



SPECIFICATION No. SS-94/5
SINGLE PHASE LARGE RESISTANCE EARTH FAULT DETECTION
NUMERICAL RELAY
AND OF A SUITABLE CURRENT TRANSFORMER

I. SCOPE

This specification covers the requirements with regard the technical characteristics, design characteristics and testing of a single phase earth fault numerical relay for the detection of high impedance earth faults and of a suitable current transformer which shall be used in connection with the above relay.

II. KEYWORDS

Numerical single-phase relay for the detection of earth fault, earth fault relay, overcurrent relay, current transformers, instrument transformers.

III. USE

The relay will be used for the detection of small earth fault currents, which by design are not being detected by the overcurrent protection relays of the MV distribution lines. The indoor type CT shall be connected to the earthing terminal of the neutral earthing resistor of the power transformer.

IV. STANDARDS

The numerical relays shall be in accordance with the following IEC standards:

- IEC – 60255-5
- IEC – 60255-22
- IEC – 61000-4

The current transformers shall be in accordance with IEC-60044-1 standard.

V. METHOD OF SUBMITTING THE OFFER

Prospective bidders are required to submit separate technical and economic offers for the two equipment of this hereby specifications. Furthermore they can submit offers only for one of the two equipment or both, but separately, if they desire so.

VI. OPERATING CONDITIONS

For the relay

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|----------------------|---|
| 1. Installation | : Inside the control building of the substation |
| 2. Temperature range | : -5°C to 50°C |
| 3. Relative humidity | : 5% to 85% |



4. Altitude : Up to 1000m above sea level

For the current transformer

1. Installation : Inside the metallic kiosk of the earthing resistor of IP 34 protection as per IEC-60529
2. Temperature range : -25°C to 45°C
3. Relative humidity : 5% to 85%
4. Altitude : Up to 1000m above sea level

VII. ELECTRICAL CHARACTERISTICS OF 20 KV SYSTEM

1. Rated Voltage (phase to phase) : 20 KV
2. Maximum Operating Voltage : 24 KV
3. Number of phases : 3
4. Rated frequency : 50 Hz
5. Short circuit level : 10 KA
6. Basic Impulse Insulation Level (Lightning impulse level) : 150 KV for outdoor equipment and 125 kV for indoor
7. Rated DC supply voltage : 110 V DC
8. Method of earthing : the 20KV system is earthed via a 12 resistor

VIII. REQUIRED TECHNICAL CHARACTERISTICS OF THE RELAY

1. Type : Numerical overcurrent relay of definite time suitable for the detection of small earth fault currents
2. Rated input current : 5A
3. Number of stages : Two (2), $I_{E>}$ and $I_{E>>}$
4. Auxiliary supply voltage : 110 V DC
5. Setting range for both stages ($I_{E>}$) and ($I_{E>>}$) : (0.01 to 6) x I_N in steps of 0.05A
6. Delay time for both stages : 0 to 150 seconds in steps of 0.1 sec
7. Thermal withstand capability of the relay in AC current input : 100 x I_N for 1 sec
40 x I_N for 2 sec
4 x I_N continuous
8. Use of the stages : One stage ($I_{E>}$) shall be used for signalling when an earth current of 1A to 1,5A is detected to flow through the



neutral of the transformer. The second stage ($I_{E>>}$) shall be used selectively to provide a tripping command to the 20 KV transformer central circuit breaker when an earth current of ≥ 10 A is detected to flow through the neutral of the transformer

9. Number of output contacts : Two (2) contacts related with stage $I_{E>}$. Both contacts shall be of the signalling type with rated current = 1A and Two (2) output contacts related with stage $I_{E>>}$. One of which shall be of the signalling type with rated current = 1A, and the other of the command type with rated current = 5A, and with making capability of 30 A for 0.5 sec and breaking capability of 0.25A at 110 V DC

IX. ADDITIONAL REQUIRED CHARACTERISTICS OF THE NUMERAL RELAY

1. The relay shall be of reduced sensitivity with regard to 3rd harmonics currents.
2. The relay shall be equipped with an RS232 port for PC communication.
3. The relay shall be equipped with an RS485 port for communication purposes via IEC-61850 protocol or IEC – 60870 –5-103 or Profibus-fms or Modbus/Rtu or DNP 3.0.
4. The relay terminals shall be of the screw type and must be suitable to be wired with control cable of cross section of 2.5mm².
5. The relay shall be suitable for panel flush mounting.
6. The degree of protection of the relay housing shall be IP52 as per IEC-60529.

X. REQUIRED TECHNICAL CHARACTERISTICS OF THE CURRENT TRANSFORMER

1. Rated Voltage : 12 KV
2. Rated Frequency : 50 Hz
3. Ratio : 25/5-5A
4. Primary rated current : 25 A
5. Number of secondary windings : Two (2). One for protection purposes and one for metering
6. Protection winding characteristics



- a. Rated current : 5 A
- b. Rated output power : 30 VA
- c. Accuracy Class : 5P
- d. Accuracy Limit factor : 10
- 7. Metering winding characteristics
 - a. Rated current : 5 A
 - b. Rated output power : 30 VA
 - c. Accuracy Class : 1
 - d. Instrument security factor : FS2
- 8. Power Frequency Voltage withstand of the primary winding : 28 KV
- 9. Lightning impulse voltage withstand (1.2/50 μ s) : 75 KV
- 10. Power Frequency voltage withstand of the secondary winding : 3 KV
- 11. Rated continuous thermal current : 1.2x25A=30A
- 12. Rated short-time thermal current (Ith) : 1250A
- 13. Rated dynamic current (Idyn) : 3125A
- 14. Limit of temperature rise of the winding when carrying the rated continuous thermal current : 75°C , insulation class E
- 15. Type of material of the insulating housing : Cycloaliphatic epoxy resin
- 16. Partial discharge level : 20pC at 14.4KV
- 17. Type : Indoor, dry type
- 18. Installation : Inside the metallic kiosk of the power transformer's neutral earthing (grounding) resistor

XI. ADDITIONAL REQUIRED CHARACTERISTICS OF THE CURRENT TRANSFORMER

- 1. The primary terminals of the CT must be suitable to be connected with a tin-plated copper strip of dimensions at 40x4mm (width x thickness) with the aid of proper bolts and nuts.
- 2. The secondary windings terminals of the CT must be suitable for connection with control cables with cross section of 4mm²
- 3. The CT must be suitable to be mounted on a metallic surface or on a metallic pedestal through bolts and for this reason it must bear at its base four (4) hot-dip galvanized steel strips with proper holes so that the CT can be supported through bolts and nuts. The necessary bolts and nuts must be part of the supply.
- 4. The dimensions of the CT can not exceed:
35cm in diameter 25cm in height and 20cm in depth.



XII. TESTS

A. Testes for the numerical relay

1. Routine Tests

- a. Power frequency voltage withstand test : 2KV, 50Hz for one (1) minute in accordance with IEC-60255-5 standard

2. Type Tests

- a. Impulse voltage withstand: 5KV peak value
In accordance with IEC – 600255-5 standard
- b. High frequency disturbance test: 2,5KV, 1MHz, $t=15\mu s$, 400 pulses/sec, 2 seconds in duration in accordance with IEC- 60255-22-1, class III standard
- c. Fast transient disturbance test: 2KV, 5/50ns, 5 MHz in accordance with IEC-60255-22-4, class III standard
4. Electrostatic discharge test : 4KV/6KV contact discharge, 8KV air discharge with both polarities 150pF, $R_i=330\Omega$ in accordance with IEC-60255-22-2 class III and IEC-61000-4-2, class III standards

B. Tests for the current transformer in accordance with IEC-60044-1 standard

1. Routine Tests

- a. Verification of terminal markings
- b. Power-frequency withstand test on primary winding: 28KV, 50Hz, 1 minute
- c. Power-frequency withstand test on the secondary winding: 3KV, 50Hz, 1 minute
- d. Partial discharge measurement ($\leq 20pC$ at 14.4KV)
- e. Determination of errors

2. Type Tests

- a. Temperature rise test
- b. Lightning impulse test for the primary winding: 75KV peak value of shape 1.2/50 μs
- c. Short-time current test
- d. Power frequency voltage wet test: 28KV, 50Hz for 1 minute



XIII. PACKING

The relays and the CT's shall be delivered packaged separately inside a robust paper box suitable for this type of equipment.

XIV. INFORMATION WHICH MUST BE PROVIDED BY ALL BIDDERS

1. All bidders must provide all information which required in **ATTACHMENT 'A'** of this hereby specification. Failure to comply with this requirement will result in rejection of the offer.
2. Dimensional and outline drawings for the relay and the current transformer.
3. Preliminary drawing depicting cross section and top view of the current transformer and also depicting how the CT is to be mounted. Failure to comply with this request will result in rejection of the offer.
4. Technical prospectus and any other information for the relay and the current transformer
5. Schematic and wiring drawing for the relay.

XV. INFORMATION WHICH MUST BE PROVIDED BY THE SUCCESSFUL BIDDER

1. Final drawings indicating dimensions, cross view and top view and supporting strips of the CT.
2. Setting instructions, maintenance instructions for the relay and any software needed for its setting and parameterization.



ATTACHMENT 'A'
SINGLE-PHASE LARGE RESISTANCE EARTH FAULT
NUMERICAL RELAY
AND SUITABLE CURRENT TRANSFORMER

Failure to answer all following questions will result in rejection of the offer.

A. RELAY

1. Manufacturer of the relay :
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2. Type of the relay :
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3. Temperature range during operation of the relay :
4. Temperature range during storage of the relay :
5. Rated frequency :
6. Rated input current :
7. Is the relay of the numerical type? :
8. Is the relay of the definite time? :
9. Number of overcurrent stages :
10. Auxiliary supply voltage :
11. Setting range of the first overcurrent stage ($I_{E>}$) :
 - step
12. Setting range of the second overcurrent stage ($I_{E>>}$) :
 - step
13. Time delay for both overcurrent stage :
 - step
14. Thermal withstand capability of the relay :
 - Continuous :
 - For two (2) second :
 - For one (1) second :



15. Can the one overcurrent stage ($I_{E>}$) be used for the defection of currents of 1 to 1.5A and to provide an output signal, and the other stage ($I_{E>>}$) to provide a tripping command when it detects a current of $\geq 10A$? :
16. Output contacts related to stage ($I_{E>}$)
- a. Number of signalling contacts :
 - b. Rated current of signalling contacts :
 - c. Making current of the signalling contacts :
 - d. Braking current of the signalling contacts :
17. Output contacts related to ($I_{E>>}$) stage
- a. Number of signalling contacts :
 - b. Number of command (tripping) contacts :
 - c. Rated current of signalling contacts :
 - d. Rated current of command contacts :
 - e. Rated making current of command contact for 0.5sec :
 - f. Breaking current of the command contact at 110V DC :
18. Is the relay of reduced sensitivity to 3rd harmonics currents? :
19. Is the relay equipped with an RS485 port for communication purposes via IEC 61850 protocol? Or IEC 60780-5-103 or Profibus-fms or Modbus/Rtu or DNP 3.0? :
20. Is the relay equipped with an RS232 port for interfacing with a PC? :
21. Are the relay terminals of the screw type and suitable to be wired with control cables of 2.5mm² in cross section? :
22. Is the relay suitable for panel flush mounting? :
23. Degree of protection of the housing of the relay :
24. Weight of the relay :
25. Power consumption of the relay in VA :



B. CURRENT TRANSFORMER

1. Manufacturer :
2. Type :
3. Rated Voltage :
4. Rated frequency :
5. Ratio :
6. Primary rated current :
7. Number of secondary windings :
8. Protection winding characteristics :
- a. Rated current :
- b. Rated output of the secondary :
- c. Accuracy class :
- d. Accuracy limit factor :
9. Metering winding characteristics :
- a. Rated current :
- b. Rated power output :
- c. Accuracy class :
- d. Instrument security factor :
10. Rated continuous thermal current :
11. Rated short-time thermal current (I_{th}) :
12. Rated dynamic current (I_{dyn}) :
13. Power frequency voltage withstand of the primary winding :
14. Power frequency voltage withstand of the secondary winding :
15. Lightning impulse voltage withstand :



16. Temperature rise limit :
17. Type of material of the insulating housing :
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18. Partial discharge level :
19. Are the primary terminals suitable to be connected to a tin-plated copper strip of 40x40mm in dimensions? :
20. Are the secondary terminals suitable to be connected to control cable of 4mm² in cross section? :
21. Does the CT bear at its base four (4) hot-dip galvanized steel strips for supporting purposes? :
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22. Are the necessary bolts, nuts, and washers for the support (mounting) of the CT part of the supply? :
23. Weight of the CT :
24. Dimensions of the CT :
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25. Insulation class as per IEC 60085 :