominal current of the current transformer of the remote end

System error = Error due to frequency, synchronization and delay time difference errors = 1 – 2% of the current.

As per manual page No. 548

Data for equation

 CT error =3% and system error =1%

* + 1. **TESTING OF I-DIFF> TRIP THRESHOLD**

|  |  |  |  |
| --- | --- | --- | --- |
| PHASE | SETTING IDIFF > (A) | Measured Pick Up Value (A) | Error  |
| R | 0.2 |  |  |
| 0.5 |  |  |
| 1.0 |  |  |
| 3 |  |  |
| Y | 0.2 |  |  |
| 0.5 |  |  |
| 1.0 |  |  |
| 3 |  |  |
| B | 0.2 |  |  |
| 0.5 |  |  |
| 1.0 |  |  |
| 3 |  |  |

For determining pick up current, the injection is gradually. Tolerance ±5% of setting

* + 1. **TIMING TEST**

Injected current =I-DIFF> \* 2

|  |  |  |  |
| --- | --- | --- | --- |
| Phase | Injected current (A) | T-DELAY I-DIFF> Setting (ms) | measured Time (ms) |
| R |  |  |  |
|  |  |  |  |
|  |  |  |  |
| Y |  |  |  |
|  |  |  |  |
|  |  |  |  |
| B |  |  |  |
|  |  |  |  |
|  |  |  |  |

NOTE: seal in time for all closers = 0.01 min value

Trip time expected = 0.0+0.01=0.01

* + 1. **UNDER SWITCH ON CONDITION:**

|  |  |  |  |
| --- | --- | --- | --- |
| PHASE | I-DIFF>SWITCH ON (A) | Measured Pick Up Value (A) | Operating Time (ms)Setting=0.0 |
| R | 0.2 |  |  |
| 0.5 |  |  |
| 1.0 |  |  |
| 3 |  |  |
| Y | 0.2 |  |  |
| 0.5 |  |  |
| 1.0 |  |  |
| 3 |  |  |
| B | 0.2 |  |  |
| 0.5 |  |  |
| 1.0 |  |  |
| 3 |  |  |

* + 1. **FOR SEAL IN TIME EFFECT ON TRIPPING**

CASE ONE:

1210 (I-DIFF>: pick up value) = A

1213 (I-DIF>SWITCH ON pick up value) = A

1134 (Line Closure) = current flow or manual close BI

1132 (seal in time after all closures) = sec

1130 (pole open current threshold) less than (add.1210) =

* + Current flow or Manual close BI in state 1 for time more than address. 1132 after that inject current as per tables below in state 2
	+ (\*) inject current in between setting of (I-DIFF> and I-DIF>SWITCH ON)

|  |  |
| --- | --- |
|  | Injected current |
| Setting I-DIFF> | R-N | Y-N | B-N |
|  |  |  |  |
| Time(sec)  |  |  |  |

This time is the summation of time in add.1217 plus add.1150 ( sec).

* (\*\*)Inject current more than I-DIF>SWITCH ON condition

|  |  |
| --- | --- |
|  Setting I-DIFF> under switch on condition | Injected current |
| R-N | Y-N | B-N |
|  |  |  |  |
| Time(sec)  |  |  |  |

The time measured is the time in add 1217 (0.0 sec)

* + 1. I-DIFF>>…add (1233)

|  |  |  |  |
| --- | --- | --- | --- |
| PHASE | I-DIFF>> | Measured Pick Up Value (A) | Operating Time (ms) |
| R | 1 |  |  |
| 1.5 |  |  |
| 2 |  |  |
| 3 |  |  |
| Y | 1 |  |  |
| 1.5 |  |  |
| 2 |  |  |
| 3 |  |  |
| B | 1 |  |  |
| 1.5 |  |  |
| 2 |  |  |
| 3 |  |  |

For determining pick up current, the injection is not gradually

* + 1. I-DIF>>SWITCHON …add (1235)

|  |  |  |  |
| --- | --- | --- | --- |
| PHASE | I-DIF>>SWITCHON (A) | Measured Pick Up Value (A) | Operating Time (ms) |
| R | 1 |  |  |
| 1.5 |  |  |
| 2 |  |  |
| 3 |  |  |
| Y | 1 |  |  |
| 1.5 |  |  |
| 2 |  |  |
| 3 |  |  |
| B | 1 |  |  |
| 1.5 |  |  |
| 2 |  |  |
| 3 |  |  |

* + 1. **INRUSH RESTRAINT CURRENT**: (second harmonic blocked test)

-choose add.2301 (Inrush Restraint) = ON

-choose add.2302 (2nd harmonic in % of fundamental) = %

-choose add.2303 (cross block) = NO

1. Inject one phase current (1A-60HZ and 0.22A-120HZ) the relay will not trip because of Second harmonic inrush block.



|  |  |  |
| --- | --- | --- |
| 2nd harmonic setting | Non block | Block value |
| % |  |  |

- 2303 (cross block) = YES

- 2310 (time for cross block with 2nd harmonic) = sec

1. Inject one phase current (1A-60HZ and 0.22 A-120HZ) and another phase by

(1A-60HZ). the relay will trip after the summation of time in (add.2310+add.1217)

By cross blocking with2nd harmonic.

|  |  |  |
| --- | --- | --- |
| Cross block set time | Actual time | Checked  |
| 2 sec |  |  |

If Cross block setting is (no) so the tripping will be blocked only if the faulted phase has 2nd harmonic but if the another phase is the faulted phase without 2nd harmonic fault and healthy phase has 2nd harmonic then the tripping will not blocked and tripping will be blocked if the setting of cross block changed to yes so the tripping blocking happen for time 2310.

* + 1. **SWITCH ON TO FAULT:**

• 0124 HS/SOTF-O/C = *Enabled*

• 2401 FCT HS/SOTF-O/C = ON

• 2405A I>>>> = SOTF Overcurrent=

• 1150A Seal-in Time after MANUAL closures = sec

1. Note:
* we have to assign binary input/output/led
* BI manual close BI (add 356) = >Manual close signal (>Manual Close)
* BO High Speed/SOTF-O/C TRIP Command L123 (HS/SOF TRIPL123)

•1130 the residual current PoleOpenCurrent =

•1131 The residual voltage PoleOpenVoltage =

•1134 Line Closure = CB OR I or M/C

•1133 T DELAY SOTF =

1. **Pole Open Current and Voltage Testing**

Without simulation of external manual closing

|  |  |
| --- | --- |
| Setting | Measured Values |
| Vpole open<(V) | Ipole open<(A) | Vpole open<(V) | Ipole open<(A) |
|  |   |  |  |

Limit = (Vpole open is and Ipole open is as per manual page no )

1. **SOTF Over Current Pick up Testing**

Without simulation of external manual closing

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| I>>>setting | I>>>pick up | >>> drop off | I>>>>setting | I>>>> pick up | I>>>> drop off |
|  |   |  |  |  |  |

Limit = (I>>>> is as per manual page no )

NOTE: I >>> ACTIVE ONLY IF

1-LOCAL CB OPEN AND IN TIME OF CLOSING

2- REMOTE CB OPEND

1. **SOTF Timing Test**

|  |  |  |
| --- | --- | --- |
| Line Closure simulation | I>>>> injected | Trip time |
| CB manual close simulation by BI |  |  |
| I M/C simulation |  |  |

* + 1. **DIFFERENTIAL RESTRAINT CHARACTERISTIC TEST:**

Setting:

CTR: 1200/1

LOCAL CT ERROR: 3%

REMOTE CT ERROR: 3%

SYSTEM ERROR: 2%

At setting 0.3

Using communication channel between two relays and by injected current in both relays by 180º ANGLE difference.

|  |  |  |
| --- | --- | --- |
| Test Phase | Differential Current at End 1 (A) | End2 (A) |
| Expected | Actual |
| R | 1.385 |  | 1 |
| 2.458 |  | 2 |
| 3.53 |  | 3 |
| Y | 1.385 |  | 1 |
| 2.458 |  | 2 |
| 3.53 |  | 3 |
| B | 1.385 |  | 1 |
| 2.458 |  | 2 |
| 3.53 |  | 3 |

I DIFF = I LOCAL – I REMOTE

I REST = I DIFF SETTING + (CT ERROR \*I LOCAL) + (CT ERROR \* I REMOTE) + SYS ERROR\*(ILOCAL +I REMOTE)

SYSTEM ERROR: 1-2%

EX: FOR I=1A

I RST=0.3+ (0.03\*1) + (0.03\*1) +0.01\*(1+1) =0.38

SETTING:

CTR:

LOCAL CT ERROR:

REMOTE CT ERROR:

SYSTEM ERROR:

At Setting: 0.5

Using communication channel between two relays and by injected current in both relays by 180º ANGLE difference.

|  |  |  |
| --- | --- | --- |
| Test Phase | Differential Current at End 1 (A) | End2 (A) |
| Expected | Actual |
| R | 1.593 |  | 1 |
| 2.666 |  | 2 |
| 3.739 |  | 3 |
| Y | 1.593 |  | 1 |
| 2.666 |  | 2 |
| 3.739 |  | 3 |
| B | 1.593 |  | 1 |
| 2.666 |  | 2 |
| 3.739 |  | 3 |

I DIFF = I LOCAL – I REMOTE

I REST = I DIFF SETTING + (CT ERROR \*I LOCAL) + (CT ERROR \* I REMOTE) + SYS ERROR\*(ILOCAL +I REMOTE)

SYSTEM ERROR: 1-2%

* + 1. **STABILITY TEST:**
1. External Through Fault:

Current of 1.0A on remote end and 1.0A on local end with 180º phase shift between the two currents. The differential and restraining currents are observed in both relays.

At setting I-Diff > 0.4

|  |  |  |  |
| --- | --- | --- | --- |
| FAULT TYPE |  | LOCAL END RELAY | REMOTE END RELAY |
| R | Y | B | R | Y | B |
| R-Y-B | IDIFF% |  |  |  |  |  |  |
| IREST% |  |  |  |  |  |  |

1. **In Zone Fault:**

Current of 1.0A on remote end and 1.0A on local end with 0º phase shift between the two currents. The differential and restraining currents are observed in both the relays.

At setting I-Diff > 0.4

|  |  |  |  |
| --- | --- | --- | --- |
| Fault Type |  | Local End Relay | Remote End Relay |
| R | Y | B | R | Y | B |
| R-Y-B | IDIFF% |  |  |  |  |  |  |
| IREST% |  |  |  |  |  |  |

1. **Charging Current**

I diff>PU= A

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PH | Address 1224IcSTAB**/**IcN | I Injected | Applied Voltage | I REST Expected% | I REST Measured% | Error% |
| R |  |  |  |  |  |  |
| Y |  |  |  |  |  |  |
| B |  |  |  |  |  |  |

I REST=IREST W/O CHARGING CURRENT + ((IC stab/IC nominal-1)\*I DIFF>PU VALUE)

1. **Testing Data Transmission**

|  |  |
| --- | --- |
| Status of Fiber optic connection | Test Result |
| Ch-1 | Ch-2 | Diff Prot active | Reception Fail |
| ON | ON | ON |  |
| ON | OFF | ON |  |
| OFF | ON | ON |  |
| OFF | OFF | OFF |  |

Note: When channel 1 fails there is a brief period of blocking of Differential Protection for a period of 20 – 25 ms before Channel – 2 takes over. When channel 1 resumes there is no further blocking.

1. **Testing Inter Trip Function:**

Indications:

Function Test result

LED: Inter trip send

LED: Inter trip receive

|  |  |  |  |
| --- | --- | --- | --- |
| Relay 1 send | Relay 2 send | Relay1 indication | Test Result |
| LED1 Intertrip Send | LED1 Intertrip Receive |
| NO | YES | OFF | ON |  |
| YES | YES | ON | ON |  |

**BREAKER FAILURE TEST**

* + 1. **CBF CURRENT PICK UP AND DROP OFF**

Address 3902 I> BF

Address 3909 Chk BRK CONTACT

Simulate CB closed by activation BI and protection trip for CBF initiation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| PHASE | I> BF (A) setting | PICKUP(A) | DROP OFF(A) | REMARKS |
| R |  |  |  |  |
|  |  |  |  |
| Y |  |  |  |  |
|  |  |  |  |
| B |  |  |  |  |
|  |  |  |  |

* + 1. **BF TIME TEST WITH CURRENT INJECTION**

I> BF *=  A ,* T1-3pole = , T2 =

Simulate CB closed by activation BI and protection trip for CBF initiation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | IINJ (A) | T1 Setting | T1 Measured | T2 Setting | T2 Measured |
| R |  |  |  |  |  |
|  |  |  |  |  |
| Y |  |  |  |  |  |
|  |  |  |  |  |
| B |  |  |  |  |  |
|  |  |  |  |  |

* + 1. **BF TIME W/O CURRENT INJECTION (LOW CURRENT MODE)**

1439 >BF Start w/o I

SIMULATE PROTECTION OPERATION BY ACTIVATION ITS BI

|  |  |  |  |
| --- | --- | --- | --- |
| T1 Setting  | T1  Measuring. | T2 Setting | T2  Measuering. |
|  |  |  |  |

* + 1. **DEFECTIVE BREAKER TEST**

In such a case it is not necessary to wait for the response of the feeder circuit breaker. If provision has been made for the detection of such condition (e.g. control voltage monitor or air pressure monitor), the monitor alarm signal can be fed to the binary input „>CB faulty“.

*T1 = , T2 = ,*T3-BkrDefective=

SIMULATE CB DEFECTIVE BY ACTIVATION BI OF >CB FAULTY AND INJECT TRIP CURRENT OF I>CBF

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 3908 Trip BkrDefect. | NO | WITH T1-TRIP | WITH T2-TRIP | WITH T1/T2 - TRIP |
| T1 MEASURED |  |  |  |  |
| T2 MEASURED |  |  |  |  |
| T3 MEASURED |  |  |  |  |
|  |  |  |  |

* + 1. **END FAULT PROTECTION**

FAULT BETWEEN CT AND CB

*T1 = S , T2 = S ,*

ADDRESS 3921 End Flt. Stage = ON

ADDRESS 3922 T-EndFault = 0

SIMULATE END FAULT BY APPLY B/I OF CB STATUS AS OPEND AND B/I BF INTIATION AND INJECT TRIPPING CURRENT.

|  |  |  |
| --- | --- | --- |
| T-EndFault EXPECTED | T-EndFault MEASURED  | REMARKS |
|  |  |  |

* 1. Back Up time Over Current Protection: (Emergency)

Note: while testing any stage of over current you have to raise the setting of the other stages.

Note: for emergency operating mode mode o/c active with the block of differential the address 2601 *= Only Emer. Prot*.

* + 1. **DEFINITE TIME TEST:**

Address 2610 for setting of Iph>>

Address 2611 for setting of T Iph>>

Address 2612 for setting of 3I0>> PICKUP,

Address 2613 for setting of T 3I0>>

Low set stage Iph>: Setting: Iph> pick up address (2620)

T Iph> time delay address (2621)

 3I0> pick up address (2622), T 3I0> time delay address (2623)

|  |  |  |
| --- | --- | --- |
| parameter | SETTING | MEASURED VALUES |
| CURRENT (A) | TIME (sec) | R (A) | Y (A) | B (A) | TIME (sec) |
| Iph> |  | T Iph>  |  |  |  |  |
|  | T Iph>  |  |  |  |  |
| 3I0> |  | T 3I0>  |  |  |  |  |
|  | T 3I0>  |  |  |  |  |
| Iph>> |  | T Iph>>0.0 |  |  |  |  |
|  | T Iph>>0.0 |  |  |  |  |
| 3I0>> |  | T 3I0> 0.0 |  |  |  |  |
|  | T 3I0> 0.0 |  |  |  |  |

* + 1. Overcurrent Stages IP, 3I0P for Inverse-time Overcurrent Protection with IEC Characteristics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cheractristic | Phase | T.M.S | Calculated Time2 Is | Formula | Measured ValueSec |
| NORMALINVERSE | R | 0.1 | 1.003 | T = 0.14TP / {( I/IP )0.02 – 1} |  |
| Y |  |
| B |  |
| N |  |
| VERYINVERSE | R | 0.2 | 2.7 | T = 13.5 TP / {( I/IP ) – 1} |  |
| Y |  |
| B |  |
| N |  |
| EXTREMELYINVERSE | R | 0.1 | 2.67 | T = 80 TP / {( I/IP )2 – 1}  |  |
| Y |  |
| B |  |
| N |  |
| LONG INVERSE | R | 0.2 | 24 | T = 120TP / {( I/IP ) – 1}  |  |
| Y |  |
| B |  |
| N |  |

T: TRIP TIME

TP: SETTING VALUE TIME MULTPLIER

IP: SETTING VALUE CURRENT

I: FAU LT CURRENT

* 1. **RELAY FINAL SETTING**
		1. 87L Differential Protection:

I-DIFF> …add (1210)

Data for equation

CT error 3% and system error =2%

1. Testing of 2\* I-DIFF> trip threshold

|  |  |  |  |
| --- | --- | --- | --- |
| PHASE | SETTING I-DIFF> (A) | Measured Pick Up Value (A) | Calculated value (A) |
| R |  |  |  |
| Y |  |  |  |
| B |  |  |  |

Tolerance ±5% of setting

1. Timing test

|  |  |  |  |
| --- | --- | --- | --- |
| PHASE | Inject current (A) | Delay Time (ms) | Operating Time (ms) |
| R | 2\* I-DIFF> | 0.0 |  |
| Y | 2\* I-DIFF> | 0.0 |  |
| B | 2\* I-DIFF> | 0.0 |  |

1. Under Switch on Condition:

|  |  |  |  |
| --- | --- | --- | --- |
| Phase | SETTING I-DIF>SWITCH ON (A) | Measured Pick Up Value (A) | Operating Time (ms)Setting=0.0 |
| R |  |  |  |
| Y |  |  |  |
| B |  |  |  |

Calculated start value =

1. For seal in time effect on tripping

Seal in time for manual close = ms

CASE ONE:

Inject fault between value 1210 and 1213 with manual close

|  |  |  |  |
| --- | --- | --- | --- |
| Setting I-DIFF> | R-N | Y-N | B-N |
|  |  |  |  |
| Seal in = ms |  |  |  |

This time is the summation of time in add.1217A plus add.1150A ( sec).

* (\*\*)Inject current more than I I-DIF>SWITCH ON condition
* Time 1217A= 0.0

|  |  |  |  |
| --- | --- | --- | --- |
|  SETTING I-DIF>SWITCH ON (A) | R-N | Y-N | B-N |
|  |  |  |  |
|  MEASURED TIME |  |  |  |

The time measured is the time in add 1217 (0.0 sec)

1. IDIFF>> …add (1233)

|  |  |  |  |
| --- | --- | --- | --- |
| PHASE | SETTING IDIFF>> (A) | Measured Pick Up Value (A) | Operating Time (ms) |
| R |  |  |  |
| Y |  |  |  |
| B |  |  |  |

1. I-DIF>>SWITCHON …add (1235)

|  |  |  |  |
| --- | --- | --- | --- |
| PHASE | SETTING I-DIF>>SWITCHON (A) | Measured Pick Up Value (A) | Operating Time (ms) |
| R |  |  |  |
| Y |  |  |  |
| B |  |  |  |

* + 1. Switch On To Fault

|  |  |  |
| --- | --- | --- |
| Setting | PU (A) | Operating Time(ms) |
| I>>>set = A |  |  |

* + 1. DifferentialRestraint Characteristic Test:

Setting:

CTR:

LOCAL CT ERROR: 3%

REMOTE CT ERROR: 3%

SYSTEM ERROR: 2%

At setting

Using communication channel between two relays and by injected current in both relays by 180º ANGLE difference.

|  |  |  |
| --- | --- | --- |
| Test Phase | Differential Current at End 1 (A) | End2 (A) |
| Expected | Actual |
| R |  |  |  |
| Y |  |  |  |
| B |  |  |  |

* + 1. Stability Test:
1. External through fault:

External Through Fault: current of 1.0A on remote end and 1.0A on local end with 180º phase shift between the two currents. The differential and restraining currents are observed in both relays.

Final setting of I-Diff >

|  |  |  |  |
| --- | --- | --- | --- |
| FAULT TYPE |  | LOCAL END RELAY | REMOTE END RELAY |
| R | Y | B | R | Y | B |
| R-Y-B | IDIFF% |  |  |  |  |  |  |
| IREST% |  |  |  |  |  |  |

1. In Zone Fault:

Current of 1.0A on remote end and 1.0A on local end with 0º phase shift between the two currents. The differential and restraining currents are observed in both the relays.

Final setting of I-Diff >

|  |  |  |  |
| --- | --- | --- | --- |
| FAULT TYPE |  | LOCAL END RELAY | REMOTE END RELAY |
| R |  | B | R | Y | B |
| R-Y-B | IDIFF% |  |  |  |  |  |  |
| IREST% |  |  |  |  |  |  |

* + 1. Testing Inter trip function:

|  |  |  |  |
| --- | --- | --- | --- |
| Relay 1 send | Relay 2 send | Relay1 indication | TEST RESULT |
| LED1 INTERTRIP SEND | LED1 INTERTRIP RECEIVE |
| NO | YES | OFF | ON |  |
| YES | YES | ON | ON |  |

* 1. Breaker Failure Test
		1. Current Pick Up : ActivatE BI CB closed & start CBF

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| PHASE | I> BF (A) | PICKUP (A) | DROP OFF (A) | REMARKS |
| R |  |  |  |  |
| Y |  |  |  |  |
| B |  |  |  |  |

* + 1. BF Time Test With Current Injection

I> BF *=  A ,* T1-3pole = , T2 =

Simulate CB closed by activation BI and protection trip for CBF initiation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| PHASE | IINJ (A) | T1 SETTING | T1 MEASURED | T2 SETTING | T2 MEASURED |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

* 1. Back Up Time Over Current Protection: (Emergency)

For IEC curve address (2660) is normal curve

Ip > = A, Io > = A

WHERE:

T: TRIP TIME

TP: SETTING VALUE TIME MULTPLIER

IP: SETTING VALUE CURRENT

I: FAULT CURRENT

I: FAULT CURRENT

IP> = 1.2A & 3IOP= 0.2A

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cheractristic | Phase | T.M.S | Calculated Time2 Is | Formula | Measured ValueSec |
| NORMALINVERSE | R |  |  | T = 0.14TP / {( I/IP )0.02 – 1} |  |
| Y |  |
| B |  |
| N |  |
| Y |  |
| B |  |
| N |  |

* 1. Fault Locator Check:

Setting:

X= Ohms / Km

Line Length = Km

|  |  |  |
| --- | --- | --- |
| X injected | Expected length | Measured length |
|  |  |  |
|  |  |  |
|  |  |  |

* 1. Binery Input Check:

This is to verify the healthiness of the DC control inputs.

Apply a rated voltage at each input and verify the status of the input through DIGSI in the online operating mode

|  |  |  |  |
| --- | --- | --- | --- |
| Control input No. | Terminal | Configuration  | Result |
| BI 1 | K17,K18 | CBF START |  |
| BI 2 | J1,J2 | SPARE |  |
| BI 3 | J3,J5 | SPARE |  |
| BI 4 | J4,J5 | SPARE |  |
| BI 5 | J6,J5 | SPARE |  |
| BI 6 | J7,J8 | SPARE |  |
| BI 7 | J9,J10 | CBF I/T SEND |  |
| BI 8 | J11,J12 | SPARE |  |
| BI9 | P17,P18 | CB MANUAL CLOSE |  |
| BI10 | N1,N2 | VT MCB TRIP |  |
| BI11 | N3,N5 | CB READY |  |
| BI12 | N4,N5 | CB CLOSED |  |
| BI13 | N6,N5 | CB OPEND |  |
| BI14 | N7,N8 | SPARE |  |
| BI15 | N9,N10 | SPARE |  |
| BI16 | N11,N12 | SPARE |  |

* 1. Control Output Relay Check:

This is to verify the healthiness of the Control output relay healthiness.

Operate each output through DIGSI® 4 in the online operating mode, the check continuity of the contact that closes.

|  |  |  |  |
| --- | --- | --- | --- |
| Output Relay No. | Terminal | Configuration  | Result |
| BO 1 | K5,K6 | DIFF G TRIP |  |
| BO 2 | K5,K7 | G I/T RECEIVE |  |
| BO 3 | K5,K8 | SPARE |  |
| BO 4 | K9,K10 | DIFF G TRIP |  |
| BO 5 | K11,K12 | G I/T RECEIVE |  |
| BO 6 | K13,K14 | CH1&CH2 FAIL |  |
| BO 7 | K15,K16 | DIFF G TRIP |  |
| BO 8 | R5,R1 | G I/T RECEIVE |  |
| BO 9 | R5,R2 | DIFF G TRIP |  |
| BO 10 | R5,R3 | SPARE |  |
| BO 11 | R5,R4 | SPARE |  |
| BO 12 | R5,R6 | SPARE |  |
| BO 13 | R7,R8 | CBF TRIP |  |
| BO 14 | R9,R10 | SPARE |  |
| BO 15 | R11,R12 | CH1 OR CH2 FAIL |  |
| BO16 | P3,P4 | O/C E/F I/T RECEIVE |  |
| BO17 | P5,P6 | CBF I/T RECEIVE |  |
| BO18 | P5,P7 | SPARE |  |
| BO19 | P5,P8 | SPARE |  |
| BO20 | P9,P10 | CBF TRIP |  |
| BO21 | P11,P12 | O/C E/F TRIP |  |
| BO22 | P13,P14 | O/C E/F TRIP |  |
| BO23 | P15,P16 | O/C E/F TRIP |  |
| BO24 | K3,K4(LIVE CONT) | LIVE CONTACT |  |

* 1. LED Status Checked:

 3.16 LED Status Checked:

|  |  |  |  |
| --- | --- | --- | --- |
| LED No. | Configuration  | COLOUR | STATUS CHECKED |
|  1 | START L1 | RED |  |
|  2 | START L2 | RED |  |
|  3 | START L3 | RED |  |
|  4 | DIFF TRIP | RED |  |
|  5 | I/T DIFF | RED |  |
|  6 | CBF I/T RECV | RED |  |
|  7 | O/C TRIP | RED |  |
|  8 | CBF TRIP | RED |  |
|  9 | O/C E/F IT RECV | RED |  |
| 10 | CBF START | RED |  |
|  11 | CH1&CH FAIL | RED |  |
| 12 | CH 1 FAIL | RED |  |
| 13 | CH 2 FAIL | RED |  |
| 14 | DIFF BLOCKED | RED |  |

1. Test Instrument Details

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name of The Instrument | Make | Type | Sl.No. | Due Date for Calibration |
|  |  |  |  |  |
|  |  |  |  |  |