

SPECIFICATION SS-131 / 9

PHASE AND EARTH **DEFINITE AND INVERSE TIME** **OVERCURRENT RELAYS** **WITH DIRECTIONAL CAPABILITY** **FOR BOTH PHASE AND EARTH** **FOR 150 kV TRANSMISSION LINE & TRANSFORMERS** **BAYS PROTECTION**

ATHENS - GREECE

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PHASE AND EARTH
DEFINITE AND INVERSE TIME
OVERCURRENT RELAYS
WITH DIRECTIONAL CAPABILITY FOR BOTH PHASE
AND EARTH
FOR 150kV TRANSMISSION LINE TRANSFORMER
BAYS & PROTECTION.

I. SCOPE

This specification covers the requirements concerning the technical and operational characteristics of definite time and inverse time 3-phase and earth overcurrent relays with directional capability for both phase and earth.

The relays are to be used as back-up protection for the 150 kV Transmission Lines and 150kV Transformers bays.

II. KEYWORDS

Overcurrent relays, phase and earth (ground).

III. 400kV/150 kV SYSTEM CHARACTERISTICS

Current transformer ratio	:	100 - 3000 / 1A or 5A.
Voltage transformer ratio	:	160000/ $\sqrt{3}$: 120/ $\sqrt{3}$ V or 400000/ $\sqrt{3}$: 100/ $\sqrt{3}$ V
System nominal voltage	:	400/150/30 kV
Maximum system voltage	:	420/170 kV
System frequency	:	50 Hz
Minimum/Maximum frequency	:	47.5/51Hz
Number of CTs	:	3, single phase
Number of VTs	:	3, single phase

IV. RELAY MOUNTING REQUIREMENTS

1. The relay shall be housed in a case which shall be suitable for flush panel mounting.
2. The relay shall be suitable for rear connection.
3. The relay shall be equipped with screw type (preferably) terminal blocks which shall be suitable for 2.5 mm² conductors and 4 mm² for the current connections.

V. RELAY REQUIRED AUXILIARY VOLTAGE
(POWER SUPPLY AND BINARY INPUTS)

The relay auxiliary voltage must be: 110 V DC or 220V DC.

VI. RELAY REQUIRED FUNCTIONS

The relay must be equipped with the following functions:

- a. Definite time overcurrent phase and earth protection with three (3) overcurrent stages, for phase and earth and two (2) overcurrent stages for negative sequence currents ($I>$, $I>>$, $I>>>$, $I_E>$, $I_E>>$, $I_E>>>$, $I_2>$, $I_2>>$), with directional capability for phase, earth and negative sequence elements.
- b. Inverse time overcurrent phase and earth protection with overcurrent stage, for both phase and earth ($I>$, $I_E>$) and with directional capability for both phase and earth.
- c. The inverse overcurrent phase and earth protection must include curve types either based on IEC or IEEE/ANSI as indicated below:

per <u>IEEE / ANSI</u>	per <u>IEC</u>
Short-time inverse	Short-time inverse
Moderately inverse	Standard inverse
Inverse	Very inverse
Very inverse	Extremely inverse
Extremely inverse	Long-time inverse

- d. Breaker failure protection. This function will check the fault current exciting the relay for a certain (adjustable) period of time after the trip command has been given to the relevant circuit breaker. In case the fault current exists after this period of time (meaning the breaker has failed to open) an appropriate contact of the relay should be energized.
Additionally, for Bays with small fault currents, the option to use a secondary contact for the position of the CB should be available.

VII. RELAY REQUIRED RATED CURRENT AND VOLTAGE INPUT AND RATED FREQUENCY.

1. Rated current (I_n) : 1 A or 5 A
2. Rated voltage (U_n) : $120/\sqrt{3}$ V
Or $100/\sqrt{3}$ V
3. Rated frequency (f_n) : 50 Hz

VIII. INFORMATION WHICH THE SUPPLIER MUST KNOW FOR THE PHASE AND EARTH DIRECTIONAL CAPABILITY OF THE RELAY

Because the relay may be supplied by three single phase CTs and three single-phase VTs, it must be capable of calculating the earth current (I_0) and earth voltage (V_0) by itself.

IX. RELAY REQUIRED SETTING RANGES

a. Definite-time overcurrent element.

a.1.

<u>Low Overcurrent Element</u>	<u>Range</u>
Phase ($I >$)	$(0.1-4) \times I_n$ in steps of 0.05A
Earth ($I_E >$)	$(0.05-4) \times I_n$ in steps of 0.05A
Delay time for $I >$ and $I_E >$	0-100 s in steps of 0.05 s

a.2.

<u>High Overcurrent Element</u>	<u>Range</u>
Phase ($I >>$)	$(0.1-20) \times I_n$ in steps of 0.05A
Earth ($I_E >>$)	$(0.05-8) \times I_n$ in steps of 0.05A
Delay time for $I >>$ and $I_E >>$	0-100 s in steps of 0.05 s

b. Inverse-time overcurrent element.

<u>Overcurrent Element</u>	<u>Range</u>
Phase ($I >$)	$(0.1-3.2) \times I_n$ in steps of 0.1 A
Earth ($I_E >$)	$(0.1-3) \times I_n$ in steps of 0.1 A
Time multiplier	0.05-15 in steps of 0.1

X. ADDITIONAL REQUIREMENTS

The relay must:

- be of numerical type.
- have a separate input for earth current.
- be equipped with fault recording capability.
- be capable of blocking 2nd harmonics.
- be equipped with at least eight (8) output contacts. All of them will be programmable to allow the user to choose which of elements are related to the contacts. One additional contact for watchdog (self-check) must be provided.
The output contacts must have the following characteristics

- Continuous current rating: 5 A.
- Breaking capacity: 0.3 A at 110 V DC for L/R=40 ms
- Making capacity: 30 A for 0.5 s
- f. Be equipped with at least seven (7) BI with 110 or 220VDC operating voltage.
- g. Be equipped with at least eight (8) fully configurable LEDs
- h. Include a VT failure monitoring function
- i. Include programming capabilities such as timers, flip-flop bits etc

XI. RELAY MEANS OF CONFIGURATION

The relay shall be configured via:

- a. an integrated keypad and an LC screen.
- b. a PC through a proper port and appropriate software which must be included in the supply.

XII. SOFTWARE

Software for the operation (5 licenses at least, included in the price of the offered devices) will be provided on the basis of a royalty free, non-exclusive, with irrevocable license to use by IPTO for the operation of the relays. This term is applicable for the software covering all issues: Setting transmission, calibration, fault analysis, communication between relay-PC and communication between relay-remote station. The software will be menu-driven, friendly to the user and easy to be followed even by an inexperienced operator. The fault analysis software will be capable of displaying on a VGA all analogue waveforms and binary signals.

XIII. TESTS

a. Routine tests.

- a.1. Insulation tests as per IEC 60255-27.
- a.1.1. Dielectric withstand : 2 kV rms, 50 Hz, 1 min,
between all terminals and case earth.

b. Type tests.

- b.1. Impulse test as per IEC 60255-27 : 5 kV peak, 1.2/50 μ s, 0.5 J
- b.2. High frequency test
as per IEC 60255-26,

or IEEE / ANSI C 37.90.1 : 2.5 kV peak, 1 MHz,
400 shots per second,
duration = 2 s.

b.3. Fast transient test
as per IEC 61000-4-4

b.4. Vibration test
as per IEC 60068-2-6 : Acceleration : $0.5g \pm 25\%$
Frequency range: 10 – 150 Hz
Number of sweep cycles: 20
Sweep rate: 1 octave / mm $\pm 10\%$.
Duration of endurance: 2 hours
30 minutes

NOTE :

Bidders are required to submit, if available, any official test reports for all of the above tests along with their technical offer. Acceptance or not lies on the judgment of IPTO S.A.

XIV. ADDITIONAL DATA TO BE SUPPLIED BY BIDDERS

1. Reference list

A reference list of the offered type relay shall be submitted in which the following shall be included :

- Country and Customer
- Number of installed relays
- Date of order.

2. Drawings pamphlets

Bidders are requested to submit along with their technical offers, outline drawings, wiring diagrams and any information and data which will attributed to the complete description of the offered relay.

3. Connection drawing of the relay with CTs and VTs

In the offer, a connection diagram must be included depicting the connection of the relay to the available CTs and VTs

4. Certificates for IEC 60255-26 and IEC 60255-27

5. Conformity statements for 2014/30EU and 2014/35/EU directives.

XV. ATTACHMENT “A”

Bidders are requested to complete attachment “A”.

Failure to comply with this request will constitute sufficient reason for rejection of the offer.

XVI. COMMUNICATION AND INTERFACES

The relay shall be equipped with all the appropriate ports for communication and interfacing purposes as described below:

1. One port suitable for connection to a PC (USB or RJ-45).
An operator program shall be available to enable user - friendly parameter setting, analysis of fault data and records and commissioning either locally or remotely.
2. Two fiber optic ports suitable for connection to a digital computerized substation control and automations system (SAS). The communication protocol shall be the IEC 61850. Relay shall be connected with the SAS through the two fiber optic ports (LAN A & B respectively) and shall utilize the PRP (IEC 62439-3) protocol.

The relevant certificates, in accordance with IEC 61850-10, must be submitted.

The certificates must be of level A (level A means independent Lab, e.g. KEMA). The certificates can be of level B (manufacturer's Lab), if the manufacturer's Lab has been qualified by the UCA International Users Group.

In the first case the certificates (level A) must be submitted along with technical offer. In the second case the certificates (level B) along with the UCA International Users Group certification to the manufacturer must be submitted in the technical offer.

3. Apart from the internal synchronization clock, the relay must be capable of being synchronized via the substation automation control system master clock, which has the capability of G.P.S. synchronization, besides that of its own.
4. A number of 20 cables for the communication of the relay with PC must be included in the offer.
5. The relay must be equipped with an integral keyboard and display for parameter setting.

XVI. GUARANTEE

Guarantee of good operation for a period of at least five (5) years must be provided.

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ATTACHMENT “A”

1. Type of the offered relay :
2. Is the offered relay suitable for flush mounting or surface mounting? :
3. Relay rated current :
4. Relay rated voltage :
5. Relay rated frequency :
6. Relay auxiliary voltage (Power supply) :
7. Are the relay's terminals of the screw type and suitable for 2.5 mm² conductors ? :
8. Does the relay meet the required functions listed in paragraph VI of the specification ? :
9. Relay setting ranges.
- 9.a. Definite Time.
- 9.a.1.

<u>Low Overcurrent Element</u>	<u>Range</u>
Phase	 x I _n in steps
Earth	 x I _n in steps
Delay time for phase and earth	 in steps

9.a.2.

High Overcurrent Element	Range
Phase	 x In in steps
Earth	 x In in steps
Delay time for phase and earth	 in steps

9.b. Inverse Time.

Overcurrent Element	Range
Phase	 x In in steps
Earth	 x In in steps
Time multiplier	 in steps

10. Can the relay block 2nd harmonics ? :
11. List all relay contacts and their characteristics
(acc. § X.d) :
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.....
12. Is the relay equipped with fault recording capability? :
13. Does the relay include a VT failure monitoring function? :
14. Does the relay include programming capabilities such as timers, flip-flop bits etc? :
15. Is the relay equipped with breaker failure function? :
16. Can the relay operated with the the assumptions of paragraph VIII? :
17. Is any parameterization software provided? :
18. Is the offered relay equipped with two (2) fiber optic ports for connection to a digital computerized substation control and automation system? :

19. Is the relay equipped with a suitable Port for connection to a PC :
20. Can the relay be configured by an integrated keyboard and an LC screen and also by a PC? :
21. Is guarantee of good operation for a period of at least five (5) years provided ? :
22. Have the offered relays been certified by conformance test performed in accordance with IEC 61850-10? :
-Are certificates provided? :
23. Power consumption of the relay :
24. Weight of the relay :
25. Dimensions of the relay :
26. Does the relay support PRP? :
27. Does the relay support time Synchronization from substation Automation and control system :.....