SYRIAN ARAB REPUBLIC
MINISTRY OF ENERGY

PUBLIC ESTABLISHMENT for TRANSMISSION and DISTRIBUTION of ELECTRICITY

(PETDE)

TECHNICAL SPECIFICATION FOR NUMERICAL DISTANCE & DIFFERENTIAL PROTECTION RELAYS

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1. General

This specification describes the general requirements for a Numerical Protection Relay to comply with National, IEC, standards and for use in the High voltage Substation to Protection Transmission Line (400 KV, 230 kV, 66kV) and Transformers (400/ 230/20 kV 3 Windings,230/66 and 66/20 kV 2 Windings).

2. Requirements for the manufacturer

2.1 Certifications

The Numerical Relay manufacturer shall have a valid ISO 9001 (2000 version) certification and an applicable Quality Assurance and Quality Control system.

The Digital Relay manufacturer shall have the Environment Certification ISO 14001 and shall be able to supply the Product Environmental Profile (P.E.P) on the engineer's request.

2.2 Experience

The Numerical relay manufacturer shall have a long term experience (more than 25 years) in designing and manufacturing Numerical Protection Relays, and have relevant business volume and references in order to provide credibility in his commitments and a long term support capability.

Also the Numerical relay shall be western origin and qualified to be worked in Syrian network and have been effective and obtained well received.

3. Basic requirements for the Digital Protection Relay

3.1 General requirements

The Numerical Protection Relay shall comply with the most relevant national, international standards and recommendations for IEC, EN as per table (1)

List Of IEC Standards – Protection Relays

Sr.No.	Standard no.	Title
Characteristic, Performance, Accuracy, Burden, Mechanical endurance test		
1.	IEC-60255-6	Thermal requirements Mechanical requirements Limiting dynamic value Accuracy requirements Rated Burden
2.	IEC-60255-11	Interruption to and alternating component in DC aux. Energizing quantity
3.	IEC-60255-3, IEC-60255-12, IEC-60255-13	Relay characteristic & Performance test
4.	IEC-60255-23	Contact Performance test
Electromagnetic Compatibility type test:		
1.	IEC-60255-22-1, Class-III,	1MHz burst immunity test
2.	IEC-60255-22-2, Class-III IEC-61000-4-2, Class-III	Electrostatic discharge test Direct application Indirect application
3.	IEC-60255-22-4, Class-A	Fast transient / burst immunity test
4.	IEC-, 60255-22-5	Surge immunity test
5.	IEC-60255-22-7, Class-A	Power frequency immunity test
6.	IEC-61000-4-8, Class-V	Power frequency magnetic field test
7.	IEC- 60255-22-3	Radiated electromagnetic field immunity
9.	IEEE/ANSI/C37.90.2	Radiated electromagnetic field disturbance
10.	IEC- 60255-22-3	Immunity to conducted disturbances induced by radio frequency fields test
11.	IEC- 60255-25	Electromagnetic emission tests - Conducted emission test - Radiated emission test

Insulation tests:		
1.	IEC- 60255-5	Dielectric test Impulse voltage test Insulation resistance
Environmental tests:		
1.	IEC-60068-2-1	Cold test Storage test
2.	IEC-60068-2-2	Dry heat test
3.	IEC-60068-2-3	Damp heat test, steady state
4.	IEC-60068-2-30	Damp heat test, cyclic
5.	IEC-60068-2-48	Storage temperature test
CE compliance		
1.	IEC- 60255-26	Electromagnetic compatibility requirements

Mechanical tests		
1.	IEC- 60255-21-1	Vibration
2.	IEC- 60255-21-2	Shock and bump
3.	IEC- 60255-21-3	Seismic
Degree of protection test		
1.	IEC 60529	Degree of Protection Provided by enclosure test
Safety test		
1.	IEC 61010-1	Single fault condition assessment Earth bonding impedance test Mechanical resistance to shock and impact - Rigidity test - Impact hammer test Protection against electrical shock Protection against the spread of fire

3.2 General Numerical Protection Relay design requirements.

3.2.1 Technology and Functionality:

The Numerical Protection Relay design shall be based on a microprocessor technology and shall accommodate a hardware and software architecture consisting of a multifunction protection and control platform with logic/analogue inputs and outputs, including Protections, Metering, Control and Monitoring, User Machine Interface with alphanumeric display, Communication Interface, Network, Machine, Switch gear and relay diagnosis functionalities.

3.2.2 Safety and Dependability (Functional Safety)

The Numerical Protection Relay design shall be part of a safety and dependability design process of the manufacturer, associating the four R.A.M.S parameters:

3.2.2.1 Reliability:

To define a predictive calculated and field measured MTTF, determine a λ Failure Rate and a useful life time of the Numerical relay.

3.2.2.2 Availability:

To prevent any nuisance or unwanted tripping by selecting the adequate settings and improve the continuity of service.

3.2.2.3 Maintainability:

To define the Time to repair and spare part requirements in the maintenance process.

3.2.2.4 Safety:

To increase the level of protection safety without lowering the process availability according to IEC 61508 requirements and determine a S.I.L (Safety Integrity Level) capability, a P.F.D (Probability of Failure on Demand) and a S.F.F (Safe Failure Fraction) measuring the percentage of failures seen by the Watchdog leading to a safe position.

The Numerical Protection Relay shall therefore be fitted with an internal self-test monitoring system ("Watchdog") testing the relay power supply, the acquisition of current and voltages signals, the processing unit (memories, processor(s)), software/hardware watchdog, logic inputs/outputs.

In case of an internal failure making the relay in operant, the relay shall be set in fail-safe position leading to a fall-back position and shall not trip the circuit breaker equipped with shunt trip coil (e.g: loss of internal or external power supply). All the relays outputs and logic inputs shall be locked in deactivated position.

The watchdog function shall be able to activate a vertical back-up protection architecture based on an upstream Protection relay rescuing a downstream defective relay.

Any minor safe internal failure shall enable the relay to normally perform its protection functions in a downgrading mode.

3.2.3 Programming and Configuration

The Numerical Protection Relay shall be programmable and configurable with an appropriate user-friendly setting software using a MS Windows program running on a standard Lap top PC. The programming and configuration shall be carried out locally (front access) through (a RS 232 or USB or Rj45 port) and remotely through a communication network.

3.2.4 Hardware and Software architecture

The hardware and software architecture shall be modular and disconnectable .

The architecture shall allow future extensions by simple and easy hardware and firmware upgrading of the protection and shall be designed to enable upward compatibility between Digital Protection Relay of different generations of the manufacturer.

The architecture shall provide easy cost efficient maintenance operations when changing modules.

3.3 Numerical Protection Relay general and practical operating requirements

The Protection Digital Relay shall operate according to the following conditions:

Temperature: Humidity	- 5°C to +55°C Up to 90%
External auxiliary power supply: Permissible tolerance :	Suitable for 110V-220V DC systems. -20 to +10 %
Rated Frequency	50 Hz
Rated Current: Permissible over load	1A and 5A configurable current transformers, (dual rated) 4In Continuously, 100In for 1 sec.
Rated Voltage: Permissible over voltage	100V: 100V/ √3 2Un

3.3.1 The output relay contact shall be capable of withstanding a 30A DC current for 0.5 seconds.

3.3.2 The Digital Protection Relay shall have a constant 150 year minimum design MTTF during its useful life time which shall not be less than 15 years in proper temperature and environmental operating conditions.

4. Digital Protection Relay description

4.1 General description:

All relays shall be fulfil the following technical functions:

- Oscillograph data recorder

  All the units should needed an Oscillograph data recorder with the next characteristics,

  *Each Record comprises the samples from analogue signals and the status of 32 selectable digital signals

*20 or more samples per cycle.

*Configurable pickup.

*Records in non volatile memory.

*The disturbances are collected and exported in COMTRADE format.

- Event Recording:

  The relay should store minimum 200 numbers or more last events in a non-volatile memory, which can retrieved from a PC with the following data,

  *Date and time of the Event.

  *Descriptive text of Event.

- Fault Recorder

  Minimum 5 or more faults are stored in the non-volatile memory, with the following data

  *Date and time of the fault pickup, beginning and end.

  *Prefault and fault values of electrical parameters.

  *Duration and Type of Fault.

  *Level of Electrical parameters at the faults occurrence time.

- Time synchronization Via communication* Via demodulated IRIG-B input

- Setting Group Independent setting groups should be available.

- Communication Ports.

  *Have front RS232 or USB or RJ45 ports and rear redundant port remote communications. Necessary latest version /communication software should be supplied for configuration, setting modification, event analysis, and SCADA communication.

DISTANCE PROTECTION RELAY

Specification for Numerical distance Protection:

- The line protection relays are required to protect the line and clear the faults on line within shortest possible time with reliability, selectivity and full sensitivity to all type of faults on lines.
- Numerical distance protection scheme shall:

a) Be fully numerical and be based on a non-switched scheme.

b) Provide protection for the transmission line from all types of faults-phase to earth faults as well as multiphase fault. The protection algorithm may have dual redundant distance protection algorithms to detect all types of power system faults so as to arrive at a secure trip decision with correct phase selection and proper direction discrimination in the shortest possible time.

c) Have non-switched measurement, which implies processing of more than six possible fault loops measurement

d) have Quad characteristics for both phase to phase & phase to ground with independently adjustable reactive and resistive reaches for maximum selectivity and maximum fault resistance coverage. The zones shall have independent settable earth fault compensation factors to cater to adjacent lines with different zero sequence to positive sequence ratios, the Zone settings for Quad (R and X) shall be adjustable between 0.05 and 250 ohm secondary , these ranges apply to 1A nominal current.

e) Have adequate number of forward zones (minimum three) and reverse zone. The zone reach setting ranges shall be sufficient to cover line lengths appropriate to each zone. Carrier aided scheme options such as permissive under reach, over reach, & blocking and non-carrier aided schemes of zone-1 extension and loss of load accelerated tripping schemes shall be available as standard. Weak in feed logic and current reversal guard also shall be provided.

f) In case the carrier channels fails, one out of the non-carrier based schemes cited above should come into operation automatically to ensure high speed and simultaneous opening of breakers at both ends of the line.

g) In addition to the conventional impedance measuring algorithm the distance protection relay should have a separate measuring technique in the same hardware completely different to the conventional impedance measuring principal. Both the algorithms should run in parallel and should take trip decisions independently.

h) Have a maximum operating time up to trip impulse to circuit breaker (complete protection time

including applicable carrier and trip relay time) with CVT being used on the line:

SIR 0.01-4: as 40ms at the nearest end and 60ms at the other end of line for SIR 4-15: as 45ms at the nearest end and 65ms at the other end of line with carrier transmission time taken as 20ms.

j) Have a secure directional response under all conditions, achieved by memory voltage polarizing and/or healthy phase voltage polarising as appropriate

k) Shall have an independent Directional Earth Fault (DEF) protection element to detect highly resistive faults. This element shall have an inverse time/definite time characteristic with a possibility to configure the DEF as a channel-aided DEF or a channel-independent DEF.

l) Have logic to detect loss of single/two phase voltage input as well as three phase voltage loss during Energisation and normal load conditions. The voltage circuit monitoring logic should in addition to blocking the distance protection element, enable an emergency over current element to provide a standby protection to the feeder till the re-appearance of voltage signal

m) The VT fuse failure function shall function properly irrespective of the loading on the line. In other words the function shall not be inhibited during operation of line under very low load conditions.

n) Have necessary logic to take care of switch-on-to-fault condition. Energisation of transformers at remote line ends and the accompanying inrush current shall not cause any instability to the operation of relay

o) Have power swing blocking feature, with facilities for:

- fast detection of power swing
- selective blocking of zones.
- settable unblocking criteria for earth faults, phase faults and three phase faults.

p) be suitable for single pole or three pole tripping.

q) Shall have inbuilt CT supervision facility. A time-delayed alarm shall be issued if a CT open circuit is detected.

r) shall have inbuilt Trip circuit supervision facility to monitor both pre and post close supervision facilities. An alarm shall be generated.

s) shall have inbuilt circuit breaker failure protection based on undercurrent detection and/or circuit breaker auxiliary contact status and/or distance protection reset status. Provision shall be given to initiate the breaker fail logic using a digital input from external protection devices.

t) Shall have inbuilt broken conductor detection. The sensitivity of the logic shall not be affected during operation under low load.

u) Shall have a fault locator with an accuracy of +/- 3% .The display shall be in kilometers, . The fault locator should have built in mutual compensation for parallel circuit.

v) Be capable of performing basic instrumentation functions and display various instantaneous parameters like Voltage, current, active power, reactive power frequency, power factor etc. in primary values. Additionally, all sequence current and voltage values shall be displayed on-line. Also the direction of power flow shall be displayed.

w) Have self-diagnostic features, to maximize relay availability and reliability. Upon detecting a failure, the relay shall be able to provide useful diagnostic information to speed up maintenance.

x) Have a local user interface comprising of a 2-line/4- line alphanumeric LCD display and a soft touch keypad to access the settings, events and records in the relay.

y) Have front of RS 232-communication port or USB or RJ45(Ethernet) port for local access to settings, events and records. Communication port should be with bi-metalicwires

z) Have a remote communication port based on IEC 61850 over TCP. All the features available via the integral user interface shall also be available remotely.

aa) Have a built-in auto-reclose function with facilities for single phase/three pole/single and three pole tripping. It shall be possible to trigger the A/R function from an external protection. A voltage checks function which can be programmed for deadline charging/dead bus charging/check synchronizing shall be included.

ab) Records containing discrete data on the last five faults shall be made available. In particular

the fault resistance value shall be available for each record.

ac) Extensive disturbance recording facility shall be available which records a minimum of 8 analogue channels (phase and residual values of the three phase currents and voltages) and a minimum of 32 digital channels which shall include various digital inputs and output relays and internal digital signals. The facility must be capable of recording at least 8 disturbances or more. The duration of all record should be of the order of at least 10 seconds, to capture maximum possible information and there should be at least eight records stored. Necessary software shall be provided for retrieving and analyzing the records. OR the maximum duration of disturbance recorder shall be 15 Sec.

ad) Facility for developing customized logic schemes inside the relay based on Boolean logic gates and timers should be available. Facility for renaming the menu tests as required by operating staff at site should be provided. Also configuring output relays and LEDs should be possible at site. Necessary software's for these should be supplied along with relays without any extra cost.

ae) Tele protection shall be possible in the classic sense via binary inputs and relay output contacts connected to a power line carrier or other communication device that can transmit binary information between the two line ends. It shall be possible to transmit phase segregated tele-protection signals to improve the single pole tripping performance.

ag) Shall have independent continuously variable time settings from 0 to 5 seconds.

ah) Shall have resetting time of less than 50 miliseconds (including the reset time of the trip relays)

ai) Shall have variable residual compensation.

aj) Shall have memory circuits with defined characteristics in all three phases to ensure correct operation during close up 3-phase faults and other adverse conditions and shall operate instantaneously when circuit breaker is closed to zero volts three phase fault.

ak) Shall be suitable for single and three phase tripping.

al) Suitable for rated 1 A and 5 A current (dual rated) and shall have a continuous current rating of 4In Continuously of rated current. The voltage circuits shall be capable of operation at 2 times rated voltage. The relay shall have the capability to carry a short circuit current of 100 times the rated current without damage for 1second.

am) Shall be provided with necessary self reset type trip duty contacts for completion of the

scheme.(a minimum number of such contacts shall be 4 per phase). The making capacity of the contacts shall be 30 amps for 0.5 seconds with an inductive load of L/R<=50ms.

an) Shall have sufficient number of potential free contacts for carrier aided tripping, Auto reclosing, Event logger, Disturbance recorder & Data acquisition system.

The minimum No. Of binary inputs, configurable output contacts, LEDs, and CT/VT inputs shall be as follows:

Relay	CT inputs	VT inputs	configurable output contacts	Binary inputs	LED
Distance protection relay for 400 kV (1 & half CB)	8	5	32	16	8
Distance protection relay for 230 and 66 kV	4	4	16	12	8

ao) Shall have directional back up Inverse and Definite minimum Time earth fault relay with normal inverse characteristics as per IEC 60255-3 as a built in feature.

ap) Shall have broken wire features having option for tripping/ annunciation.

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DIFFERENTIAL PROTECTION RELAYS:

a) Transformer differential protection scheme shall be of numerical relays (low impedance type) suitable for two and three windings Transformers.

b) Shall be triple pole type with faulty phase identification / indication.

c) Shall have an operating time not greater than 30 ms at 5 times the rated current.

d) Shall have 2 instantaneous high set over current units.

e) Shall have an adjustable bias setting range of 10 -- 50%.

f) Suitable for rated 1 A and 5 A current (dual rated). And shall have a continuous current rating of 4In Continuously of rated current. The relay shall have the capability to carry a short circuit current of 100 times the rated current without damage for 1second. The voltage circuits shall be capable of operation at 2 times rated voltage.

g) Shall have 2nd harmonics or other inrush restraint features, and also should be stable under normal over fluxing conditions. Magnetizing inrush features shall not be achieved any intentional time delay.

h) Shall have an operating current setting of 15% or less.

I) Shall have an internal feature of the relays to take care of the angle and ratio correction.

j) Shall have provision of self-monitoring and diagnostic feature.

k) Shall have provision of recording features to record graphic from of instantaneous values during faults and disturbances for the pre and post fault period and during running conditions.

l) Current in all the windings in separate analogue channels and voltage in one channel.

j) Shall have feature of two nos. of independent REF protection for two winding transformers. This function should be provided to maximize the sensitivity of the protection of earth faults. The REF function should be a Low impedance element. The REF function should be able to share CT's with the biased differential function. As in traditional REF protections, the function should respond only to the fundamental frequency component of the currents.

k) Shall have built in features of Over Current Protection

The relay shall have two stages of definite time over-current protection as backup operating with separate measuring systems for the evaluation of the three phase currents, the negative sequence current and the residual current. In addition, the relay shall have one stage of Inverse time over-current protection operating on the basis of one measuring system each for the three phase currents, the negative sequence current and the residual current.

l)The offered relay should have minimum No. Of binary inputs, configurable output contacts, LEDs, and CT/VT inputs shall be as follows:

Relay	CT inputs	VT inputs	configurable output contacts	binary inputs	LED
Differential protection relay for 400/230/20 kV (3Windings) transformers (1 & half CB)	14	4	24	24	8
Differential protection relay for 230/66 and 66/20 kV transformers	8	1	16	10	8

Protection Function

1-Differential Unit protection (87) which includes:

*Three phase differential protection

*Digital correction of vector group and Ratio

*Homopolar component filter, which is used to remove the Homopolar component from the phase currents.

*Instantaneous Differential Trip.

*2nd and 5th harmonic restraint features.

2-Restricted Earth Fault Protection (87G)

3- Current Unbalance (46), which protects against current unbalances resulting from anomalies in the power system or unbalanced loads.

4- Thermal image (49), which protects the transformer against damage resulting from heating up during overloads.

5- Breaker Failure Protection(50BF), Which verifies the breaker correct actuation for clearing a fault, otherwise, the trip of the necessary breakers to clear that fault

6- Phase over current protection (2*50/51) with time delayed, as a backup protection for Transformer external faults, if external faults are not cleared by primary protections.

7- Over Excitation protection (V/Hz) (24) with two independent levels, which prevents transformers from at a greater flow density than that for which they were designed. And also avoiding heating and consequent damage in the transformer due to over excitation.

8- Over Excitation protection (5th harmonic)

9- Neutral Earth fault with time delayed and Instantaneous for each winding as for backup protection.

10- Frequency protection (81O/U)

11- Over Voltage protection (59)

12- Ground Over current Protection (50G/51N), which act as an over current function by using the current measured at the grounding of the power transformer, being its function to detect faults to earth.

13- Data Acquisition Functions

The following Measurements should be available

*Current in each winding (A)

*Average current in each winding (A)

*Differential current (A)

*Voltage (KV)

*Frequency (Hz)

Participation in Factory Acceptance Testing (FAT)

PETDE reserve the right to witness the FAT of a sample quantity of the offered equipment as per IEC. The contractor will bear the costs of attendance of two PETDE representatives at such tests for each delivery. The costs borne by the contractor will include return air fares from Damascus to the manufacture's test premises and all accommodation and subsistence expenses for one week in the country of the manufacturer's test premises.

TEST Certification

All relays must be precision tested and calibrated for life at the factory, the routine test data must be delivered with each unit as well as test certificate,

TRAINING

Training for PETDE Engineers for one week should be provided.

Training shall be theoretical and practical; Training program should be delivered to PETDE before 15 days from starting date.

TENDER DOCUMENTS:

The tender shall include the following documents:

guarantee schedules shall be completely filled and signed by bidder and manufacturer

Manufacturer Qualifications:

Bidders should submit the following qualification documents:

• Manufacturer's experience in designing and manufacturing Protection relays (relays types and

years of experience).

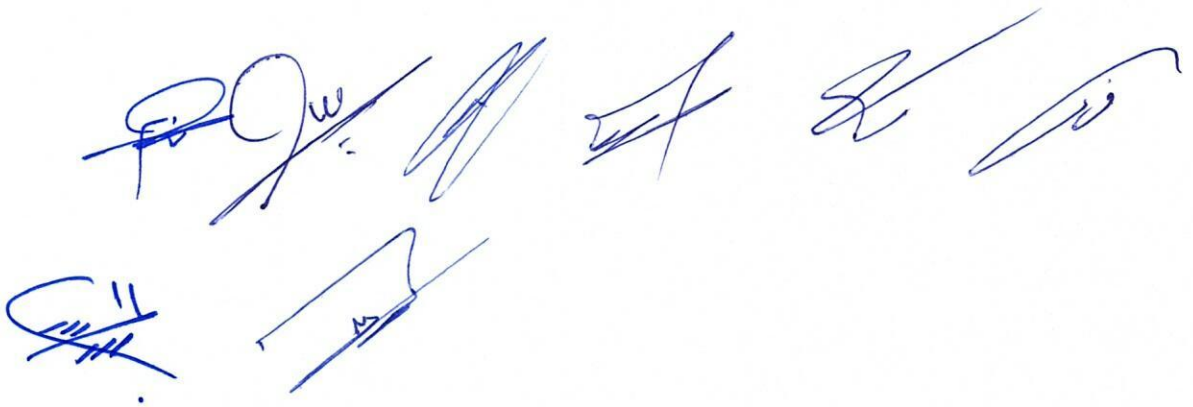
• Manufacturer's quality certificates (ISO).

• Manufacturer's annual production capacity.

• Manufacturer's quality assurance plan.

• Certificates and test reports for similar types from independent international laboratories for the offered protection relays.

• Key customers for the manufacturers during last five years with fax Nos. and addresses.



Tender No. ( ) Manufacturer qualification form for Equipment (protections relays)

		Description	Offered Data
General	1.1	Type (model)	
	1.2	Manufacturer / country of origin	
	1.3	Manufacturing country /factory location	
	1.4	Date of foundation the factory	
	1.5	Manufacturers address	
	1.6	If equipment Manufactured under license, give name and country of licensor	
	1.7	List of similar equipment Manufactured by you during the last five years .	
	1.7.1	National: a) No. of equipments b) total value of equipment	
	1.7.2	International: a) No. of equipment b) Total value of equipment	
Technical and financial	2.1	Date of starting production: of the equipment	
	2.2	Total quantity of offered equipment produced of the same type	
	2.3	Enclose list of main clients during last 3 years	
	2.4	Approximate annual turnover of the Manufacturer during last 3 years	
Quality	3.1	Do you have quality department? to whom it reports .	
	3.2	Are you qualified to ISO 9001, enclose certificate.	
	3.3	Date of qualification and validity.	
	3.4	Do you maintain comprehensive records of manufacturing, inspection and test .	
Testing	4.1	Do you have routine test facilities.	
	4.2	Do you have type test facilities	

Guarantee Schedule For Transformer Numerical Differential Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
1	Manufacturer			
	country		western origin	
2	ISO 9001 certificate and year			
3	Type reference			
4	Order Number			
5	Principle of operation	Yes/No	Numerical	
6	Period of proven reliability.	years		
7	Number of years of guaranteed parts manufacturing and supports.	years		
	ANALOG INPUT			
8	Rated Frequency	Hz	50	
9	Currents			
	No. of CT inputs		for 400 kV: min14 for 230&66 kV: min 8	
	Rated Current Secondary In	A	1&5 configurable (dual rated)	
	Rated Current Primary	A	1-2500	
	CT Burden per phase			
	a) - For 1A			
	b) - For 5A			
	CT Burden per earth			
	a) - For 1A			
	b) - For 5A			
	Thermal overload capacity of CT			
	a) - Continuously		4 In	
	b) - For 1 sec.		100 In	
10	Voltages			
	Rated Voltage Un	V	100/√3	
	VT Ratio		1 - 4000	
	No. of VT inputs		for 400 kV: min 4 for 230&66 kV: min 1	
	VT burden per phase at Un			
	Thermal overload capacity of VT			
	- Continuously	V	2Un	
11	Auxillary Voltage			
	Rated Voltage	Vdc	110-220 Vdc	
	Tolerance	%	-20%	
		%	+10%	
	Power consumption			
	- Quiescent state	W		
	- Energized state	W		

Guarantee Schedule For Transformer Numerical Differential Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
12	Binary inputs			
	Number of inputs		for 400 kV: min 24 for 230&66 kV: min 10	
	Polarity			
	Oparating voltage		110&220 Vdc	
13	Output contacts			
	Number of contacts		for 400 kV: min 24 for 230 & 66 kV: min 16	
	Polarity		NO & switchover NO/NC	
	No. of NO contacts	no		
	No. of switch over NO/NC contacts	no		
	Rated Voltage	Vdc	110-220	
	Continuous current	A	min 5	
	Make and carry for 0.5s	A	min 30	
	Breaking capacity (L/R<=50ms)		< 25	
	Contact material		Silver	
	Oparate time	ms	< 4	
	Two Watch dog contacts		provided for Self supervision	
14	Led			
	Healthy (Run)		green	
	Out of Service (ERROR)		red	
	Trip		red	
	Alarm			
	Number led can be Programmble			
	Reset mode		Self-Reset or Latched	
15	Communication			
	Front port connection		RS232 & Rj45 or USB for connecting a PC	
	Rear port		RS485 & Rj 45 for connecting to a control system via IEC 61850 Ethernet protocol	
	protocols		IEC61850 & Modbus TCP	
	Synchronization facility with GPS		IRIG-B	
	- connection		rear	
	- Voltage Level			

Guarantee Schedule For Transformer Numerical Differential Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
16	Mechanical design			
	housing/dimension			
	Weight			
	type of mounting		Rack or panal mounting	
	Degree of protection			
	-Surface	IP	≥ 40	
	- Front	IP	≥ 40	
	- Rear port	IP	≥ 20	
17	Climate stress test			
	permissible ambient temperature during operation		-5 to +55 °C	
	permissible ambient temperature during Storage		-5 to +55 °C	
	permissible humidity		Up to 90%	
18	Insulation test			
	Standard		IEC 60255-5	
	high voltage test			
	-all circuit except auxiliary voltage		2KV	
	-voltage circuit		2KV	
	impulse voltage test on all circuits		5KV peak 1.2/50ms	
	Function			
19	Number of Setting Group		min 3	
20	Differental Protection			
	Setting range dI >		0.05-0.5 In	
	Number of slops		min 2	
	Bais current for start of slope 1			
	m 1 slope 1 range		0.1 - 1.5	
	Bais current for start of slope 2			
	m 2 slope 2 range		0.1 - 1.5	
	Second harmonic blocking	Both	Enable or Disable	
	Fifth harmonic stabilitng ratio setting			
	Range			
	Reset time			
	Reset ratio			
	Operating time Id> 1.2 Iset			
	Operating time Id> 5 Iset	ms	max 30	
	Setting range dI >>			
	Reset time			
	Reset ratio			

Guarantee Schedule For Transformer Numerical Differential Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
	Restricted earth-fault Protection			
	Number of element		min 2	
	pickup range and step			
21	Slope range			
	Second harmonic blocking	Both	Enable or Disable	
	Operating time at 1.1*pickup	ms		
	Operating time at 10*pickup	ms		
	Over Current Protection			
	Number of Characteristic		2 definite Time and 1 Inverse Time	
	Definite Time			
	Pickup value I > for In=1A and step			
	Pickup value I > for In=5A and step			
	Pickup value I >> for In=1A and step			
	Pickup value I >> for In=5A and step			
	Time delay for definite time stages and step			
	Tolerances for current pickup		1%In	
22	Tolerances for Delay time		1% of setting	
	Inverse Time			
	Pickup value I > for In=1A and step		0.05-4 A	
	Pickup value I > for In=5A and step		0.25- 20A	
	Triping Characterstic (Curve Type)		IEC Normal inverse,Long inverse, exteremely inverse, long time	
	Time multiplier and step			
	Reset time	ms		
	Reset Ratio		0.97	
	timing accuracy for DT function			
	timing accuracy IDMT function			
	Earth fault Protection			
	Characteristic		2 definite Time and 1 Inverse Time	
	Definite Time			
	Pickup value 3I0> for In=1A and step			
	Pickup value 3I0> for In=5A and step			
	Pickup value 3I0>> for In=1A and step			
	Pickup value 3I0>> for In=5A and step			
	Time delay for definite time stages and step			
	Tolerances for current pickup		1%In	
23	Tolerances for Delay time		1% of setting	
	Inverse Time			
	Pickup value 3I0> for In=1A and step		0.05-4 A	
	Pickup value 3I0> for In=5A and step		0.25- 20A	

Guarantee Schedule For Transformer Numerical Differential Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
	Triping Characterstic		IEC Normal inverse,Long inverse, exteremely inverse, long time	
	Time multiplier and step			
	Reset time			
	Reset Ratio		0.97	
	timing accuracy for DT function			
	timing accuracy IDMT function			
24	Unbalanced protection (Negative-sequence)			
	Setting range			
	Characterictic		Definite time	
25	Trip circuit supervision			
	Number of supervision Trip curcuit		≥2	
	Number of required binary inputs per trip curcuit			
	Indication Relay	s	1-30s step 1s	
26	Thermal overload protection			
	Function		Provided	
27	Breaker failure protection			
	Number of stage			
	Pickup of current element			
	Time delays and step		0-10 s step 0.01s	
28	Over Excitation			
	Function		Provided	
	Number of stage			
29	Frequency protection			
	function under frequency	Yes/No	Yes	
	number of under frequency			
	setting range			
30	voltage protection			
	under voltage function	Yes/No	Yes	
	over voltage function	Yes/No	Yes	
31	Event			
	number event		>200	
	Time-tag		1ms	
	Triggers		any element bickup,droupout,operate,digital input & output change	

Guarantee Schedule For Transformer Numerical Differential Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
32	Disturbance recording			
	a.measured values		8 Analogues and 32 digital channel	
	b. starting signal		User Configureable	
	c. recording management			
	d. maximum no of simultaneous available recor		minumum 8 record each duration of 3s	
	e. max. recording period		15 s	
	f. pre fault time		User Configureable	
	g. post fault tim		User Configureable	
	h. max. period of one record		5 s	
	I. sampling rate of analog input		1000 HZ	
	j. sampling rate of binary inputs		1 ms	
	k:save or export COMTRADE format		Yes	
33	Fault Report			
	Number of elements			
	Pre-fault trigger			
	fault trigger			
	Recorder quantities			
34	programmable scheme logic			
	supported operation		and,or.not,xor,nand	
	input			
	output		logical variable,led,contacts	
	number of configurable logic schemes can be implemented			
35	Display			
	Dimension	cm		
	number of characters per line			
	number of lines			
36	Actual metering			
	phasor diagram			
	Actual value			
	- differential current			
	- currents and voltages			
	- impedance			
	- symmetrical components			
	- power			
	- frequency			
	- power factor			

Guarantee Schedule For Numerical Line Distance Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
1	Manufacturer			
	country		western origin	
2	ISO 9001 certificate and year			
3	Type reference			
4	Order Number			
5	Principle of operation	Yes/No	Numerical	
6	Period of proven reliability.	years		
7	Number of years of guaranteed parts manufacturing and supports.	years		
	ANALOG INPUT			
8	Rated Frequency	Hz	50	
9	Currents			
	Rated Current Secondary In	A	1&5 configurable (dual rated)	
	Rated Current Primary	A	1-2500	
	No. of CT inputs		for 400 kV: min 8 for 230&66 kV: min 4	
	CT Burden per phase			
	a) - For 1A			
	b) - For 5A			
	CT Burden per earth			
	a) - For 1A			
	b) - For 5A			
	Thermal overload capacity of CT			
	a) - Continuously		4 In	
	b) - For 1 sec.		100 In	
10	Voltages			
	Rated Voltage Un	V	100/√3	
	VT Ratio		1 - 4000	
	No. of VT inputs		for 400 kV: min 5 for 230&66 kV: min 4	
	VT burden per phase at Un			
	Thermal overload capacity of VT			
	- Continuously	V	2Un	
11	Auxillary Voltage			
	Rated Voltage	Vdc	110 - 220	
	Tolerance	%	-20%	
		%	+10%	
	Power consumption			
	- Quiescent state	W		
	- Energized state	W		

Guarantee Schedule For Numerical Line Distance Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
12	Binary inputs			
	Number of inputs		for 400 kV: min 16 for 230&66 kV: min 12	
	Polarity			
	Oparating voltage		110&220 Vdc	
13	Output contacts			
	Number of contacts	no	for 400 kV: min 32 for 230 & 66 kV: min 16	
	Polarity		NO & switchover NO/NC	
	No. of NO contacts	no		
	No. of switch over NO/NC contacts	no		
	Rated Voltage	Vdc	110& 220	
	Continuous current	A	min 5	
	Make and carry for 0.5s	A	min 30	
	Breaking capacity (L/R<=50ms)	W	< 25	
	Contact material		Silver	
	Oparate time	ms	< 4	
	Two Watch dog contacts		provided for Self supervision	
14	Led			
	Healthy (Run)		green	
	Out of Service (ERROR)		red	
	Trip		red	
	Alarm			
	Number led can be Programmble			
	Reset mode		Self-Reset or Latched	
15	Communication			
	Front port connection		RS232 or Rj45 or USB for connecting a PC	
	Rear port		RS485 & Rj 45 for connecting to a control system via IEC 61850 Ethernet protocol	
	protocols		IEC61850 & Modbus TCP	
	Synchronization facility with GPS		IRIG-B	
	- connection		rear	
	- Voltage Level			
16	Mechanical design			
	housing/dimension			
	Weight			
	type of mounting		Rack or panal mounting	
	Degree of protection			
	-Surface	IP	≥ 40	
	- Front	IP	≥ 40	
	- Rear port	IP	≥ 20	

Guarantee Schedule For Numerical Line Distance Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
17	Climate stress test			
	permissible ambient temperature during operation		- 5 to +55 ºC	
	permissible ambient temperature during Storage		- 5 to +55 ºC	
	permissible humidity		Up to 90%	
18	Insulation test			
	Standard		IEC 60255-5	
	high voltage test			
	-all circuit except auxiliary voltage		2KV	
	-voltage circuit		2KV	
	impulse voltage test on all circuits		5KV peak 1.2/50ms	
	Function			
19	Number of Setting Group		min 3	
20	Distance protection			
	a-Length of line	km	0.3-1000	
	b-line Angle			
	c-Characteristics		Quadrilateral for ph-ph & ph-Ground	
	d-Number of zones		3 forward & 1reverse Zones at least	
	e-Directionality		Forward,Reverse,or Non-Directional per zone	
	f-Zone Setting			
	-Range Impedance reaches for In=1A			
	Step size			
	-Range Impedance reaches for In=5A			
	Step size			
	-Range resistive reaches for ph-ph faults In=1A			
	Step size			
	-Range resistive reaches for ph-ph faults In=5A			
	Step size			
	-Range resistive reaches for ph-E faults In=1A			
	Step size			
	-Range resistive reaches for ph-E faults In=5A			
	Step size			
	-time stage			
	-Range of timer		0-10s	
	g-residual compensation	Yes	Yes	
	h-Parallel line mutual compensation	Yes	Yes	
	i-instantaneous tripping level			

Guarantee Schedule For Numerical Line Distance Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
	j-direction detection		Relay to be provided with memory polarization and cross polarization to ensure the correct operation	
	k:directional sensitivity			
	l:operating time		one cycle	
	m:reset time	ms	50	
	n:tolerance for impedance fault detection		5%	
	o-tolerance for distance measurement		5% for Zone1	
	p:Tolerance for amplitude measurement		5% for Zone1	
	r: Number Al gorithems used for discriminating the faults		min 2	
	q-timer accuracy	ms	4	
21	Switch on to fault			
	a) high current start		Provided	
	b) shortest command time	ms	20	
22	Power swing			
	Function		Provided	
	detection principle		Measurment of the rate of change impedance	
	Modes		power swing blocking and or triping for out of step	
	blocking program		All Zone Blocked can be programmable	
23	Load Enchroachment			
	Function		Provided	
	Load angle range			
	Resestance range for 1A			
	Resestance range for 5A			
24	Auto-reclosure			
	number of auto-reclosure		min 4	
	Mode		1p & 3 ph	
	Dead times			
	Active times			
	Reclaim time			
25	Synchronism Check			
	Initiate option		Auto-reclosure	
	Permissible voltage difference		User settable	
	Permissible frequency difference		User settable	
	Permissible angle difference		User settable	

Guarantee Schedule For Numerical Line Distance Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
26	Tele (pilot) protection for distance protection			
	mode:			
	PUTT Scheme			
	DUTT Scheme			
	POTT Scheme			
27	Weak-infeed protection			
	mode		Echo,Trip&Echo	
28	Over Current Protection			
	Number of Characteristic		min: 2 definite Time and 1 Inverse Time	
	Definite Time			
	Pickup value I > for In=1A and step			
	Pickup value I > for In=5A and step			
	Pickup value I >> for In=1A and step			
	Pickup value I >> for In=5A and step			
	Time delay for definite time stages and step			
	Tolerances for current pickup		1%In	
	Tolerances for Delay time		1% of setting	
	Inverse Time			
	Pickup value I > for In=1A and step		0.05-4 A	
	Pickup value I > for In=5A and step		0.25- 20A	
	Triping Characterstic (Curve Type)		IEC Normal inverse,Long inverse, exteremely inverse, long time	
	Time multiplier and step			
	Reset time	ms		
	Reset Ratio		0.97	
	timing accuracy for DT function			
	timing accuracy IDMT function			
29	Earth fault Protection			
	Characteristic		2 definite Timeand 1 Inverse Time	
	Definite Time			
	Pickup value 3I0> for In=1A and step			
	Pickup value 3I0> for In=5A and step			
	Pickup value 3I0>> for In=1A and step			
	Pickup value 3I0>> for In=5A and step			
	Time delay for definite time stages and step			
	Tolerances for current pickup		1%In	
	Tolerances for Delay time		1% of setting	
	Inverse Time			
	Pickup value 3I0> for In=1A and step		0.05-4 A	
	Pickup value 3I0> for In=5A and step		0.25- 20A	

Guarantee Schedule For Numerical Line Distance Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
	Triping Characterstic		IEC Normal inverse,Long inverse, exteremely inverse, long time	
	Time multiplier and step			
	Reset time	ms		
	Reset Ratio		0.97	
	timing accuracy for DT function			
	timing accuracy IDMT function			
30	Trip circuit supervision			
	Number of supervision Trip curcuit		>2	
	Number of required binary inputs per trip curcuit			
	Indication Relay	s	1-30s step 1s	
31	Directional over current			
	Characteristic		2definite time+1 inverse time OR can be make Logic with OC	
	Measured signals for direction decision			
	Torque angle range		-90 +90	
	Direction		forward/back	
32	Directional Earth Fault			
	Characteristic		2definite time+1 inverse time OR can be make Logic with OC	
	Measured signals for direction decision		IE and VE , I2 and V2	
	zero-sequence voltage range and step		0.5-10 V step 0.1	
	Negative-sequence voltage range and step		0.5-10 V step 0.2	
	zero-sequence current range and step			
	for In = 1A		0.05 to 1A	
	for In = 5A		0.25 to 5 A	
	Negative-sequence current range and step			
	for In = 1A		0.05 to 1 A	
	for In = 5A		0.25 to 5 A	
	Torque angle range		-90 +90	
	Direction		forward/back	
33	Thermal overload protection			
	Function		Provided	
34	Breaker failure protection			
	Number of stage			
	Pickup of current element			
	Time delays and step		0-10 s step 0.01s	
35	Broken conductor protection			
	function		Provided	
	How ration I2/IL			

Guarantee Schedule For Numerical Line Distance Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
43	programmable scheme logic			
	supported operation		and,or.not,xor,nand	
	input			
	output		logical variable,led,contacts	
	number of configurable logic schemes can be implemented			
45	Display			
	Dimension	cm		
	number of characters per line			
	number of lines			
46	Actual metering			
	phasor diagram			
	Actual value			
	- currents and voltages			
	- impedance			
	- symmetrical components			
	- power			
	- frequency			
	- power factor			

Guarantee Schedule For Numerical Line Distance Protection

Item	Description	Unit	REQUIRMENTS	OFFER VALUE
36	Frequency protection			
	function under frequency	Yes/No	Yes	
	number of under frequency			
	setting range			
37	voltage protection			
	under voltage function	Yes/No	Yes	
	over voltage function	Yes/No	Yes	
38	VT Fuse failure			
	function		Provided	
39	Fault Locator			
	output of distance to fault		Km	
	setting reactance per unit for 1A			
	setting reactance per unit for 5A			
	start signal		Trip & pickup	
	measuring tolerance		max 3%	
40	Event			
	number event		>200	
	Time-tag		1ms	
	Triggers		any element bickup,droupout,operate,digital input & output change	
41	Disturbance recording			
	a.measured values		8 Analogues and 32 digital channel	
	b. starting signal		User Configureable	
	c. recording management			
	d. maximum no of simultaneous available recor		minumum 8 record each duration of 3s	
	e. max. recording period		15 s	
	f. pre fault time		User Configureable	
	g. post fault tim		User Configureable	
	h. max. period of one record		5 s	
	I. sampling rate of analog input		1000 HZ	
	j. sampling rate of binary inputs		1 ms	
	k:save or export COMTRADE format		Yes	
42	Fault Report			
	Number of elements		min 5	
	Pre-fault trigger			
	fault trigger			
	Recorder quantities			

LIST OF PRICES AND QUANTITIES

Item	Description	Unit	Qty.	Unit Price SYP	Total Price SYP
1	Numerical Differential protection relay for 400/230/20 kv transformers (3 winding transformers)	No	2		
2	Numerical Differential protection relay 230/66 kV transformers (2 winding transformers)	No	4		
3	Numerical Differential protection relay 66/20 kV transformers (2 winding transformers)	No	4		
4	Numerical Distance protection relay for 400 kV OHTL	No	4		
5	Numerical Distance protection relay for 230 kV OHTL		8		
6	Numerical Distance protection relay for 66 kV OHTL	No	8		
6	Laptop PC for configuration and maintenance with necessary software and connections.	No	2		
7	testing	man/week	2		
8	Training as per tender document	man/week	8		
	Total