ANNEXURE-1B TO PY55223

STANDARD SPECIFICATION FOR NUMERICAL RELAYS

PROJECT	**40MW CDQ WASTE HEAT RECOVERY CO-GENERATION POWER PLANT**
CUSTOMER	**M/S TATA STEEL LIMITED, JAMSHEDPUR**
CONSULTANT	**TATA CONSULTING ENGINEERS, KOLKATA**

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1.0 General

1.1 Introduction

This specification covers the minimum requirement of design, manufacture, testing, packing and dispatch of numerical relays. The specification also defines the requirement of serial communication and integration with data concentrator, substation Man Machine Interface and upper level control system.

1.2 Codes and Standards

The equipment shall comply with the requirements of latest revision of following standards, unless otherwise specified.

IEC 60068-2-1/2/30/48 IEC 60529	Basic environmental testing procedure (part-1 - cold, part 2-dry heat, part 30-damp heat, cyclic, part 48-storage temperature) Degree of protection provided by enclosure
IEC 60255	Electrical Relays
IEC 60255 -3	General performance requirement
IEC 60255 -5	Insulation tests for electrical relays {Voltage With stand test insulation resistance test,) Dielectric test, Impulse voltage withstand test, clearance and creepage distance
IEC 60255 -6	Measuring relays & protection equipment (Measurement of accuracy, rated burden, thermal requirement, dynamic value, limits and dependency of frequency, ambient temperature and auxiliary voltage range, marking and data, mechanical durability)
IEC 60255 -11	Interruption to and alternating component (ripple) in DC auxiliary energizing quantity of measuring Relay
IEC 60255-21-1/2/3	Vibration tests/ Shock and bump test/ Seismic test
IEC 60255-22-1	1 MHz burst disturbance test
IEC 60255-22-2	Electrostatic discharge test
IEC 60255-22-3	Radiated electromagnetic field disturbance tests
IEC 60255-22-4	Fast transient disturbance test
IEC 60255-22-25	Conducted and radiated radio frequency emission tests
IEC 60255-23	Contact performance requirement
IEC 61000	Electromagnetic compatibility (EMC);
IEC 61000-4-2	Electrostatic discharge immunity test
IEC 61000-4-3	Radiated, radio frequency and electromagnetic field immunity
IEC 61000-4-4	Electrical fast transient/ burst immunity test.
IEC 61000-4-5	Surge immunity test
IEC 61000-4-6	Immunity to conducted disturbance induced by radio frequency field
IEC 61000-4-8	Power frequency magnetic field immunity test
IEC 61000-4-9	Pulse magnetic field immunity test
IEC 61000-4-10	Damped oscillatory magnetic field immunity test
IEC 61000-4-11	Voltage dips, short interruption and voltage variation immunity test
IEC 61000-4-16	Immunity to conducted, common mode disturbances in the frequency range 0-150 Hz
ENV 50204	Radiated electromagnetic field disturbance test
EN 55022Class A	Radio Interference test

2.0 Site Conditions

The relays shall be suitable for satisfactory operation when installed in a panel located in a pressurized substation with restricted natural air ventilation, in tropical humid and corrosive atmosphere. Relay shall be designed to perform all its functions and operate under site conditions specified. If not specifically mentioned there in, a design ambient temperature of 50°C and an altitude not exceeding 1000M above the mean sea level shall be considered.

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3.0 General Technical Requirements

3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.

3.2 Numerical relays with IEC61850 protocol with IEC characteristic curves shall be used.

3.3 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least for 15 years from the date of supply.

3.4 Vendor shall give a notice for at least one year to the end user of equipment and BHEL before phasing out the product/spares to enable the end user for placement of order for spares and services.

3.5 The Relay manufacturer through his Indian partner or subsidiary company in India shall provide application, testing, commissioning and other necessary support for minimum of 15 years to customer. Their Indian partner or subsidiary company in India shall also maintain adequate inventory of each type of relay or spares to meet the requirement arising during project execution and plant operation. Relay manufacturer shall possess a signed MOU with their Indian partner/ subsidiary company for providing customer support.

4.0 Specific Technical Requirements

4.1 Auxiliary Power Supply

Unless otherwise specified, relay shall be suitable to accept both AC/DC supplies with range 110V to 240V with tolerance of ± 15%. The auxiliary power supply shall preferably be site-selectable requiring no additional hardware.

4.2 Basic Requirement and Construction Details

4.2.1 Relay shall be suitable for flush mounting. The relay enclosure shall be dust tight having degree of protection minimum as IP5X.

4.2.2 Digital inputs to numerical relays shall work on the same voltage level as the auxiliary voltage of the relay.

4.2.3 Relay terminals shall be suitable for termination of 2.5/4 sq mm wires.

4.2.4 Relay shall have drawout feature with plug in type PCB for easy replacement. In case of fixed type relay, the relay terminals shall be easily accessible for testing and commissioning.

4.2.5 Current operated relay shall have provision for 4-wire CT input and 2 wires CBCT input. However the voltage-operated relay shall have provision for 4-wire PT input. In case of comprehensive single numerical relay, the relay shall have provision of both current and voltage inputs.

4.2.6 CT shorting link shall be provided at terminal block as required.

4.2.7 All numerical relays shall have key pad/ keys to allow relay setting from relay front. All hand-reset relays shall also have reset button on relay front. Self-reset or hand reset feature of the relay shall be software selectable and password protected.

4.2.8 Relay shall be suitable for both 1 A or 5A CT secondary. CT secondary 1A or 5A shall either be software selectable or by providing suitable link. Selection between 1A or 5A should be possible at site.

4.2.9 Relays shall have self-diagnostic feature with indication of relay failure on relay front.

4.2.10 All numerical relays shall be communicable type & suitable for connection to DCS through Ethernet Switch on IEC 61850 protocol with time stamping and time synchronization.

4.2.11 Relays shall, as a minimum, have protection functions, metering and control as per SLDs.

4.2.12 Serial port on front of numerical relay shall be provided for setting of numerical relay from local laptop. Suitable interconnecting cable shall also be provided.

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4.2.13 Numerical relay failure alarm (watchdog) shall be provided through self-contact of relay at manned location.

4.2.14 Numerical relay shall be with change over logic (preferably in-built) to reduce weak links in inter-panel wiring and auxiliary relays.

4.3 Software Security Password

The relays shall be provided with suitable security (pass word protection) against unauthorized WRITE ACCESS for change in relay setting. However, it should be possible to view metering, protection settings, status and event data as READ ONLY without password protection. Hardware lock etc. shall not be provided.

4.4 Indication and Display

4.4.1 All relays shall have LED/ LCD display for display of settings, status, faults and events. If specified relay shall have graphic display for mimic/ motor starting characteristic, setting, status, faults and events in place of LED/LCD display.

4.4.2 LCD display shall be backlit and temperature compensated up to 65 °C for contrast and legibility.

4.4.3 As a minimum, the relay shall have LED- indicating lamps for Fault trip, Relay healthy, Relay unhealthy, Control- supply ON.

4.4.4 All numerical relays shall be suitable for disturbance recording and provision shall be provided to display fault traces on local laptop as well as remote location through SAS.

4.5 Protection Functions

4.5.1 Over Current Protection

i. This section includes Non directional over current protection function, which mainly include different setting stages such as low set, high set and high set instantaneous (51, 50, 51N, 50N). Over current protection function provided should have IDMTL characteristic for low set and high set stages and definite time delay for high set instantaneous stage.

ii. Over current relay shall be three phase type with 4 elements; 3 elements for inverse and definite time delay over current and one element for inverse and definite time delay earth fault current. Selection of inverse or definite time feature shall be user selectable.

iii. The IDMTL characteristic (for 51 and 51N) shall be as per IEC. The inverse characteristics shall include normal inverse, very inverse, extremely inverse and long inverse and shall be software selectable. Inverse element shall have two or more stages (low and high set) for selection of required inverse characteristic to achieve close protection as required.

iv. Definite time characteristic shall have minimum 2 stages with adjustable current and time setting.

v. Relay shall also have separate current input from CBCT for earth fault current element. It shall be possible to connect earth fault element either through CBCT or to be connected residually. Minimum setting current for sensitive earth fault element shall be 1 %.

vi. Differential protection relays shall be numerical type and shall display spill current. The relays shall have dedicated control supply.

4.5.2 Motor Protection

i. Motor protection relay shall have all protection function such as over current, thermal (over load), locked rotor current, zero sequence, negative sequence, maximum number of start, motor overload pre-alarm, motor re-acceleration, lock out, inhibit of over current protection during motor starting through contactor feeders, hour run count, inhibit start after elapse of maximum number of starts etc.

ii. The numerical relay shall be provided with 6 nos RTD and 2 nos BTD analog inputs. The RTDs & BTDs of the motors shall be hooked up to the respective numerical relay for alarm/trip provision. The distance

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between motor and switchboard may be considered as 1000m and the cable as 2.5 sq.mm, multi core, Cu conductor cable.
iii. In comprehensive motor protection relay, start/ stop pushbutton from field and interlocks from DCS shall directly be wired to the relay as digital input using 2.5sq.mm, multi core, Cu conductor cables. The distance between push buttons/interlock to switchboard may be considered as 1000m. The additional components as required to overcome the cable capacitance effect shall be considered as a part of supply of relay. The digital input to relay for start/ stop and interlock contacts shall be momentary type. Logic to latch the momentary contact, as required shall be built as a part of comprehensive motor protection relay.

4.5.3 Special Protection Functions

i. These protection functions shall include minimum but not limited to directional biased over current, feeder and bus differential, over current, restricted earth fault, generator protection, reverse power functions, distance protection etc.

ii. A separate numerical relay shall be considered for providing the above special protection function.

iii. The differential relay and REF relay shall have feature for CT circuit supervision. Bus differential relay shall be provided with feature having check differential.

iv. In case separate hard-wired relay is used for check differential, the status/ event of same to be communicated through the numerical relay provided for main differential application

v. Stabilizing resistor and non-linear resistor (varistor) as required for differential and REF applications

vi No ICT shall be provided either for ratio error correction or for transformer primary and secondary vector grouping. The necessary correction shall be programmable at numerical relay.

vii. Transformer differential relay shall be suitable to achieve harmonic restraint during switching.

viii. Directional relays, power relays and voltage biased over current relay shall have analog inputs for both current and voltage.

4.5.4 Voltage Operated Protection Functions

i. These functions include under voltage (27), over voltage (59), ON delay and OFF delay timers, phase sequence voltage, neutral displacement and synchro-check functions etc.

ii. If specified in SLD, relay shall have under and over frequency protection function.

4.6 Master Trip Relay (86), TCSR (95), ARs and Timer Functions

4.6.1 Relay shall have built in lock out function. Lock out feature shall be self-reset or hand reset and shall be software selectable.

4.6.2 Relay shall have built in trip circuit supervision function. If this function is not available as a part of numerical relay, the hardwired relay shall be provided and the annunciation from hard -wired relay shall be communicated to numerical relay for display and further communication to data concentrator/ substation HMI.

4.6.3 Auxiliary relays/ Timers function etc. as required for control schematics shall be programmable as a part of numerical relay. The number of such elements as required for schematic shall be considered.

4.6.4 Timer function shall be programmable for both ON/OFF delays.

4.7 Data Storage and Disturbance/ Event Recording

4.7.1 Status, event data and disturbance record data shall be stored in the relay in non-erasable memory or memory backed up by lithium battery. Under no circumstances such as withdrawal of power to the relays shall the status, data and events in the memory get erased. Unless otherwise specified, it should be possible to save minimum 3 records of each event and the last disturbance record. Subsequent event shall be overwritten following principle of FIFO.

4.7.2 All disturbances/ events shall be displayed with time stamp.

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4.7.3 *Deleted.*

4.8 Galvanic Isolation, Input/ Output Interface and Filters

4.8.1 All IOs shall have galvanic isolation. Analog inputs shall be protected against switching surges, harmonics etc.

4.8.2 Voltage (through PT) input to relay shall be 110V +/- 10%.

4.8.3 Output relays shall have at least 4NO contacts; each shall separately be programmable for either hand reset or self- reset. The contact rating shall be minimum 5A at 250V AC/DC.

4.8.4 Relay shall be made immune to capacitance effect due to long length of cables. Any external hardware, if required for avoiding mal-operation of relay due to cable capacitance shall be included as a standard feature.

4.8.5 Relay shall have current input from CT secondary rated either 1A or 5A. It shall have flexibility to set the relay operating parameter as1 Amp or 5 Amp through programing or through hard- wired selection at site.

4.9 Relay Communication with Data concentrator

4.9.1 In IEC-61850 based communication network, Ethernet switches shall provide error free communication in harsh substation environment and shall be immune to EMI. The Ethernet switches shall comply with IEC 61850-3 and shall be KEMA approved.

4.9.4 Ethernet switch shall have dual power supply facility. Ethernet switch shall have 110V DC Auxiliary supply.

4.9.5 For real time deterministic performance, managed Ethernet switch shall be considered in the Ethernet network. The switch shall support following features:

- Full duplex operation
- Priority Queuing
- Virtual LAN (VLAN)
- Rapid Spanning tree
- Multicast filtering

4.9.6 Ethernet switch shall have 20% ports as spare.

4.9.7 The maximum number of relays in one LAN shall be decided so as to achieve maximum scan time as 500 ms for SOE and 3 to 6 sec for status and historical data considering total number of serial loop and star coupler as a total integration. The above scan time does not include screen refresh rate at HMI..

4.9.8 For sequence of event recording, time discrimination between two events shall be maintained to 1 m sec or better.

4.10 Data Concentrator

Deleted.

4.11 Human Machine Interface (HMI)

Deleted.

4.12 Time Synchronization

Deleted.

5.0 Testing And Acceptance

5.1 Relays shall have been type tested as per relevant Indian/ international standards. Type tests shall include as minimum but not be limited to the following:

5.1.1 Temperature withstand
5.1.2 Disturbance immunity
5.1.3 Electromagnetic compatibility (EMC)
5.1.4 HV withstands test for insulation
5.1.5 Impulse voltage test
5.1.6 Functional tests and Communication integrity
5.1.7 Relay characteristics verification
5.1.8 Degree of protection
5.1.9 Mechanical stress/ vibration test

5.2 During assembly, owner/BHEL or his authorized representative shall be permitted to assess the progress of work as well as to ascertain quality raw materials are used for the same. All assistance as required during inspection shall be given to inspector.

5.3 Final acceptance tests shall be carried out at manufacturer/ assembler's works under his care and expense. Manufacturer shall also arrange instruments and equipment as required for testing. Owner's/BHEL's representative shall be given minimum 2 weeks prior notice for witnessing the tests. Manufacturer shall furnish test certificates indicating test results. Acceptance tests shall include visual checks, insulation checks, heat run tests and functional tests as a minimum or as per the manufacturer's quality plan.

5.4 In case of fully assembled and tested relays sourced from abroad, manufacturer shall furnish type, routine and acceptance test certificates along with the supply of numerical relays for owner's/BHEL's perusal.

6.0 Packing and Dispatch

The relays along with six set of detailed catalog, type test certificate, acceptance test certificate shall be shipped to switchboard manufacturer in world-class packing as per manufacturer's standard. The relay shall be duly protected with polythene sheets and packed in box duly filled with fillers to prevent damage. Necessary warning "HANDLE WITH CARE" shall be inscribed on the box.

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