



امارت اسلامی افغانستان  
ISLAMIC EMIRATE OF AFGHANISTAN  
DA AFGHANISTAN BRESHNA SHERKAT



## TECHNICAL REQUIREMENTS and specification

For

**PROCUREMENT AND SUPPLY OF 220 AND 20kV, NEW  
EQUIPMENT IN AQGHA NEW PLAN SUBSTATION IN JUZJAN,  
AFGHANISTAN**

**DA AFGHANISTAN BRESHNA SHERKAT (DABS)**

Procurement and Supply, of  
220 /20 KV new substation equipment in Aqcha Juzjan, Afghanistan

**INVITATION FOR BID NO.:**

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**ISSUED**

**ON:**

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## **1-Scope of Supply and project Overview Aqcha Substation**

### **1.1 General**

This project situated between three main road Mazar, Aqcha and Sheberghan. This area is extensive and flat ground, three-transmission line has been passed from this place, 220kv transmission line from Pulkhurasan to Mazar substation, 110kv transmission line from Jarqdoq to Mazar substation and 500kv transmission line from Andkhoy substation to Khoja Alwan substation. Aqcha substation located between three-transmission lines, according to the DABS inspection the survey team proposed the three option they compared distances of three-transmission line from the Aqcha substation. Distance from 500kv transmission line to substation is not specified, distance from 110kv line to Aqcha substation is 23.4km and distance from 220kv line to Aqcha substation is around 2km.

The scope of supply of equipments for this project shall include manufacture design, assembly and acceptance testing at manufacturer's workshop as well as the supply, customs clearance, delivery, unloading, adjusting, painting, identification, testing and final checking, to facilitate the handing over and DDP at site and suitable for satisfactory operation.

The project shall be on DDP site basis, (Aqcha SS) including transportation & insurance and unloading at site.

**1.2 Completion of Project:** all the materials shall be delivered so that the project must be completed including uploading at site **7 months** from the date of execution of the contract agreement.

1.4 The Contractor is to guarantee the efficient and satisfactory working of the plant erected under the Contract **for a period of twelve (12) months** from the date on which the Employer takes over the plant in accordance with the General Conditions of Contract.

**Data sheets** Defines the overall technical specification and Data sheets for the new 220/20kV substation equipments at Aqcha District.

The detailed scope of work, supply services for the 220/20 kV substation equipments at Aqcha is as specified below the contractor is responsible to send submittal for approval of Dabs engineer and then start the process of manufacturing.

The project shall be on DDP site basis, including transportation & insurance and unloading at site (Aqcha SS)

## **2-TESTING AND INSPECTION**

The tests shall be carried out in order to determine whether the materials and equipment comply with the Specification.

Not less than Two weeks' notice of all tests shall be given to DABS. As many tests as in the opinion of DABS are possible shall be arranged together. Three copies of the records of all tests shall be furnished to DABS.

With the exception of the manufacturer's routine and sample tests, waive all type tests may, at the option of DABS, if available and are approved by the Engineer.

The cost of tests shall be deemed included in the Contract Price except for the expenses for the DABS personals

Testing shall be in accordance with the relevant clauses of the standards as mentioned in this Specification and as per the relevant international standards

### **2.1 Participation of Employer's Staff in FATs**

The Employer's staff or his representative has the right to witness all FATs carried out by Contractor or his Sub-supplier which should be requested by the contractor for all equipments that need to witness by employer as per IEC standard or other international standards. The Contractor must inform the Employer at least 4-weeks.in advance when and where the FAT will be carried out and submit FAT procedures for comment and approval as per IEC Standards. and Contractor should provide all required accommodation (Visa, Tickets, traveling, hotel expenses, Documentation, etc.) And Perdiem (according to first kick off meeting) for employer's staff while

Attending the FAT.

The FAT expenses of each equipment has been considered in all substation equipments prices.

The Fat test Have to considered for the Main Equipments of 220-20-0,4kV (CB,Ds,CVT,CT,LA,ACPanel,DC panel, control Panel, Relay Panel Battery , Rectifier ,20kV Panel switchgears)....have to be tested and approved by DABS engineers.

### **2.2 Documents to be submitted with the Bid (As per Later No 26072 Date 27/2/1445 of COO Type test certification or Type test report is Not Applicable) and to be submitted before product.**

Each bidder shall submit with its bid the following documents, data and information in addition to any other information called for elsewhere in the Bidding Documents to enable DABS to fully evaluate the proposal of the Bidder.a. Type test certification or Type test report for main equipments.

The Bidder shall include with its bid the recent type test certificates or test data for the offered CB,DS,LA,CT,CVT,,AC Panel, DC Panel ,Control panel ,Relay Panel ,battery ,rectifier

switchgear panels units. The document shall have been issued by an approved internationally acknowledged, reputable, independent testing laboratory.

b. Certification that the same type of units with the same mechanical rating have been sold to foreign customers and a record of past successful operation for use on projects at a voltage level 110 – 220 kV or above for a period of at least 8 years.

c. A list of at least two foreign purchasers of the offered units giving date of delivery, quantities supplied, and full name and address of these purchasers.

d. Outline drawings of units showing all dimensions, main characteristics, description of materials, unit weight, etc.

e. General description of the factory, giving information concerning the capacity of production, manufacturing techniques used and quality system of the manufacturer.

### **2.3 Document to be submitted after Award of Contract**

a. Confirmation of data provided in the Bid.

b. Technical particulars.

c. Outline drawings of all Mentioned BOQ units.

e. Inspection Quality and Testing Procedure.

f. Quality control procedure.

## **3-Steel Structures**

### **3.1. General**

Steel structures shall be provided under this Contract for supporting the insulators, circuit Breaker, CT, surge Arrester switchgear, earth wires, and other equipment and fittings generally as shown on the drawings, and have to be designed and erected according to the relevant international recognized standards.

The structures shall include all necessary access ladders to give access to the various levels of the high-level equipment and shall incorporate all necessary screens to comply with the requirements of insulation levels and minimum clearances.

Step, ladders, handrails, guards and other facilities shall be provided on the inside of the columns near the junction of the beam and column, to facilitate safe inspection and maintenance for the structures. Step bolts are not acceptable for the steel structures.

The design and arrangement of supporting structures shall be subject to approval by the Owner/Engineer. The structures shall be rigid and self-bracing against all dead, wind, pull-off and other applied loads. Wherever such an arrangement can be adopted, horizontal beams at intermediate or high level to provide an integrated framework shall brace structures. At or near

ground level, all uprights shall be provided with holding down bolts provided under this Contract.

The rigidity of the structures shall be such that the alignment of the apparatus

The loads to which the structures are subjected shall not disturb which they carry.

#### **4 Design**

All structures shall be designed so that no failure or permanent distortion shall occur when tested with applied forces equal to 2.5 times the maximum simultaneous working loads.

The maximum allowable stresses in tensile members shall be such as to give a factor of safety of not less than 2.5 on the elastic limit strength.

Bolts and nuts shall be fitted with spring washers. Taper washers are to be added where necessary. Threads of bolts shall be spun galvanized and the threads of nuts shall be greased.

The diameter of bolts and nuts, which are mechanically stressed, shall not be less than 12 mm and shall have metric screw threads. Nuts and heads of all bolts shall be of the hexagonal type. Minimum quality of for bolt shall be in accordance to the respective standards (5.6 of DIN 267).

Bolt holes are not to be more than 1.5 mm larger in diameter than the corresponding bolt diameter. The design is to be such as to keep the number of different parts as small as possible and is to facilitate transport, erection and inspection.

#### **3. Deformation – Deflection Conditions**

Under permanent loads and with normal wind but with no short-circuit and no earthquake, deformations are never higher than the following values:

- Beam:

Vertically: 1/200 of the span

Horizontally: 1/200 of the span

- Column: 1/150 of the height in both directions measured at the level of the horizontal axis of the beam.

#### **5 Material**

Material for steel members and plates of towers shall be of the type and grade most suitable for the application intended and shall conform to the latest applicable standard, specifications and recommended practices of the industry. The quality of steel to be used for the fabrication on the towers shall at least correspond to SS400 and SS540 according to JIS G 3101. The steel to

be used shall be of a quality that will not have its physical properties changed or become embrittled by hot dip galvanizing.

All material shall be tested at the steel mill in accordance with applicable specification and standards under which they are manufactured. The contractor shall apply all certified mill tests. Test shall be conducted in accordance with ASTM A 370. The test to be conducted shall include, but are not limited to uniformity of galvanizing coating, mechanical and chemical properties of all steel and additional embitterment testing on high strength steel.

High tensile steel, when stores in the fabricators stockyard prior to fabrication and galvanizing, shall be marked continuously throughout its length with a light blue water paint line. In addition the grade number of the steel shall be painted on and ringed round with paint.

The steel shall be free from blisters, scale and other defects.

Main members and bracings of lattice structures shall be not less than 6 mm and 5 mm thick respectively.

## **6 Construction**

The compression members of steel structures shall consist of rolled steel sections and the tension members of rolled steel sections or flats.

All members shall be stamped or marked for erection purposes as specified.

All members shall be stamped or marked in an approved manner with numbers and/or letters corresponding to number and/or letter on the drawings or material lists. Drawings and material lists shall be submitted to the Engineer for approval. The erection marks if stamped, shall be stamped before galvanizing and shall be clearly visible after galvanizing.

Pockets and depressions likely to hold water shall be avoided and all parts of the structures shall be properly drained.

Where overhead transmission lines are terminated at the substation structures, landing plates welded to the structures shall be provided for reception of the transmission line insulator fittings and earthwire clamps.

Special care shall be taken not to injure the skin on galvanized or special treated surface during erection. Care shall be taken to prevent or remove any white rust, streaks or foreign matter deposited on galvanized surfaces during storing or transport or after erection.

Approved means shall be provided for fixing and bonding copper conductors to the steel work at sufficient points to obtain efficient earthing. Earth connection shall be made to a vertical face, clear of the ground. Foundation bolts shall not be used for their attachment.

To facilitates inspection and maintenance the structures shall be provided with steps, ladders, handrails, screens, guards and other facilities. Step bolts are not acceptable for substations structures

## **6. Workmanship**

All members shall be cut to jig and holes shall be drilled or punched to jig. All parts shall be carefully cut and holes accurately located so that when the members are in position the holes can be accurately aligned before being bolted up. Drifting or reaming of holes will not be permitted. All burrs shall be removed before galvanizing.

The drilling, punching, cutting, bending and welding of all fabricated steelwork shall be carried out before galvanizing and shall be such as to prevent possibility of irregularity occurring which might cause any difficulties in the erection of steel structures on the site.

Except where specified to the contrary, all iron and steel used in the construction of the work shall be galvanized.

The hot dip process for all parts according with ASTM A-123, A-143, shall apply galvanizing and A-153 shall be applied by the hot dip process and shall consist of a suitable thickness of zinc coating of not less than 610 grams of a zinc per square meter of surface.

The zinc coating shall be smooth, clean and of uniform thickness and free from defects. The preparation for galvanizing itself shall not adversely affect the mechanical properties of the coated materials.

Built members shall, when finished, be true and free from all kinks, twists and open joints, and the material shall not be defective or strained in any way.

Steel gauges of the stud type shall be provided to enable the Engineer to carry out such checking of members as he may consider necessary.

## **7 Other Materials**

### **(7.1) General**

All construction materials such as conduit, steel angles, steel channels, steel plate, bolts, nuts and other related items required for operation shall be provided without extra charge and shall comply with the highest-grade requirements of relevant standards.



## **8 CIRCUIT BREAKERS**

### **8.1 GENERAL**

These specifications cover furnishing of outdoor, SF<sub>6</sub> gas-insulated circuit breaker equipment, materials, and accessories indicated on the High Voltage SF<sub>6</sub> Circuit Breaker Specification and Data Sheets included at the end of this section. Circuit breakers furnished shall be complete with all accessories ready for mounting, assembly, connection, and immediate service. The Contractor shall provide a standard design for the items within the scope of the specification, but which are not covered in detail by these specifications. The standard design shall be in accordance with accepted industry practices for electrical power transmission, distribution, and/or generation.

## **8.2 CODES AND STANDARDS**

All equipment provided under this specification shall conform to the applicable European Standard (EN) and International Electro technical Commission (IEC). The circuit breakers shall be designed, fabricated, and tested in accordance with these specifications.

## **8.3 CONSTRUCTION DETAILS**

Circuit breakers shall be 3 pole, single-throw, single pressure puffer type using SF<sub>6</sub> gas as the insulation and arc quenching medium. Each circuit breaker shall be mechanically and electrically suitable for tripping and reclosing as indicated on the data sheets.

The circuit breaker design shall be live-tank type.

Circuit breakers shall be capable of withstanding without damage or internal flashover 1.5 times nominal line-to-ground system voltage under one atmosphere of SF<sub>6</sub> gas pressure. Under this condition, the circuit breaker is not required to open or close.

The following articles describe the general construction of the circuit breakers.

## **8.4 Enclosures**

The operating mechanism and necessary auxiliary and control devices shall be furnished in a weatherproof, dust resistant enclosure (control cabinet) mounted on the breaker frame.

The breaker control cabinet shall provide the internal wiring for the breaker system and the interface between the Contractor's control and power circuits to the breaker. The control cabinet shall allow sufficient space for termination of Contractor-furnished control and power circuits.

Enclosure door handles shall include provisions for padlocking.

All control switches, push buttons, fuses, shorting type terminal blocks, and other devices requiring Contractor interface shall be mounted at a height and location to be easily accessible. Such devices shall be located less than 1500 mm but more than 600 mm above the top of foundation.

## **8.5 Operating Mechanism**

The operating mechanism shall consist of a spring charged stored energy mechanism. The operating mechanism shall include all auxiliary devices and other accessories for the operating mechanism furnished. The mechanism, regardless of the operating medium utilized, shall be electrically trip-free and shall include anti-pump auxiliary relays and devices.

The operating mechanism shall include a mechanical position indicator. The indicator shall provide a positive indication of the breaker position by direct mechanical coupling to the operating rod. The indicator shall consist of a suitable sign utilizing green with the word

"OPEN" when in the open position, and red with the word "CLOSED" when in the closed position.

The operating mechanism shall include dual, low energy type (below 12 amperes operating current) trip coils. The trip coils shall be electrically, mechanically, and magnetically independent. The trip coils shall be located such that heat or fire damage to one trip coil shall not preclude the proper operation of the other trip coil. The trip coils shall be suitable for parallel trip coil operation. Loss of dc voltage to one trip coil shall not impair the operation of the other trip coil or the breaker close mechanism. The trip coils shall be wired to individual terminals to allow independent activation and testing.

The stored energy operating mechanism shall operate according to the rated operating cycle stated on the Specification and Data Sheets without auxiliary power available.

Each operating mechanism shall include spare auxiliary switch contacts for use by the Owner. The spare auxiliary switch contacts shall be mechanically linked to the mechanism operating rod and shall be field adjustable as either "a" or "b" contacts.

One permissive control switch (69 device) shall be furnished. It shall be a two-position, manually operated switch that in one position permits the closing of the circuit breaker and in the other position prevents the circuit breaker from being operated. It shall be mechanically interlocked with a manual trip lever that is accessible from outside the control cabinet so that, if this lever trips the breaker, the 69 device must be manually reset before the breaker can again be operated. The manual trip device shall electrically trip all three poles, with the 69 device being moved to the lockout position. The manual trip lever shall be painted red, shall have a guard to prevent accidental activation, and shall have a plastic engraved label worded "Emergency Trip."

Each breaker close control scheme shall include a field adjustable 0.1 to 1 second time delay pickup close relay, factory preset to provide a 20 cycle automatic reclose time (including breaker close time) after energization of the close circuit.

#### **8.6 Auxiliary Power Supply**

The Owner shall furnish one auxiliary power supply to each circuit breaker at the voltage specified on the Specification and Data Sheets. If the Contractor chooses to furnish motors or other auxiliary equipment designed to operate at a different voltage from the specified auxiliary power supply, he shall furnish all equipment required to transform the voltage of auxiliary power to the design voltage of the equipment furnished. The Contractor shall provide suitable branch circuit protection.

## **8.7 Auxiliary Power and Control Power Disconnects**

Two-power supply disconnects and four knife switches per breaker shall be provided. The close circuit and auxiliary power supply shall be fed from individual disconnects. One knife switch shall be wired in series with each of the disconnects feeding the auxiliary power supply and close coil. The two remaining knife switches shall feed trip coils one and two. The type of disconnect device (molded case circuit breaker or fuse blocks) shall be as indicated on the Specification and Data Sheets.

## **8.8 SF<sub>6</sub> Gas System**

Temperature compensated pressure switches or gas density switches shall be provided to monitor the SF<sub>6</sub> gas density.

A drop in SF<sub>6</sub> gas density shall initiate a low SF<sub>6</sub> gas density alarm. A further drop in density shall initiate a trip or block any further breaker operation as specified on the Specification and Data Sheets.

The breaker shall be furnished with sufficient SF<sub>6</sub> gas to fill, test, and energize each breaker. The SF<sub>6</sub> gas shall be free of moisture and impurities. SF<sub>6</sub>/nitrogen gas mixtures shall not be supplied.

The SF<sub>6</sub> to air seals and gaskets shall prevent SF<sub>6</sub> gas leakage in excess of 1 percent per year of gas weight, through the duration of the guarantee period. Corrosive arc products due to moisture infiltration shall be prevented to the maximum extent possible through the use of desiccant moisture absorbing chambers and an arc product filter.

## **8.9 Arc Containment Chamber**

The arc containment chamber shall be designed to prevent mechanical failure and withstand pressure buildup if the breaker fails to interrupt full rated fault current. The use of a pressure relief device is acceptable and shall be so stated in the Proposal Data section.

## **8.10 Dual Monitoring and Control System**

The circuit breaker shall be furnished with dual alarm and control schemes, which monitor the SF<sub>6</sub> gas system. The dual alarm and control schemes shall be mechanically and electrically independent with each alarm and control scheme wired into a separate trip coil circuit.

## **8.11 Space Heaters**

Each enclosure furnished shall be provided with space heaters to prevent condensation of moisture within the enclosure. Space heater capacity shall be as required to maintain the enclosure internal temperature above the dew point. The heaters shall be spaced away and thermally insulated from any devices or painted surfaces.

Space heaters shall be sized to provide adequate heating when energized at the applied voltage indicated on the Specification and Data Sheets. The Contractor shall provide all space heater wiring integral to the breaker and suitable branch circuit protection. An adjustable thermostat, factory set to close (ON) at 29 C (85 F) and open (OFF) at 35 C (95 F), shall control space heaters.

#### **8.12 SPARE PARTS**

The Proposal shall include a list of spare parts for each circuit breaker as required in Part 8 titled, SPARE PARTS.

One complete set of spare gaskets and O-rings shall be furnished. The set shall contain all gaskets and O-rings needed for one complete breaker including operating mechanism seals and SF<sub>6</sub> gas-to-air seals.

#### **8.13 WIRING DIAGRAMS**

Schematic, connection, and interconnection wiring diagrams furnished by the Contractor shall be on a per circuit breaker basis.

#### **8.14 PAINTING**

Except for electrical connection surfaces, all exterior circuit breaker metallic parts, including galvanized steel surfaces, support steel, raceway, etc... Shall be painted. Painting shall be in accordance with the Manufacturer's Standards.

#### **8.15 FACTORY TESTS**

Each breaker shall be subjected to and shall meet all requirements of the routine tests as listed and described in EN 62271-100.

Three certified copies of the test results shall be delivered to the Owner not later than 10 days after completion of all factory tests. Copies of the test reports shall be included in the instruction manuals for this equipment. Test reports for each circuit breaker shall be submitted and identified by serial number.

A type test report for each circuit breaker type shall be provided to the Owner with the proposal data. It is not necessary for the Contractor to type test the breakers.

#### **8.16 PREPARATION OF BREAKERS FOR SHIPMENT**

Circuit breaker components shall be clean, dry, and sealed when shipped from the factory. Each component not shipped with SF<sub>6</sub> gas shall contain a packaged moisture-absorbing chemical as required to keep it moisture free during shipment. Tanks, interrupters, support insulators, or other SF<sub>6</sub> containers, which are found to contain moisture when received at the jobsite, shall be dried, and moisture damage shall be repaired at the Contractor's expense.

Complete instructions outlining the Contractor's recommended procedures for inspection upon receipt at the construction site, moisture free maintenance during storage, and preparation for SF<sub>6</sub> filling shall accompany each breaker. These instructions shall be shipped inside the breaker control cabinet.

### 8.17 SPECIFICATION DATA SHEET

high voltage SF<sub>6</sub> circuit breakers shall comply with the Technical Specifications and shall be furnished in accordance with the following requirements:

### 8.18 RATINGS

	220 kV System	Offered
Rated Voltage, (U <sub>r</sub> ):	245 kV	
Rated Insulation Level:	1050 kV	
Rated Frequency (f <sub>r</sub> ):	50 Hz	
Rated normal current (I <sub>r</sub> ):	1600A for line 1250 A for TR bay.	
Rated short-time withstand current (I <sub>k</sub> ):	40 kA	
Rated peak withstand current (I <sub>p</sub> ):	100 kA	
Rated duration of short circuit (t <sub>k</sub> ):	3 second	
Rated supply voltage (U <sub>a</sub> ), dc:	110V	
Rated supply voltage (U <sub>a</sub> ), ac:	240, 1 phase	
Rated supply frequency:	50 Hz	
Rated pressure of compressed gas supply for insulation or operation:	Manufacturer's Standard	
Number of poles:	3	
Class:	Outdoor	
Rated operating sequence:	O - 0.3s - CO-3 minutes - CO	
Operating time, cycles	3	
Trip and close requirements:	1 pole trip and close and single pole operate	
Mechanical operations:	M2	

### 8.19 Type tests

Dielectric tests according to Clause 6.2 yes

Measuring of resistance of main contacts according to Clause 6.4 yes

Temperature rise test according to Clause 6.5 yes

Short time withstand current and peak withstand current test according to Clause 6.6 yes

Additional test on auxiliary and control circuits according to Clause 6.10 yes Mechanical operation tests on ambient temperature according to Clause 6.101.2.1 to 6-101.2.3 yes

Short circuit making and breaking test according to Clause 6.102 to 6.106 yes

Radio interference tests according to Clause 6.3. Yes

Verification of degree of protection test (IP) according to Clause 6.7. Yes

Single-phase test according to Clause 6.108. Yes

Capacitive current switching test according to Clause 6.111.5. Yes

#### 8.20 Routine tests

Dielectric tests on main circuit according to Clause 7.1. IEC 62271-100 and Clause 7.1 IEC 62271-1 yes

Tests on auxiliary and control circuits according to Clause 7.2. yes

Measurement of resistance of main contacts according to Clause 7.3. yes

Tightness test according to Clause 7.4 yes

Design and visual check according to Clause 7.5 yes

Tripping logic for low SF<sub>6</sub> gas operating pressure:

Trip and Block Close

X Block Trip and Close

Bushing data:

Minimum creepage distance: 31 mm/kV<sub>L-L</sub>

Color: ANSI 70 gray X Brown

Control power disconnects:

Molded case circuit breakers X Fuse blocks

Space heaters: Voltage rating: 230 volts ac Applied voltage: 230 volts ac

#### 8.21 SWITCHING CAPABILITY

Each breaker shall be capable of 180-degree out-of-phase switches. The circuit breaker shall be capable of switching.

#### 8.22 SERVICE CONDITIONS

The service conditions shall be as indicated in Section V, Part 2A, and Site Conditions for Transmission Lines and Substations.

#### 8.23 ACCESSORIES

Standard accessories shall be provided with each breaker. Accessories shall include, but not necessarily be limited to, the following as indicated.

An auxiliary switch with 6 "a" and 6"b" contacts in addition to those required for control of breaker mechanism. All contacts shall be wired to terminal blocks.

X Contact surfaces shall be silver-plated.

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Four spare contacts from each Breaker 52X close relay.

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Cutoff and latch checking switches.

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X One local-remote control switch wired for local-remote operation.

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One trip-close push button station wired for local breaker test operation. One push  
X button for each trip coil.

---

One maintenance closing and opening device shall be furnished for use with all  
X breakers at each substation site.

---

X Position indicator visible from the outside of the control cabinet.

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Loss of voltage alarm relay on each auxiliary power and control power feed to the breaker, one for the auxiliary power, one for close control power, and one for each of the trip coil circuits.

---

X Operations counter to count trip operations.

---

X One elapsed time meter for the stored energy mechanism motor.

---



X 400 volt ac lamp with door operated switch in the control cabinet.

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One 400 volt, single-phase receptacle shall be installed in each control and  
X mechanism cabinet, and shall be accessible from outside the cabinet.

---

X Nameplates to identify switches, relays, and other auxiliary devices.

---

X One SF<sub>6</sub> gas sampling valve for use in moisture testing.

---

X SF<sub>6</sub> gas system pressure gauge.

---

X Density switch for annunciation of low SF<sub>6</sub> gas density.

---

Density switch with 3 independent contacts for annunciation of low SF<sub>6</sub> gas density  
X cutoff.

---

Bushing terminals, 4 hole spade type, tinned bronze or silver plated aluminum, both  
sides of terminal suitable for electrical connections. 14.3 mm holes on  
X 44.5 mm centers.

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Two 2 hole grounding pads with tinned bronze, bolted type terminals for attachment  
to the Owner's 95 mm<sup>2</sup> to 240 mm<sup>2</sup> stranded copper ground cables. The grounding  
pads shall be on diagonally opposite locations on the frame.

X

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## **9. OUTDOOR DISCONNECT SWITCHES**

### **9.1 GENERAL**

Outdoor disconnect switches and accessories shall be furnished in accordance with this section and as indicated on the drawings. The Contractor shall provide a standard design for the items within the scope of the specification, but which are not covered in detail by these specifications. The standard design shall be in accordance with accepted industry practices for electrical power transmission, distribution, and/or generation.

The requirements of the Specification Data Sheet(s) shall govern should conflicts occur between them and the written text of these specifications.

### **9.2 CODES AND STANDARDS**

All equipment supplied under this specification shall conform to the applicable standards of European Standard (EN) and International Electro Technical Commission (IEC). The disconnect and earthing switches shall be designed, fabricated, and tested in accordance with these specifications.

### **9.3 EQUIPMENT REQUIRED**

The Contractor shall furnish disconnect switches and accessories as indicated on the drawings and specified herein.

### **9.4 INSULATORS**

Disconnect switch insulators shall be furnished as specified elsewhere in these specifications.

### **9.5 SWITCH RATINGS**

Disconnect switches shall be furnished with the ratings indicated on the Specification Data Sheet(s) included at the end of this section.

All switches shall be suitable for operation at the altitude indicated on the Specification Data Sheet(s) included at the end of this section.

### **9.6 SWITCH CONSTRUCTION**

Switches shall be complete with switch blades, contacts, terminals, bases, and leveling devices, and with all bolts, nuts, and other hardware required to assemble the switches, mount the insulators, and mount the switches on steel structures. Switch bases shall be designed to resist all dynamic and static loads imposed by the switch. Switch bases shall be steel channel, hot-dip galvanized after fabrication.

All switch components fabricated of ferrous materials shall be hot-dip galvanized after fabrication or shall be stainless steel.

All switches shall be designed for satisfactory operation under ice loading conditions indicated on the Specification Data Sheet(s).

Switch parts shall be capable of carrying the continuous current specified in an ambient temperature of 40°C without exceeding the temperature rises listed in EN 62271-102, and shall have sufficient strength for all mechanical requirements.

All switches shall be furnished with copper or aluminum alloy live parts. Copper switchblades shall be hard drawn and tinned after fabrication; aluminum switchblades shall be extruded electrical grade aluminum. Where disconnect switch terminals are fabricated of copper, the copper shall be tinned.

All other switch components which are fabricated of copper and are in contact with aluminum shall have the copper tinned, and shall be provided with electrical joint compound between the contact surfaces.

Switch bearings shall be maintenance free of the sealed, greaseless type.

Switch contacts shall be high-pressure, silver insert, wiping action type. The jaw contact fingers of switches so equipped shall be designed to increase contact pressure with increasing current. Contact finger pressure springs shall be outside of the load current path.

Disconnect switches shall be furnished with terminal pads with 14.3 mm diameter bolt holes on 44.5 mm centers (NEMA). Both sides of each terminal pad shall be suitable for electrical connection to the bus system. The quantity and arrangement of bolt holes in each terminal pad shall be coordinated with the switch continuous current rating and shall be in accordance with the following table:

Switch Current Rating, amperes	Continuous Quantity of Bolt Holes	Hole Arrangement
600	2	Parallel to center line of switch
601 through 2,000	4	Square
2,001 through 4,000	6	Rectangular, with longer dimension perpendicular to center line of switch

All bolts, nuts, and other hardware required to attach the disconnect switch bases to the steel structures and the station post insulators, and make the electrical connections to the bus system shall be provided. The quantity of bolts, nuts, and other hardware provided shall include an overage of 5 percent plus ten bolts of each type, size, and length.

## **9.7 OPERATORS**

Operators shall be complete with interphase shafts, operating rods, couplings, guide bearings, mounting brackets, offsets, manual or motor operators, and all bolts, nuts, and other hardware required to assemble the operators and mount the operators on steel structures.

Operators shall be furnished with multi-revolution grounding devices or braids and with provisions for padlocking in the open and closed positions. Braids shall be tinned copper.

All levers, interphase shafts, and operating rods shall be cut to length and threaded at the factory. All operator components fabricated of ferrous materials shall be hot-dip galvanized after fabrication or shall be stainless steel.

### **9.8 Manual Operators**

Manual operators for switches rated 66 kV or above shall be swing handle type or heavy-duty geared crank type with gearbox as indicated on the Specification Data Sheet(s). The hub of the crank type operator handle shall be located approximately 900 mm above the structure baseplate.

Each disconnect switch manual operator, as indicated on the Specification Data Sheet(s) included at the end of this section, shall be provided with an auxiliary switch, with contacts in accordance with the Specification Data Sheet(s), enclosed in a weatherproof housing equipped for threaded rigid steel conduit connection. The auxiliary switch housing shall contain a 230 VAC space heater. Auxiliary switch contacts shall be field convertible. The auxiliary switch shall be for field mounting on the operating pipe.

### **9.9 Motor Operators**

Each motor operator shall be complete with an ac or dc motor rated as indicated on the Specification Data Sheet(s) included at the end of this section. Each operator shall have provisions for manual operation without removal or disassembly of the motor operator. The motor operator shall be located such that the hub of the manual operator handle is located approximately 900 mm above the structure baseplate.

Motor operators shall have sealed bearings with permanent lubrication.

Each operator shall be provided with an auxiliary switch including contacts as indicated on the Specification Data Sheet(s). Auxiliary switch contacts shall be field convertible.

In addition, each motor operated switch shall be provided with a cam actuated type auxiliary switch assembly to be field mounted to the operating pipe as specified on the Specification Data Sheet(s). There shall be contacts in the assembly as specified on the Specification Data Sheet(s), and they shall be field convertible. All contacts from the assembly shall be terminated in the motor operator enclosure on terminal blocks.

The following accessories shall be furnished for each motor operator:

One space heater rated 230 volts ac, single-phase; with thermostat, (applied voltage shall be 230 volts ac).

One reversing contactor to permit the use of shortly closed external contacts as initiating devices.

Position indicating target Local push-button control Local-remote selector switch

#### **9.10 Switch operations counter**

Each motor operator shall be mounted in a non-corrosion type aluminum or stainless steel enclosure suitable for protecting the operator for the service conditions indicated in the Specification Data Sheet(s). Painted enclosures are not acceptable.

Provisions shall be supplied in the motor operator control circuit for the Employer's external interlock contacts.

#### **9.11 TIGHTENING OF CONNECTIONS**

The Supplier shall include on his erection and assembly drawings complete information for tightening of all electrical connections secured with bolts or studs. The information furnished shall include torque wrench settings or complete details of other tightening procedures recommended for bus joints, connector attachments, and contact attachments.

#### **9.12 EARTH SWITCH**

Furnishing of earth switches with the disconnect switches shall be required as indicated on the drawings. If provided, earth switches shall be integral to the disconnect switches and shall meet the applicable requirements of EN 62271-102.

Earth switches shall be furnished with ratings in accordance with EN 62271-102. Earth switches shall have no continuous current ratings but shall have voltage and withstand current ratings equal to the disconnect switch ratings.

Earth switches shall be designed for satisfactory operation under ice loading conditions in accordance with EN 62271-102 and to meet the requirements listed in the Specification Data Sheet(s).

Earth switches shall be mechanically interlocked with the disconnect switches to prevent operation of the ground switch unless the disconnect switch is in the fully open position.

### 9.13 SPECIFICATION DATA SHEET

Outdoor disconnect switches shall be furnished in accordance with the following:

RATINGS	220 kV System	Offered
Rated Voltage, ( $U_r$ ):	245 kV	
Rated Insulation Level:	1050 kV	
Rated Frequency ( $f_r$ ):	50 Hz	
Rated normal current ( $I_r$ ):	1600A for Line 1250A for TR Bay.	
Rated short-time withstand current ( $I_k$ ):	40 kA	
Rated peak withstand current ( $I_p$ ):	85 kA	
Rated duration of short circuit ( $t_k$ ):	3 second	
Rated supply voltage ( $U_a$ ), dc:	110 V	
Rated supply voltage ( $U_a$ ), ac:	230/400 V	
Rated supply frequency:	50 Hz	
Rated pressure of compressed gas supply for insulation or operation:	N/A	
Earthing switch rated short circuit making current:	31.5 kA	
Rated mechanical endurance:	M2	
Rated value for electrical endurance for earthing switches:	10000 or more	

### 9.14 Factory Test requirements

Applied standard IEC IEC 62271-102 60694

Type test

Dielectric tests on main, auxiliary and control circuits according to IEC 60694 Clause 6.2 yes

Radio interference voltage test according to IEC 60694 Clause 6.3 yes

Measurement of resistance of main current path according to IEC 60694 Clause 6.4 yes

Temperature rise test according to IEC 60694 Clause 6.5 yes

Short time withstand current and peak withstand current test according to IEC 60694 Clause 6.6. Yes Test to verify the degree of protection of the enclosure according to IEC 60694 Clause 6.7 yes

Test to prove satisfactory operational and mechanical endurance according to IEC 62271-102 Clause 6.102. Yes

Test to prove satisfactory operation at temperature limits according to IEC 62271- 102 Clause 6.104. Yes

Test to prove satisfactory operation of position indication devices according to IEC 62271-102 Clause 6.105 and Annex A. yes

Test to prove satisfactory bus transfer current switching capability according to IEC 62271-102 Clause 6.106 and Annex B. yes

Routine tests IEC IEC 62271-102 60694

Dielectric tests on the main circuits according to IEC 60694 Clause 7.1 yes

Tests on the auxiliary and control circuits according to IEC 60694 Clause 7.2 yes

Measurement of resistance of main current path according to IEC 60694 Clause 7.3 yes

Design and visual checks according to IEC 60694 Clause 7.5 yes Mechanical operations tests according to IEC 62271-102 Clause 7.101. Yes

## 9.15 REQUIREMENTS

Insulators:	X	Required	Not Required
Integral Ground Switch:	X	Required, display on drawings	Not Required
Location:	X	Refer to drawings	
Disconnect Switch Operator:		Manual	X Motor
Disconnect Switch Manual Operator Type:		900 mm Swing Handle	1500 mm Swing Handle

	<hr/>	Gear	<hr/>	
		Mechanism		Hook
Earth Switch Operator:	<hr/>	Manual	<hr/>	X Motor
Earth Switch Manual	<hr/>	900 mm Swing	<hr/>	1,500 mm
Operator Type:		Handle		Swing Handle
	<hr/>	Gear	<hr/>	
	X	Mechanism		Hook
	<hr/>		<hr/>	

Manual operator cam-actuated drum type auxiliary switch contacts:

Minimum number "a" type 6

Minimum number "b" type 6

Motor operator auxiliary switch contacts in addition to those required for motor operator control:

Minimum number "a" type 6

Minimum number "b" type 6

A cam-actuated drum type auxiliary switch assembly is required for each motor operated disconnect switch. The auxiliary switch shall include not less than 6 "a" and 6 "b" contacts.

## 9.16 SERVICE CONDITIONS

The service conditions shall be as indicated in the Section V, Part 2A, and Site Conditions for Transmission Lines and Substations.

## 10. CAPACITOR VOLTAGE TRANSFORMERS

### 10.1 GENERAL

Capacitor voltage transformers (CVTs) and line tuners shall be furnished in accordance with this section and as indicated on the drawings. The Contractor shall provide a standard design for the items within the scope of the specification, but which are not covered in detail by these specifications. The standard design shall be in accordance with accepted industry practices for electrical power transmission, distribution, and/or generation.

The requirements of the Specification Data Sheet(s) and drawings shall govern should conflicts occur between them and the written text of these specifications.



## **10.2 CODES AND STANDARDS**

All equipment supplied under this specification shall conform to the applicable standards of European Standard (EN) and International Electro technical Commission (IEC).

Capacitor voltage transformers shall be designed, fabricated, and tested in accordance with IEC 60044-5 and these specifications. Line tuners shall be designed, fabricated, and tested in accordance with IEC 481 and these specifications.

## **10.3 EQUIPMENT REQUIRED**

The Contractor shall furnish CVTs as specified on the Specification Data Sheet(s). CVTs furnished shall be complete with all accessories ready for mounting, assembly, connection, and immediate service.

The quantity and types of CVTs furnished shall be as indicated on the drawings and per the control and protection requirements in Section V, Part 3E, Equipment and Material Requirements for Transmission Lines and Substations.

## **10.4 RATINGS**

All CVTs shall be suitable for operation at the altitude and shall be rated as indicated on the Specification Data Sheet(s) included at the end of this section.

## **10.5 DETAILS OF CONSTRUCTION**

Each CVT Shall be designed and fabricated in accordance with the latest revisions of the applicable Codes and Standards..

Each CVT assembly shall include line connectors, coupling capacitor units, and base support assembly. Each CVT shall be factory adjusted, designed, and fabricated in accordance with IEC 60044-5.

Furnish each CVT Shall with a 100-mm wide 4-hole line terminal pad, 14.3 mm holes on 44.5 mm centers (NEMA), unless otherwise indicated on the Specification Data Sheet(s) included at the end of this section.

CVTs shall be furnished with all field connection hardware for field mounting on steel supports described in these specifications. All hardware shall be hot-dip galvanized.

CVTs rated 220 kV and above shall be equipped with corona shields as required

Carrier accessories and wide band filters shall be provided for the CVTs where indicated on the drawings, and as indicated on the Specification Data Sheet(s).

The CVTs shall be furnished with the following accessories:

Primary terminal per the Specification Data Sheets

Four lifting eyes in base

## **10.6 Capacitor Units**

The coupling capacitor shall be a standard assembly of capacitor units including a lower coupling unit with such additional upper coupling units as are required to provide the necessary series capacitance between line and ground.

The lower coupling unit shall include one or more insulating bushings projecting through the bottom for connection to the voltage transformer and carrier current networks (if required) and shall be mounted on the base support assembly.

The upper coupling unit shall be standard, arranged for bolting to the lower unit and for supporting other upper bolt-secured units.

#### Base Support Assembly

The base support assembly shall be an outdoor, weatherproof welded enclosure designed and fabricated to support and mount the coupling capacitors specified above and house the following equipment:

- 1 Electromagnetic unit factory adjusted, including protective gaps, , potential grounding switch with external hooks witch operator, carrier grounding switch with external hook switch operator (carrier equipped units only), and a transformer with main and auxiliary secondary windings, each rated in accordance with IEC 60044-5.
- 1 Space heater sized to prevent moisture from condensing on internal components, with the voltage rating specified on the Specification Data Sheet(s) included at the end of this section.
- 1 Carrier lead-in bushing (carrier equipped CVTs only)
- 1 Grounding terminal, tinned bronze, bolted clamp type, for Employer's 95 mm<sup>2</sup> to 240 mm<sup>2</sup> copper ground cable size.
- 1 Terminal box, weatherproof with threaded conduit hubs

## 10.7 SPECIFICATION DATA SHEET

Capacitor voltage transformers (CVTs) and/or line tuners shall be furnished in accordance with the following:

Space heater rated voltage, VAC230

Space heater applied voltage, VAC 230

Bushing Data:

Porcelain color:

ANSI 70 grey, ☒ Brown Minimum creepage distance, mm 31 mm/kV<sub>LL</sub>

Terminal pad: 4 - hole spade type pad, 14.3 mm holes on 44.5 mm centers

Carrier accessories required ☒ Yes ☐ No

## 10.8 RATINGS

	220 kV System	Offered
Rated Insulation Level:	1050 kV	
Rated Frequency ( $f_r$ ):	50 Hz	
Rated short-time withstand current ( $I_k$ ):	40 kA	
Rated peak withstand current ( $I_p$ ):	85 kA	
Rated duration of short circuit ( $t_k$ ):	3 second	
Rated supply voltage ( $U_a$ ), ac:	230/400 V	
Rated supply frequency:	50 Hz	
Rated primary voltage ( $U_{pr}$ ) A - N:	220 kV/ $\sqrt{3}$ ,	
Rated secondary voltage ( $U_{sr}$ ):	2 x 0.1 kV/ $\sqrt{3}$	
Rated output:	10/25 VA	
Accuracy class:	0.5-3P/0.5-3P	
Rated thermal limiting output:	500 VA	

## 10.9 Type tests

Temperature rise tests according to IEC 60044-5 Clause 8.1 yes

Short circuit withstand capability test according to IEC 60044-5 Clause 8.2 yes

Lightning impulse test according to IEC 60044-5Sub-Clause 8.3.2 yes

Wet tests for outdoor transformers according to IEC 60044-5Clause 8.4 yes

Determination of errors according to IEC 60044-5Sub-Clause 12.3 and 13.6.2 yes

Measurement of radio interference voltage (RIV) according to IEC 60044-5Clause 8.5 yes

Routine tests

Verification of terminal markings according to IEC 60044-5Clause 9.1 yes

Power frequency voltage withstand test on primary terminals according to IEC 60044-5Sub-clause 9.2 yes

Partial discharge measurement according to IEC 60044-5Sub-Clause 9.2.4 yes

Power frequency voltage withstand test on secondary windings according to IEC 60044-5Sub-clause 9.3 yes

Power frequency voltage withstand test between sections according to IEC 60044-5Clause 9.3 yes Determination of errors according to IEC 60044-5Clause 12.4 and 13.7 yes

#### **10.10 Special tests**

Chopped impulse withstand test on primary winding according to IEC 60044-5Sub-clause 10.1 yes Measurement of capacitance and dissipation factor according to IEC 60044-5Sub-clause

10.2 yes Mechanical tests according to IEC 60044-5Clause 10.3 yes

#### **10.11 SERVICE CONDITIONS**

The service conditions shall be as indicated in Section V, Part 2A, and Site Conditions for Transmission Lines and Substations

### **11. FREE-STANDING CURRENT TRANSFORMERS**

#### **11.1 GENERAL**

Free-standing current transformers shall be furnished in accordance with this section and as indicated on the drawings. The Contractor shall provide a standard design for the items within the scope of the specification, but which are not covered in detail by these specifications. The standard design shall be in accordance with accepted industry practices for electrical power transmission, distribution, and/or generation.

The requirements of the Specification Data Sheet(s) and drawings shall govern should conflicts occur between them and the written text of these specifications.

#### **11.2 CODES AND STANDARDS**

All equipment supplied under this specification shall conform to the applicable standards of European Standard (EN) and International Electro technical Commission (IEC).

The free standing current transformers shall be designed, fabricated, and tested in accordance with EN 60044-1.

### **11.3 EQUIPMENT REQUIRED**

The Contractor shall furnish current transformers as specified on the Specification Data Sheet(s). Current transformers furnished shall be complete with all accessories ready for mounting, assembly, connection, and immediate service.

The quantity and types of current transformers furnished shall be as indicated on the drawings.

### **11.4 RATINGS**

The current transformers shall be rated as indicated on the Specification Data Sheet(s) included at the end of this section.

The current transformers shall be suitable for operation at the altitude specified on the Specification Data Sheet(s) included at the end of this section

### **11.5 CONSTRUCTION DETAILS**

Each current transformer shall be designed and fabricated in accordance with the latest revisions of the applicable Codes and Standards.

Current transformers shall be furnished with all field connection hardware for field mounting on supports described in these specifications. All hardware shall be hot-dip galvanized.

Each current transformer assembly shall include line connectors and base support assembly.

The current transformers shall be furnished with the following accessories:

Primary terminals - aluminum or tin-plated bronze, 4-hole spade type, 14.3 mm holes on 44.5 mm centers (NEMA).

Oil level indicator.

Oil drain and filling valves.

Four lifting eyes in base.

Porcelain color shall be in accordance with the Specification Data Sheet(s).

The number of cores shall be as indicated in the Specification Data Sheets.

### **11.6 Base Support Assembly**

The base support assembly shall be an outdoor, weatherproof enclosure designed and fabricated to support and house the following equipment:

- 1 Space heater sized to prevent moisture from condensing on internal components, with the voltage rating specified in the Specification Data Sheets
  
- 1 Grounding terminal, tinned bronze, bolted clamp type, for Owner's 95 mm<sup>2</sup> to 240 mm<sup>2</sup> copper ground cable

- 1 Terminal box, weatherproof with threaded conduit hubs

## 11.7 SPECIFICATION DATA SHEET

Transformers shall be multi-ratio furnished in accordance with the following:

## 11.8 RATINGS

Table 2.1.5: 220KV Current Transformers				
Item	Description/Details		Unit	Specified
1	220KV Current Transformers: Line, and Bus Coupler* Bays			
1.1	Rated voltage		KV	245
1.2	Core ,1 -2	Ratios	Turns	400-800- 1600/1/1/1/1A
1.3		Continuous Thermal Current (min)	I(cth)	20 0%
1.4		Accuracy	Class	PX
1.5		Winding Power	VA	25
1.6	3 & 4 characteristics, each multi-ratio	Ratios	Turns	1600- 2400/1/1/1/1A
1.7		Continuous Thermal Current (min)	I(cth)	200 %
1.8		Accuracy	Class	Class PX, VK=1500V
1.9		Winding Power	VA	25
	Core 5 characteristics, each multi-ratio	Ratio		400-800- 1600/1/1/ 1/1/1A
		Continuous Thermal Current (min)	I(cth) )	200%
		Accuracy	Class	0.2
		Winding Power	VA	25
2	220KV Current Transformer: Transformer Bays			

2.1	Manufacturer's type and reference		Each	TBD
2.2	Rated voltage		KV	245
2.3	Core 1,2	Ratios	Turns	100-200-400/1/1/1/1A
2.4		Continuous Thermal Current (min)	I(cth)	200%
2.		Accuracy	Class	PX
		Winding Power	VA	25VA,
	Core 3 & 4 characteristics, each multi-ratio	Ratios	Turns	1600-2400/1/1/1/1A
		Continuous Thermal Current (min)	I(cth)	200%
2.6		Accuracy	Class VA	PX-25
2.7	Core 5 characteristics, each multi-ratio	Ratios	Turns	100-200-400/1/1/1/1A
2.8		Continuous Thermal Current (min)	I(cth)	200%
2.9		Accuracy	Class	0.2
2.10		Winding Power	VA	25

220 kV System

Offered

Rated Voltage, ( $U_r$ ):	245 kV	
Rated Insulation Level:	1050 kV	
Rated Frequency ( $f_r$ ):	50 Hz	
Rated normal current ( $I_r$ ):	1250 A	
Rated short-time withstand current ( $I_k$ ):	40 kA	
Rated peak withstand current ( $I_p$ ):	100 kA	

Rated duration of short circuit ( $t_k$ ):	3 second	
Rated supply voltage ( $U_a$ ), dc:	N/A	
Rated supply voltage ( $U_a$ ), ac:	240, 1 phase	
Rated supply frequency:	50 Hz	
Rated pressure of compressed gas supply for insulation or operation:	Manufacturer's Standard	
Number of cores in each unit:	5	
Rated secondary current:	1A	
Rated continuous thermal current ( $I_{cth}$ ):	150%	
Rated output	As per design	
Accuracy class	As per design	
FS/ALF	20	
Rated transformation ratio ( $K_n$ ):	TBD	

### 11.9 Factory Test Requirements:

Applicable standard IEC 61869-2

### 11.10 Type tests

Temperature rise test according to IEC 61869- 2 Sub-clause 7.2.2 yes

Impulse withstand test on primary terminals according to IEC 61869-2 Sub-clause 7.2.3 yes

Wet tests for outdoor transformers according to IEC 61869 Sub-clause 7.2.4 yes

Electromagnetic compatibility test according to IEC 61869-2 Sub-clause 7.2.5 yes

Accuracy test according to IEC 61869-2 Sub clause 7.2.6 yes

Verification of the degree of protection of the enclosures according to IEC 61869-2 Subclause

7.2.7. Yes Enclosure tightness test at ambient temperature according to IEC 61869-2 Subclause

7.2.8 yes

Pressure test for the enclosure according to IEC 61869-2 Sub-clause 7.2.9. Yes

Short time current test according to IEC 61869-2 Sub-clause 7.2.201 yes

Routine tests



Power frequency voltage withstand test on primary terminals according to IEC 61869-2 Sub-clause 7.3.1 yes

Partial discharge measurement according to IEC 61869 -2 Sub-clause 7.3.2 yes

Power frequency voltage withstand test between sections according to IEC 61869-2 Sub-clause 7.3.3 yes

Power frequency voltage withstand test on secondary terminals according to IEC 61869-2 Sub-clause 7.3.4 yes

Accuracy tests according to IEC 61869-2, Sub-clause 7.3.5. Yes

Verification of markings according to IEC 61869-2 Sub-clause 7.3.6 yes

Enclosure tightness test at ambient temperature according to IEC 61869-2 Subclause 7.3.7 yes

Pressure test for the enclosure according to IEC 61869-2 Sub-clause 7.3.8. Yes

Determination of secondary winding resistance according to IEC 61869-2 Sub clause 7.3.201 yes Determination of secondary loop time constant according to IEC 61869-2 Sub-clause 7.3.202 yes Test for rated knee point e.m.f and exciting current at knee point e.m.f according to IEC 61869-2 Sub=clause 7.3.203 yes

Inter-turn overvoltage test according to IEC 61869-2 Sub-clause 7.3.204 yes

Special tests Chopped impulse withstand test on primary terminals according to IEC 61869-2 Subclause 7.4.1 yes

Multiple chopped impulse withstand test on primary terminals according to IEC 61869-2 Sub-clause 7.4.2 yes

Measurement of capacitance and dissipation factor according to IEC 61869-2 Sub-clause 7.4.3 yes Mechanical tests according to IEC 61869-2 Sub-clause 7.4.5 yes

Enclosure tightness test at low temperature and high temperature according to IEC 61869- 2 Sub-clause 7.4.7 yes

Corrosion tests according to IEC 61869-2 Sub-clause 7.4.9 yes

Bushing Data

Porcelain color:\_\_\_\_\_ ANSI 70 grey, \_\_\_X\_\_\_ Brown

Minimum creepage distance, mm\_\_\_31\_\_\_ mm/kV<sub>LL</sub>

## **12. SURGE ARRESTERS**

### **12.1 GENERAL**

Surge arresters for outdoor use shall be furnished in accordance with this section and as indicated on the drawings. The Contractor shall provide a standard design for the items within the scope of the specification, but which are not covered in detail by these specifications. The

standard design shall be in accordance with accepted industry practices for electrical power transmission, distribution, and/or generation.

The requirements of the Specification Data Sheet(s) and drawings shall govern should conflicts occur between them and the written text of these specifications.

## **12.2 CODES AND STANDARDS**

All equipment supplied under this specification shall conform to the applicable standards of European Standard (EN) and International Electro technical Commission (IEC).

Surge arrestors shall be designed, fabricated, and tested in accordance with EN 60099-4 and these specifications.

## **12.3 EQUIPMENT REQUIRED**

The Contractor shall furnish surge arresters as specified on the Specification Data Sheet(s).

Surge arresters furnished shall be complete with all accessories ready for mounting, assembly, connection, and immediate service.

## **12.4 RATINGS**

Surge arresters shall conform to the requirements indicated on the Specification Data Sheet(s) included at the end of this section.

The arresters shall be suitable for operation at the altitude indicated on the Specification Data Sheet(s) included at the end of Part 5G.

## **12.5 CONSTRUCTION DETAILS**

The surge arresters shall be metal oxide type.

The line terminal shall be as indicated on the Specification Data Sheet(s). Surge arresters shall be corona free when energized at the specified maximum operating system voltage.

Surge arresters shall be furnished with all hot-dip galvanized hardware for field mounting on steel supports described in other sections of these specifications.

The arresters shall have a 2-hole ground connector suitable for connection up to a 185 mm<sup>2</sup> aluminum conductor.

## **12.6 SPECIFICATION DATA SHEET**

Surge arresters shall be furnished in accordance with the following:

## **12.7 RATINGS**

	220 kV System	Offered
Rated Voltage, (U <sub>r</sub> ):	245 kV	

Rated Insulation Level:	1050 kV	
Rated Frequency (f <sub>r</sub> ):	50 Hz	
Rated nominal discharge current	10,000 A	
Continuous Operating Voltage (U <sub>c</sub> ):	220	

## 12.8 Factory Test Requirements

Applicable standard IEC 60099-4

### 12.9 Type tests

Insulation withstand test on arrester housing according to IEC 60099-4 Clause 7.2 and modifications according to Clause 9.7.2 yes

Residual voltage tests according to IEC 60099-4 Clause 7.3 yes Long duration current impulse withstand test according to IEC 60099-4 Clause 7.4 and Clause 9.7.4. Yes

Operating duty test according to IEC 60099-4 Clause 7.5 and modification according to Clause 9.7.5. Yes

Sort circuit test according to IEC 60099-4 Annex O. yes

Arrester disconnections test according to IEC 60099-4 Clause 7.6 and modification according to Clause 9.7.6. Yes

Internal partial discharge test according to IEC 60099-4 Clause 7.8. Yes

Moisture ingress test according to IEC 60099-4 Clause 7.9 and modifications according to Clause 9.7.9. Yes

Current distribution test according to IEC 60099-4 according to Clause 8.1e. Yes

Bending moment test according to according to IEC 60099-4 Clause 13.7.2 yes

Environmental tests according to IEC 60099-4 Clause 13.7.3 yes

### 12.10 Routine tests

Measurement of reference voltage according to IEC 60099-4 Clause 2.35 and 5.2 yes

Residual voltage test according to IEC 60099-4 Clause 7.3. Yes

Internal partial discharge tests according to IEC 60099-4 Clause 7.8. Yes

Leakage check according to IEC 60099-4 Clause 13.7.4 yes

Current distribution test for multicolumn arresters according to IEC 60099-4 according to Clause 8.1e. Yes

Line terminal type: X 4-hole pad, -in. bolt circle

14.3 mm diameter

Holes on 44.5 mm

Centers

Color: ANSI 70 grey, X Brown

Minimum creepage distance: 31 mm/kV<sub>L-L</sub>

#### **12.11 SERVICE CONDITIONS**

The service conditions shall be as indicated in Section V, Part 2A, and Site Conditions for Transmission Lines and Substations.

### **13. INSULATORS**

#### **13.1 GENERAL**

The Contractor shall provide a standard design for the items within the scope of the specification, but which are not covered in detail by these specifications. The standard design shall be in accordance with accepted industry practices for electrical power transmission, distribution, and/or generation.

The requirements of the Specification Data Sheet(s) and drawings shall govern should conflicts occur between them and the written text of these specifications.

#### **13.2 CODES AND STANDARDS**

All equipment supplied under this specification shall conform to the applicable standards of European Standard (EN) and International Electro technical Commission (IEC).

Post insulators shall be designed, fabricated, and tested in accordance with IEC 60273 and these specifications. String insulator units shall be designed, fabricated, and tested in accordance with EN 60305 and these specifications.

#### **13.3 INSULATORS REQUIRED**

The Contractor shall furnish insulators as specified on the Specification Data Sheet(s). Insulators furnished shall be complete with all accessories ready for mounting, assembly, connection, and immediate service.

#### **13.4 DESIGN REQUIREMENTS**

Insulator design requirements are covered in the following paragraphs. Fittings and clamps shall be hot-dip galvanized, malleable iron or bronze. Aluminum fittings and clamps shall not be used.

#### **13.5 Station Post Insulators**

Station post insulators shall be provided in accordance with the Specification Data Sheet(s) included at the end of this section.

These station post insulators shall be used on disconnect switches and as rigid bus supports. All mounting hardware for insulator field assembly and mounting to equipment and steel structures shall be furnished with an overage of 5 percent plus 10 bolts of each type, size, and length.

### 13.6 String Insulator Units

String insulator units shall be provided in accordance with the Specification Data Sheet(s) included at the end of this section.

String insulator units shall be used for the strain bus. All mounting hardware for insulator field assembly and mounting to the gantry structures shall be furnished with an overage of 5 percent plus 10 bolts of each type, size, and length.

### 13.7 SPECIFICATION DATA SHEET

Station post insulators and string insulator units shall be furnished in accordance with the following:

### 13.8 RATINGS

Post Insulators	220 kV System	Offered
Type:	Outdoor, cylindrical post external metal	
Fittings:		
Bolt circle diameter (minimum):	As per design	
Top:	127 mm	
Bottom:	As required for failing load	
Material:	Porcelain / Polymer	
Rated Voltage, (Ur):	245 kV	
Rated Frequency, (fr):	50 Hz	
Lightning impulse withstand voltage:	1050 kV	
Power frequency impulse withstand voltage, wet:	460 kV	
Switching impulse withstand voltage, wet:	750 kV	
Minimum nominal creepage distance:	31 mm/kV	
standards:	IEC 60050-471	

Bending:	As required to meet Substation design criteria	
Torsion:	As required to meet Substation design criteria	
String Insulator Units	220 kV System	
Type:	Cap and pin	
Coupling:	Ball and socket	
Nominal dimensions:		
Diameter:	255 mm	
Spacing:	146 mm	
Material:	Porcelain / Polymer	
Failing load (minimum):	120 kN	
Minimum nominal string creepage distance:	31 mm/kV	
String configuration:	V	
Number of bells per string (minimum):	15	

### 13.9 Post Insulator

Applicable standard IEC 60168

Manufacturer

Type: porcelain

Operating voltage kV 220

Highest voltage of equipment kV 245

Rated power frequency voltage kV rms 460

Rated lightning impulse withstand voltage kV peak 1050

Minimum creepage distance mm/kV 31.5

Factory Test Requirements

Type tests IEC 60168

Dry lightning impulse tests according to IEC 60168 Clause 4.5 yes

Wet power frequency withstand test according to IEC 60168 Clause 4.8 yes

Mechanical failing load tests according to IEC 60168 Clause 5.2 yes

Sample tests Verification of dimensions according to IEC 60168 Clause 5.1 yes

Temperature cycle test according to IEC 60168 Clause 5.4 yes

Mechanical failing load test according to IEC 60168 Clause 5.2 yes

Porosity test according to IEC 60168 Clause 5.6 if applicable. yes

Galvanization test according to IEC 60168 Clause 5.7 yes

Routine tests Visual inspection according to IEC 60168 Clause 5.8 yes

Routine mechanical tests according to IEC 60168 Clause 5.9 yes

Polymer suspension type insulators with the same electrical and failing load characteristics may be substituted for the porcelain insulator strings.

Color: ANSI 70 gray      X      Brown

Assembly:      X      Factory Field

## **14. CONTROL AND PROTECTION CUBICLES**

### **14.1 GENERAL**

This section covers furnishing substation control and protection equipment cubicles, materials, and accessories as specified herein. The Contractor shall provide a standard design for the items within the scope of the specification, but which are not covered in detail by these specifications. The standard design shall be in accordance with accepted industry practices for electrical power transmission, distribution, and/or generation.

### **14.2 CODES AND STANDARDS**

All equipment supplied under this specification shall conform to the applicable standards of European Standard (EN) and International Electro technical Commission (IEC).

Relays shall be designed, fabricated, and tested in accordance with EN 60255 and these specifications. The cubicles shall be designed, fabricated, and tested in general accordance with EN 60439 as applicable.

### **14.3 EQUIPMENT REQUIRED**

All relays, equipment, materials, and accessories shall be furnished, mounted, and connected as required to provide the functional control and protective systems as described in Part 3E titled, SUBSTATION DESIGN REQUIREMENTS and as shown on the one-line.

### **14.5 CUBICLE CONSTRUCTION DETAILS**

The cubicles shall be completely enclosed at the front, rear, top, and both sides. The front panel shall be hinged with concealed hinges that are not visible from the outside of the panel. Leveled 3 mm (minimum) gauge steel sheets and formed steel members shall be welded together to form a rigid self-supporting structure. Welds on exposed surfaces of the structure

shall be ground smooth. Cubicle nominal panel size shall be as indicated on the Specification Data Sheet(s).

Finished cubicle surfaces shall be free of waves, bellies, and other imperfections.

Exterior cubicle surfaces shall be sand blasted, ground smooth, filled, primed, and finished with enamel. Interior surfaces shall be sandblasted, primed, and finished with enamel. The paint color shall be as described in the Specification Data Sheets.

Mounting brackets, as required, shall be arranged inside the cubicle for mounting and wiring auxiliary devices and terminal blocks.

They shall be located so they do not interfere with the back of the equipment rack mounted on the front of the fixed panel. Final arrangement of devices inside the cubicle shall be submitted to the Employer for acceptance.

Panel space not used by equipment shall remain clear for addition of possible future equipment. A 15A, 230 VAC receptacle shall be furnished, mounted, and wired in a convenient location near the hinged door of the cubicle.

The receptacle is for portable tools and drop lights and shall be supplied from a 230 volt, single-phase ac source furnished by the Employer.

The Contractor shall furnish internal panel wiring and circuit protection.

The interior of each cubicle shall be illuminated with a single fluorescent fixture mounted inside the top of the switchboard and controlled from a switch mounted inside the door.

The cubicle section shall be mounted on a suitable steel channel.

Each cubicle shall be furnished with accessories described in the following sections.

#### **14.6 LIFTING EYES**

Each individual cubicle shall be equipped with removable lifting eyes.

#### **14.7 TERMINAL BLOCK**

Each cubicle shall be furnished with terminal blocks. The terminal blocks shall be 750V, 30A (minimum) suitable for mounting on DVE MN35 DIN rails. Four pole current shorting blocks shall be provided for terminating external current transformer field wiring. Unless otherwise required (current rating, etc.) or as specified, terminal blocks shall be suitable for connecting the following conductors on each side of the terminal block:

All CT circuits – a minimum of four 6 mm<sup>2</sup> copper conductors.

All VT circuits – a minimum of four 4 mm<sup>2</sup> copper conductors.



Control circuits – a minimum of two 4 mm<sup>2</sup> copper conductors.

AC and DC power supply – a minimum of two 10 mm<sup>2</sup> copper conductors.

A minimum of 20 percent spare terminal block points shall be provided in each cubicle.

#### **14.8 RACEWAY**

An adequate raceway system shall be provided for all wiring on each side of each cubicle.

A complete system of separate vertical wiring raceways shall be provided for all factory and field wiring. This shall include vertical raceways along both sides of each panel. The raceway shall consist of a formed sheet metal or rigid heavy-duty plastic assembly integral to the cubicle structure and of similar construction and shall include snap or bolt-on removable covers.

The raceways for factory wiring shall be sized so that fill does not exceed 30 percent. Vertical raceways for field wiring shall be twice as large as those provided for factory wiring or shall have a minimum cross-sectional area of 22,000 mm<sup>2</sup>, whichever is larger.

Vertical raceways for field wiring shall be so constructed as to be accessible to conductors entering from the bottom of the cubicle.

Horizontal wiring raceways shall be plastic wiring duct with covers.

#### **14.9 BUSES**

Control, potential, and alarm buses of 2.5 mm<sup>2</sup> or larger cubicle wire shall be furnished and installed as required.

A continuous 7 mm by 25 mm cross-section bare copper horizontal earth bus shall be provided in the cubicle. The earth bus shall be located at the bottom of each cubicle. Cubicles located adjacent to each other shall be furnished with a similar copper earth bus section for field interconnection of each cubicle's earth bus to form one continuous earth bus. The Contractor shall furnish a compression or clamp-type connector at each end of the continuous earth bus. All cubicle equipment requiring earthing shall be connected to this earth bus. The earth bus shall be furnished with holes tapped for standard screws.

A continuous 7 mm by 14 mm cross section bare copper earth bus of similar construction as the earth bus previously described shall be installed to extend vertically the entire length of the terminal blocks on each side between the terminal blocks and the cable entrance opening for

cable shield earthing. The earth bus shall be furnished with hole tapped for standard screws. Each vertical earth bus shall be connected to the cubicle's horizontal earth bus.

#### **14.10 POWER SUPPLY DISCONNECT**

Each cubicle mounted device requiring ac or dc supply shall have in its supply circuit a cubicle mounted fuse or disconnecting link connected to isolate the device from the power supply in the tripped or open condition.

#### **14.11 NAMEPLATES**

Engraved nameplates shall be furnished and installed for each device in the cubicle. The nameplates shall be laminated white phenolic engraving stock with black core not less than 3 mm thick. The lettering shall not be less than 5 mm high. The nameplates shall be mechanically attached to the cubicle with screws or rivets. Attachment by adhesive shall not be allowed.

#### **14.12 WIRING AND WIRING DIAGRAMS**

The Contractor shall provide internal cubicle wiring, connections, and diagrams in accordance with the requirements of the following articles.

##### **Cubicle Wiring**

All wiring used within the cubicle shall be installed and tested at the factory.

All wiring shall be neatly and carefully installed in wiring gutters or raceway.

The size of wire used in the cubicle shall conform to the requirements in the Specification Data Sheets.

##### **Diagrams**

Cubicle internal wiring diagrams furnished by the Contractor shall be based on schematic (elementary) diagrams and terminal block layout drawings developed by the Contractor, and shall conform to the requirements of Part 1B titled, ENGINEERING DATA of these specifications. The Contractor shall check the schematic diagrams for correctness and conformance with equipment furnished.

The Contractor shall prepare his connection and interconnection diagrams, which shall show the same terminal designations and terminal arrangement as indicated on the AC and DC schematics. Cable color/number codes and circuit numbers shall be shown on the outgoing side of the terminal blocks.

#### **14.13 RELAYS AND CONTROL SWITCHES**

The relays and control switches shall be factory installed in the cubicles and fully functionally tested at the factory. Each relay and control switch shall have a unique identifier acceptable to the Employer and this unique identification shall be indicated on the nameplate. Microprocessor based relays shall also have the unique identifier stored in nonvolatile memory.

#### **Microprocessor Based Relays**

Microprocessor based relays shall incorporate such features as a local HMI, remote interrogation, disturbance recording and sequence-of-events recording, and self-checking, and shall be flush mounted or rack mounted.

Remote interrogation facilities shall be provided via an external series interface. The relays shall have two independent communications ports. One port shall be dedicated to communicating with the Substation Automation System and the other port shall be for local interrogation.

The settings and records menu structure shall be arranged in such a way that it is easy and convenient for operators to interpret the information stored in the relay. The information in the menu shall be in the form of alphanumeric characters in the English language. No indirect codes or memory addresses are acceptable for this purpose. Events and programming shall be stored in nonvolatile memory.

The relays shall include a real-time clock synchronizable to allow accurate time stamping of events.

The relays shall incorporate a self-checking feature that continuously monitors or automatically checks at regular intervals the condition of the relay and provides a warning of incipient or actual failure by means of an alarm.

All relays shall be password protected and a provision to change the factory default password shall be available at the site.

#### **Electromechanical Relays**

Electromechanical protection relays shall be flush mounted and equipped with operation indicators. Internally mounted auxiliary relays shall be surface mounted and front connected with covers. Machine tool relays are not acceptable.

Auxiliary relays for circuit breaker tripping and closing functions shall be high speed with operating times not exceeding 0.4 cycles on a 50 hertz basis.

Manual reset lockout relay operating times shall not exceed 0.025 second (1.25 cycles on a 50 hertz basis). White and amber indicating lights shall be provided for coil monitoring and to indicate operation of the device.

#### **Control Switches**

Control switches shall be spring return to center with modern pistol grips. The switch escutcheons shall have targets and shall be engraved "OPEN-CLOSE" in English. Red and green indicating lights shall be provided to indicate the position of the equipment controlled.

### **14.14 MAINTENANCE AND OPERATING EQUIPMENT**

Each cubicle shall be provided with the following spare parts:

1 Lot of fuses and LEDs for indicating lights, and color caps as follows:

100 percent replacement of fuses

20 percent replacement of each color LED or bulb for indicating lights.

50 percent replacement of each color cap.

### **14.15 FACTORY TESTS**

After the cubicles have been fabricated and all parts assembled, the complete gear, including instruments and devices, shall be factory tested.

#### **Functional Tests**

Each individual item of equipment/subsystem/software package furnished by the Contractor as well as the complete system in accordance with this specification shall be inspected and functionally tested by the Contractor for full compliance with specification requirements, completeness, proper assembly, proper operation, cleanliness, and state of physical condition as applicable.

The Contractor shall conduct a point-by-point wiring continuity check to every input and output and verify that the wiring connections agree with the drawings and other relevant documentation.

#### **Notification for Functional Tests**

Contractor shall send notification regarding readiness for functional tests and indicate the proposed date for commencement of the tests to enable the Employer to assign or appoint representatives for participating in these tests. The notification shall be sent to the Employer not less than 1 month prior to commencement of the tests.

#### 14.16 SPECIFICATION DATA SHEET

Substation cubicles shall comply with the Technical Specifications and shall be furnished in accordance with the following requirements:

CUBICLE SIZE Nominal size:

800 mm Wide

2000 mm Tall

800 mm Deep

#### PAINT COLOR

Exterior: X ANSI 61 gray X RAL 7035

Interior: X gloss white

CUBICLE WIRE Service

Minimum Wire Size, mm<sup>2</sup>

Power supplies and packaged control systems 10

Current transformer circuits 6

Potential transformer circuits 4

Control wiring 2.5

Annunciator wiring 2.5

Analog circuits 2.5

(shielded cable)

EARTH BUS Vertical earth bus for cable shields to be provided. Yes X No

#### 14.17 REQUIRED AND GUARANTEED TECHNICAL REQUIREMENTS AND CHARACTERISTICS OF EQUIPMENT

Item - No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			

<b>C1.9 Protection and Control</b>				
	<b>General</b>			
	<b>Relays</b>	-	Digital	
	- standard	-	IEC 60255	
	- maximum ambient temperature for rated accuracy	°C	40	
	- maximum temperature by storage	°C	60	
	- maximum humidity	%	80	
	- electromagnetic compatibility tests	-	EN 50081 EN 50082-1  IEC 60255-6	
	- insulation tests	-	IEC 60255-5  IEC 60870-	
	- mechanical tests (vibration and shock stress)	-	IEC 60255-2-1	
	- other: all other Norms as specified on technical document	-	IEC	
	Contact rating			
	- make and carry for 0.2 s	VA		
	- break			
	- operation indicator			
	- manufacturer references	year	3	
	<b>Panels</b>			
	- standard	-	IEC 60529	

Item - No.	Da Afghanistan Breshna Sherkat (DABS) Agcha Substation			
	Schedule of Technical Data	Unit	Required	Offered
	Protection and Control			
C1.9 Protection and Control				
	- protection class	-	IP 52??	
	- pre-wired	-	Yes	
	- floor-mounted	-	Yes	
	- steel sheet thickness	mm	> 2	
	- maximum height	mm	2000	
	- maximum width	mm	800	
	- maximum depth	mm	600	
	- front-door material	-	Glass	
	- coloring	-	RAL 7035	
	<b>Line differential protection (ANSI: 87L)</b>			
	Type	-		
	Manufacturer	-		
	Place of manufacture	-		
	Rated values			
	- frequency	Hz	50	
	- phase current	A	1	
	- DC voltage	V	110	
	- communication		via OPGW	
	Settings			
	- ranges of values of restricted protection	I/I <sub>NO</sub>	0.05 – 2.00	
	- ranges of values of unrestricted protection	I/I <sub>NO</sub>	0.5 – 35.00	
	- ranges of times	sec	0.00 – 30.00	
	- trip mode	-	1-/3 pole	
	- minimum number of auto-reclose cycles (AR- cycles)	-	3	
	- fault locator and event (disturbance)	-	Yes	
	<b>Remote communication</b>			
	- protocol	-	IEC 61850	

Item- No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	- transmission rate	Baud	9600	
	Distance protection (ANSI: 21)			
	Type	-		
	Manufacturer	-		
	Place of manufacture	-		
	Rated values			
	- frequency	Hz	50	
	- phase current	A	1	
	- phase to phase voltage	V	110	
	- DC voltage	V	110	
	Settings			
	- ranges of values	Ohm	0.050 – 600	
	- ranges of times	sec	0.00 – 30.00	
	- minimum number of independent impedance zones	-	4	
	- type of characteristic of tele protection	-	PUTT, POTT	
	- trip mode	-	1-/3 pole	
	- minimum number of auto-reclose cycles (AR-cycles)	-	3	
	- fault locator and event (disturbance) recorder	-	Yes	
	Remote communication			
	- protocol	-	IEC 61850	
	- transmission rate	Baud	9600	



Item- No.	Da Afghanistan Breshna Sherkat (DABS) AqchaSubstation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	Back-up directional overcurrent protection (ANSI: 67&67N)			
	Type	-		
	Manufacturer	-		
	Place of manufacture	-		
	Rated values			
	- frequency	Hz	50	
	- phase current	A	1	
	- phase to phase voltage	V	110	
	- DC voltage	V	110	
	Settings			
	- ranges of current values	A	0.10 – 35.00	
	- ranges of voltage values	V	0.10 – 120	
	- ranges of times	sec	0.00 – 30.00	
	- minimum number of DTL stages for 67	-	2	
	- minimum number of IDMT stages for 67	-	2	
	- minimum number of DTL stages for 67N	-	2	
	- minimum number of IDMT stages for 67N	-	2	
	- trip mode	-	1-/3 pole	
	Remote communication			
	- protocol	-	IEC 61850	
	- transmission rate	Baud	9600	
	Overload protection (ANSI: 49)			
	- k-factor		0.1 – 4.0	
	- time constant	min	1.0 – 999.0	
	Transformer (Transformer) differential protection (87T)			

Item- No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	Type			
	Manufacturer			
	Operating principle			
	Rated values			
	- phase current	A	1	
	- frequency	Hz	50	
	- DC voltage 220	V		
	Current settings			
	- ranges of values of restrained protection	I/I <sub>n0</sub>	0.05 – 2.00	
	- ranges of values of unrestrained protection	I/I <sub>n0</sub>	0.5 – 35.00	
	- ranges of times	sec	0.00 – 30.00	
	Integrated functions			
	- back-up overcurrent (eventual directional)			
	- back-up earth fault (eventual directional)			
	- breaker-failure			
	- others			
	Remote communication			
	- protocol	-	IEC 61850	
	- transmission rate	Baud	9600	
	Transformer (Transformer) restricted earth fault protection (87N)			
	Type			
	Manufacturer			
	Operating principle			
	Rated values			
	- phase current	A	1	
	- frequency	Hz	50	
	- DC voltage 110	V		

Item- No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	Current settings			
	- ranges of values of restricted protection	I/I <sub>nO</sub>	0.05 – 2.00	
	- ranges of values of unrestricted protection	I/I <sub>nO</sub>	0.5 – 35.00	
	- ranges of times	sec	0.00 – 30.00	
	Remote communication			
	- protocol	-	IEC 61850	
	- transmission rate	Baud	9600	
	Busbar (Bus Arrangement) differential protection (ANSI: 87BB) Not Applicable.			
	Type	-		
	Manufacturer	-		
	Place of manufacture	-		
	Rated values			
	- frequency	Hz	50	
	- phase current	A	1	
	- DC voltage	V	110	
	Settings			
	- ranges of values of restricted protection	I/I <sub>nO</sub>	0.05 – 2.00	
	- ranges of values of unrestricted protection	I/I <sub>nO</sub>	0.5 – 35.00	
	- ranges of times	sec	0.00 – 30.00	
	CT supervision			
	Operating time	ms		
	DC burden	W		
	AC burden	Ohm		
	Remote communication			
	- protocol	-	IEC 61850	
	- transmission rate	Baud	9600	
	Back-up overcurrent protection (ANSI:			

Item- No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	50/51&50N/51N)			
	Type	-		
	Manufacturer	-		
	Place of manufacture	-		
	Rated values			
	- frequency	Hz	50	
	- phase current	A	1	
	- DC voltage	V	110	
	Settings			
	- ranges of current values	A	0.10 – 35.00	
	- ranges of times	sec	0.00 – 30.00	
	- minimum number of DTL stages for 50/51	-	2	
	- minimum number of IDMT stages for 50/51	-	2	
	- minimum number of DTL stages for 50N/51N	-	2	
	- minimum number of IDMT stages for 50N/51N	-	2	
	Remote communication			
	- protocol	-	IEC 61850	
	- transmission rate	Baud	9600	
	Load unbalance protection (ANSI: 46)			
	Manufacturer	-		
	Place of manufacture	-		
	Rated values			
	- frequency	Hz	50	
	- phase current	A		
	Settings			
	- setting range current stage 1	A	0.10 – 35.00	
	- setting range current stage 2	A	0.10 - 35.00	

Item- No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	- setting range time delay stage 1	sec	0.00 – 30.00	
	- setting range time delay stage 2	sec	0.00 – 30.00	
	Remote communication			
	- protocol	-	IEC 61850	
	- transmission rate	Baud	9600	
	Undervoltage protection (ANSI: 27)			
	Manufacturer			
	Place of manufacture			
	Rated values			
	- frequency	Hz	50	
	- phase to phase voltage	V	110	
	Settings			
	- setting range undervoltage stage 1	V V	0.05 - 100	
	- setting range undervoltage stage 2	sec	0.05 - 100	
	- setting range time delay stage 1	sec	0.00 - 30.00	
	- setting range time delay stage 2		0.00 - 30.00	
	Remote communication			
	- protocol	-	IEC 61850	
	- transmission rate	Baud	9600	
	Overvoltage protection (ANSI: 59)			
	Manufacturer			
	Place of manufacture			
	Rated values			
	- frequency	Hz	50	
	- phase to phase voltage	V	220	
	Settings			

Item- No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	- setting range overvoltage stage 1	V V	0.5 - 100	
	- setting range overvoltage stage 2	sec	0.5 -100	
	- setting range time delay stage 1	sec	0.00 - 30.00	
	- setting range time delay stage 2		0.00 - 30.00	
	Remote communication			
	- protocol	-	IEC 61850	
	- transmission rate	Baud	9600	
	Breaker failure protection (ANSI: 50BF)			
	Manufacturer			
	Place of manufacture			
	Rated values			
	- frequency	Hz	50	
	- phase current	A	1	
	- DC voltage	V	110	
	Settings			
	- ranges of current flow monitoring	A	0.05 – 20.00  or 0.25 - 100	
	- ranges of times	sec	0.00 – 30.00	
	Automatic Reclosure (79)			
	Manufacturer			
	Place of manufacture			
	Type		1-pole, 3- pole or 1-/3- pole	
	Settings			
	- ranges of times	sec	0.01 – 30.00	

Item- No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	Synchro check Relay (25)			
	Manufacturer			
	Place of manufacture			
	Rated values			
	- frequency	Hz	50	
	- phase to phase voltage	V	110	
	Settings			
	- ΔU measurement	V	1 - 60	
	- Δφ measurement	degree	2 -80	
	Remote communication			
	- protocol	-	IEC 61850	
	- transmission rate	Baud	9600	
	Transmission medium		FOC	
	Transmission rate	MBit/s	100	
	Ethernet switches if required.			
	Number of Ethernet switches			
	Manufacturer			
	Location of manufacturing site			
	Type			
	Power supply from station battery	V DC	110	
	Management		Port Monitoring; RMON; SNMP	
	Alarm indication		Diagnostics LEDs	
	Security		Disabling of	

Item- No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered
	Protection and Control			
C1.9 Protection and Control				
			Ports; Authentication (IEEE802.1x )	
	Number of optical ports		≥ 10	
	Minimal distance covered	m	> 100 m	
	Clock system if required.			
	Number of clock systems		1	
	Manufacturer			
	Location of manufacturing site			
	Type			
	Synchronization source		GPS or Radio	
	Synchronization interval	ms	≤ 1	
	Maximum time Deviation by Running without radio reception		≤ 50msec/Day	
	Alarm LED		Yes	

RTCC Panel: This technical specification covers the design, manufacture, testing, and supply of the RTCC (Remote Tap Changing Control) panel for a 220/20kV - 16MVA power transformer.

2. Rated Voltage: 220/20kV

3. Rated Power: 16MVA

4. Tap Changer Type: On-load Tap Changer (OLTC)

5. Control Voltage: 110V DC

6. Tap Steps: 17

7. Tap Voltage Range: -15% to +15% in steps of 1%

8. Input Supply: 3 Phase, 4 Wire, 415V AC, 50Hz

9. Control Circuit: Microprocessor-based control circuit with provision for remote control

10. Display: 16x2 LCD Display for displaying Tap Position, Status Indication, Faults, etc.

11. Communication: Provision for Modbus Serial Communication for remote monitoring and control

12. Protection: The RTCC panel shall provide protection against Over Voltage, Under Voltage, Over Current, Short Circuit, and Earth Fault.

Standards: IEC 60076-1

Not if any requirement is not include in BOQ the contractor is not responsible for that.



Item- No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	Common bay unit ( Not Applicable)			
	Number of common bay units		1	
	Manufacturer			
	Location of manufacturing site			
	Type			
	Power supply from station battery	V DC	110	
	Interfaces to remote control centers			
	Number of remote control centers to be interfaced simultaneously	≥	2	
	Serial interface		IEC 60870-5-104	
	Transmission medium		FOC	
	Minimum data transmission rate	MBit/s	100	
	Other serial interface			
	Transmission medium			
	Data transmission rate			
	Mouse type		Optical mouse	
	Desk		Not Required	
	Chair		Not Required	
	Service and Analysis Software if required			
	Manufacturer			
	Type			

Item- No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	Service unit( Not Applicable)			
	Hardware		Laptop	
	Manufacturer			
	Type			
	Power supply from UPS	V AC	230	
	CPU			
	Working memory			
	Hard disk	GB	≥ 160GB	
	Operating system			
	External memory		DVD	
	Screen size	inch	14	
	Pixels		1280 x 1024	
	Service Software			
	Manufacturer			
	Type			
	Bay Control Cubicles(			
	Pre-wired		Yes	
	Floor-mounted		Yes	
	Steel sheet thickness	mm	> 2	
	Protection class		IP 52	
	Maximum height	mm		
	Maximum width	mm		
	Maximum depth	mm		
	Front-door material			
	Coloring		RAL 7035	

Item- No.	Da Afghanistan Breshna Sherkat (DABS) AqchaSubstation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Protection and Control			
C1.9 Protection and Control				
	Bay control units (IEDs) for high voltage application			
	Number of bay control units			
	Manufacturer			
	Location of manufacturing site			
	Type			
	Power supply from station battery	V DC	110	
	Protocol		IEC 61850	
	Other protocols if any			
	Bay control units (IEDs) for medium voltage application			
	Manufacturer			
	Location of manufacturing site			
	Type			
	Power supply from station battery	V DC	110	
	Protocol		IEC 61850	
	Other protocols			
	W-meter			
	Manufacturer			
	Type			
	size	mm x mm		
	accuracy class	%	0.5	
	VAr-meter			
	Manufacturer			
	Type			
	size	mmxmm		
	accuracy class	%	0.5	

Item-No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Control System			
C1.10 Digital Substation Control and Monitoring System				
	for the alarm list			
	Max. number of entries per list		configurable: ≥ 5000	
	Update time		< 5 sec.	
	Desk		3	
	Chair		3	
	System Performance ( Not Applicable )			
	Exchange of display (first reaction) Presentation of	Sec.	< 1	
	a binary change in the process display	Sec.	< 0.5	
	Presentation of an analogue change in the process display	Sec.	< 1	
	From order to process output	Sec.	< 0.5	
	From order to updating the display	Sec.	< 1.5	
	Hardcopy printer (Not Applicable)			
	Number of hardcopy printers		3	
	Power supply from UPS Format	V AC	230	
	Color	DIN	A3	
	Pages / min.		Yes	
	Noise		> 12	
		dB(A)	≤ 55dB(A)	
	Service and Analysis Software (Not Applicable)			
	Manufacturer			

Item-No.	Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation			
	Schedule of Technical Data	Unit	Required	Offered Data
	Control System			
C1.10 Digital Substation Control and Monitoring System				
	Type			
	Service unit			
	Number		1	
	Hardware		Laptop	
	Manufacturer			
	Type			
	Power supply from UPS	V AC	230	
	CPU			
	Working memory			
	Hard disk	GB	≥ 500GB	
	Operating system			
	External memory		DVD	
	Screen size	inch	14	
	Pixels		1280 x 1024	

Not : The contractor is responsible to consider One laptop and one 1TB Hard disk for the mentioned relays software in this contract. And the price is include in overall contract price.

## **15. CONDUCTORS**

### **15.1 GENERAL**

Insulated cable and conductors shall be furnished in accordance with the requirements of this section of these specifications. The Contractor shall provide a standard design for the items within the scope of the specification, but which are not covered in detail by these specifications. The standard design shall be in accordance with accepted industry practices for electrical power transmission, distribution, and/or generation.

The requirements of the Cable Specification Data Sheet(s) shall govern should conflicts occur between them and the written text of these specifications.

### **15.2 CODES AND STANDARDS**

All equipment supplied under this specification shall conform to the applicable standards of European Standard (EN) and International Electro technical Commission (IEC).

### **15.3 CABLE SPECIFICATIONS**

The cable furnished shall conform to the Cable Specification and Data Sheet(s) included at the end of this section.

#### **Power and Control Cable Color Coding**

The color code used for single and multiconductor power and control cable shall be in accordance with the Cable Specification and Data Sheet(s). All of the wiring diagrams being prepared by the Contractor shall be based on this table.

#### **Analog Signal Cable Color Coding**

The color code used for analog signal cable (twisted shielded pair) shall be in accordance with the Cable and Specification Data Sheet(s). All of the wiring diagrams being prepared by the Contractor shall be based on this table.

#### **Flexible Radio Frequency Coax Cable**

The coax cable shall be suitable for use with a power line carrier system. The coax cable shall be suitable for installation in dry or wet areas, cable tray, cable trench, and conduits.

### **15.4 SPECIFICATION DATA SHEET**

#### **MULTICONDUCTOR POWER AND CONTROL CABLE**

Conductor: Class 2 copper, normal maximum operating temperature 90° C

Insulation: XLPE, 750 V, normal maximum operating temperature 90° C, wet or dry

Shield: Copper tape, 5 mils nominal thickness, 2 mils nominal thickness of adhesive coating on both sides

Conductor jacket: None

Cable jacket: PVC

Conductor color: Cable assemblies with four conductors or less shall be as listed below.  
Cable assemblies with five or more conductors shall be black with white numbers.

Conductor Conductor Color

1	Blac
k	
2	Brow
n	
3	Grey
4	Blue

Cable jacket color: Black

Cable assembly: The conductors shall be cabled together with polypropylene fillers, as necessary, to make the finished cable round

#### SINGLE CONDUCTOR POWER CABLE

Conductor: Class 2 copper, normal maximum operating temperature 90° C

Insulation: PVC, 750V, normal maximum operating temperature 90° C, wet or dry

Shield: None

Conductor jacket: None

Cable jacket: None

Conductor color: Black

Cable jacket color: Not applicable

#### ANALOG SIGNAL CABLE

Conductor: Class 2 copper, normal maximum operating temperature 90° C

Insulation: XLPE, 750V, normal maximum operating temperature 90° C, wet or dry

Pair shield: Aluminum mylar, 100 percent coverage with a minimum 20 percent overlap, 0.5 mm<sup>2</sup> (minimum) copper drain wire

Cable shield: Aluminum mylar, 100 percent coverage with a minimum 20 percent overlap, 0.5 mm<sup>2</sup> (minimum) copper drain wire

Conductor jacket: None

Cable jacket: PVC

Conductor color: Black and red numbered pairs

Cable jacket color: Black

Cable assembly: The conductors shall be cabled together with polypropylene fillers, as necessary, to make the finished cable round

#### FLEXIBLE RADIO FREQUENCY COAX CABLE

Conductor: Class 2 copper

Insulation: Polyethylene

Shielding: Copper braid, minimum 95 percent coverage

Cable jacket: PVC

Cable jacket color: Black

Nominal impedance: 50 ohms

**Table: LV Underground Cable 0.6/1 kV, NYY 4 x 50SM**

Designation	Unit	Required	Offered
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Manufacturer's name		To be specified	
Cable type (four – core)		NYY	
Conductor material		Copper	
Conductor shape		Sector Stranded	
Nominal cross-sectional area of conductor	mm <sup>2</sup>	50	
Insulation material of conductor		PVC	
Insulation thickness	mm	1.4	
Outer sheath material		PVC	
Thickness of outer sheath	mm	1.9	
Overall diameter of cable(D)	mm	32	
Weight of cable	kg/km	2300 up 2500	
Weight of copper	kg/km	2300up to 2400	
Minimum bending radius	mm	15 D	
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 70° C	Ω/km	0.233	
Max. admissible short circuit current (1s)	kA	5.75	
Current carrying capacity (in ground)	A	165	
Inductance per conductor	mH/km	To be specified	
Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	

**Table: LV control Cable 0.6/1 kV, 2c x 4 mm<sup>2</sup>**

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Conductor material		Copper	
Conductor shape		Sector Stranded	
Nominal cross-sectional area of conductor		2cx4	
Insulation material of conductor	mm <sup>2</sup>	PVC	
Insulation thickness		To be specify	
Outer sheath material	mm	PVC	
Thickness of outer sheath		To be specify	
Overall diameter of cable(D)	mm	To be specify	
Weight of cable	mm		
Weight of copper	kg/km	To be specify	
Minimum bending radius	kg/km	To be specify	
	mm		
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 70° C	Ω/km		
Max. admissible short circuit current (1s)	kA		
Current carrying capacity (in ground)	A	To be specify	
Inductance per conductor	mH/km	To be specified	
Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	

**Table: LV control Cable 0.6/1 kV, 4c x 4 sq mm**

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Conductor material		Copper	
Conductor shape		Sector Stranded	
Nominal cross-sectional area of conductor		4cx4	
Insulation material of conductor	mm <sup>2</sup>	PVC	
Insulation thickness		To be specify	
Outer sheath material	mm	PVC	
Thickness of outer sheath		To be specify	
Overall diameter of cable(D)	mm	To be specify	
Weight of cable	mm		
Weight of cupper	kg/km	To be specify	
Minimum bending radius	kg/km	To be specify	
	mm		
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 70° C	Ω/km		
Max. admissible short circuit current (1s)	kA		
Current carrying capacity (in ground)	A	To be specify	
Inductance per conductor	mH/km	To be specified	

Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	
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**Table: LV control Cable 0.6/1 kV, 7 x 2.5sqmm**

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Conductor material		Copper	
Conductor shape		Sector Stranded	
Nominal cross-sectional area of conductor		7x2.5	
Insulation material of conductor	mm <sup>2</sup>	PVC	
Insulation thickness		To be specify	
Outer sheath material	mm	PVC	
Thickness of outer sheath		To be specify	
Overall diameter of cable(D)	mm	To be specify	
Weight of cable	mm		
Weight of copper	kg/km	To be specify	
Minimum bending radius	kg/km	To be specify	
	mm		
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 70° C	Ω/km		
Max. admissible short circuit current (1s)	kA		
Current carrying capacity (in ground)	A	To be specify	
Inductance per conductor	mH/km	To be specified	

Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	
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**Table: LV control Cable 0.6/1 kV, 12 x 2.5 sqmm**

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Conductor material		Copper	
Conductor shape		Sector Stranded	
Nominal cross-sectional area of conductor		12x2.5	
Insulation material of conductor	mm <sup>2</sup>	PVC	
Insulation thickness		To be specify	
Outer sheath material	mm	PVC	
Thickness of outer sheath		To be specify	
Overall diameter of cable(D)	mm	To be specify	
Weight of cable	mm		
Weight of copper	kg/km	To be specify	
Minimum bending radius	kg/km mm	To be specify	
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 70° C	Ω/km		
Max. admissible short circuit current (1s)	kA		
Current carrying capacity (in ground)	A	To be specify	
Inductance per conductor	mH/km	To be specified	

Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	
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### Bare copper conductor 1x120 mm<sup>2</sup>

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Conductor material		Copper	
Conductor shape		(i.e. Without insulation)	
Nominal cross-sectional area of conductor	mm <sup>2</sup>	1x120	
Operation temperature		90 degree or higher	
Insulation thickness	mm	To be specify	
Thickness of outer sheath		To be specify	
Overall diameter of cable(D)	mm	To be specify	
Weight of cable	mm	To be specify	
Weight of copper	kg/km	To be specify	
Minimum bending radius	kg/km	To be specify	
	mm		
Frequency	Hz	50	
Standards		IEC 60228 DIN 48204	
Test report		Yes	

### Bare copper conductor 1x150 mm<sup>2</sup>

Designation	Unit	Required	Offered
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Manufacturer's name		To be specified	
Conductor material		Copper	
Conductor shape		(i.e. Without insulation	
Nominal cross-sectional area of conductor	mm <sup>2</sup>	1x150	
Operation temperature		90 degree or higher	
Insulation thickness	mm	To be specify	
Thickness of outer sheath		To be specify	
Overall diameter of cable(D)	mm	To be specify	
Weight of cable	mm	To be specify	
Weight of copper	kg/km	To be specify	
Minimum bending radius	kg/km mm	To be specify	
Frequency	Hz	50	
Standards		IEC 60228 DIN 48204	
Test report		Yes	

Copper Clad Steel Earth Rod, diameter 16mm, Length 3000mm



Cable 20KV ,1core ,300mm<sup>2</sup> ,between Transformer to main switchgear PANEL 20 KV

Type: N2XS2Y

Conductor material and form: Copper / Circ stranded

Nominal cross section of conductor: 300mm<sup>2</sup>

Nominal cross section of screen: 25mm<sup>2</sup>

Insulation material of conductor: XLPE

Insulation thickness: 5.5mm

Outer sheath material: PE

Thickness of outer sheath: 2.5mm

Overall diameter of cable: 41 - 46mm

Weight of cable: 3630 - 3880 Kg/km

Minimum bending radius: As per standards

Nominal voltage: 12/20Kv

Service voltage actual (future): 15(20)Kv

Frequency: 50Hz

Effective a.c. resistance at 90°C: 0.0804Ω/Km

Operating capacitance: 0.0340μF/Km

Max. admissible short circuit current (1s) of conductor ( screen) :42.9KA

Installation in ground

Current carrying capacity: 599A

Ohmic losses: 1.2W/km

Inductance per conductor: 0.330mH/Km

Standards: IEC 60502

**Table: LV Underground Cable 20kv 1 x 50 RM**

Designation	Unit	Required	Offered
Cable type (one – core)		XLPE	
Conductor material		Copper	
Conductor shape		Circular stranded	
Nominal cross-sectional area of conductor		50	
Insulation material of conductor	mm <sup>2</sup>	XLPE	
Insulation thickness	mm	1-1.4	
Outer sheath material			
Thickness of outer sheath		1-1.4	
Overall diameter of cable (D)	mm	14.3	



Weight of cable	mm	To be specify	
Minimum bending radius	kg/km mm	To be specify	
Nominal voltage	kV	20-24	
Max. Permissible operating voltage	kV	24	
Service voltage	kV	20	
Frequency	Hz	50	
Effective a.c. resistance at 20° C	Ω/km	To be specify	
Max. admissible short circuit current (1s)	kA	To be specify	
Current carrying capacity (in air)	A	To be specify	
Inductance per conductor	mH/km	To be specified	
Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	

## 15.5 20KV INDOOR METAL CLAD SWITCHGEAR PANELS

### General Specifications

#### General

This Specification covers the Design, construction and testing of 20kV Indoor Metal Clad Switchgear Panels. Subsequent paragraphs will give detailed descriptions and requirements for the Switchgear Panels, including Circuit Breakers, Current Transformers, Voltage Transformers, Protection Relays, Metering and Measuring, Indicating and Control devices and other equipments/Devices, specified herein.

#### Standards

Ratings, characteristics, tests and test procedures, etc. for the 20kV metal-clad switchgear panels and all the protection relays, measuring and indicating instruments and the control

and monitoring devices and accessories, including current transformers and voltage transformers shall comply with the provisions and requirements of the standards of the international electro- technical commission (IEC), and also relevant ANSI standards where specified.

The latest revision or edition in effect at the time of bid invitation shall apply. Where references are given to numbers in the old numbering scheme from IEC it shall be taken to be the equivalent number in the new five-digit number scheme.

#### Unit of Measurement and Language

In all correspondence, in all technical schedules and on all drawings prepared by the manufacturer, the metric units of measurement shall be used. On drawings or printed pamphlets where other units have been used, the equivalent metric measurements shall be added. All documents, correspondence, drawings, reports, operating and maintenance instructions/manuals and nameplate details of the equipment shall be in English language.

#### **Service Conditions**

##### Switchgear room Temperature.

The switchgear shall be installed in a room without air conditioning but with ventilation to allow natural cooling. Therefore all the protection and control devices employed shall be capable of operating in this environment without failure for their designed life time. Particularly the power supply modules of the protection and control devices shall be designed for minimum heat generation and effective heat dissipation to ensure that the temperature of these devices enclosed in the relay panels at the listed ambient temperatures shall not exceed the maximum operating temperature of the device.

#### Working Stress and Equipment/Apparatus Design

##### General

- a) The design, dimensions and materials of all parts shall be such that they will not suffer damage under the most adverse conditions nor result in deflections and vibrations, which might adversely affect the operation of the equipment. Mechanisms shall be constructed to avoid sticking due to rust or corrosion.
- b) The equipment and apparatus shall be designed and manufactured in the best and most substantial and workmanlike manner with materials best suited to their respective purpose and generally in accordance with up-to-date recognized standards of good practice.

- c) The equipment shall be designed to cope with seismic conditions of the area where substation is proposed.
- d) Whenever possible, all similar parts, including spare parts, shall be made interchangeable. Such parts shall be of the same materials and workmanship and shall be constructed to such tolerances as to enable substitution or replacement by spare parts easily and quickly.
- e) All equipment shall be designed to minimize the risk of fire and consequential damage, to prevent ingress of vermin and dust and accidental contact with electrically energized or moving parts. The switchgear panels shall be capable of continuous operation with minimum attention and maintenance in the exceptionally severe conditions likely to be obtained in a desert climate and where the switchgear is called upon to frequently interrupt fault currents on the system and also where the duty of operation is high.

**Strength and quality**

- a) All steel castings and weldings shall be stress-relieved by heat treatment before machining, and castings shall be stress-relieved again after repair by welding.
- b) Liberal factors of safety shall be used throughout, especially in the design of all parts subject to alternating stresses or shocks.

**Design data low voltage equipment**

Low voltage equipment and installation shall be designed in accordance with EM directives. The rating and design criteria for low voltage equipment shall be as follows:

**a) AC Supply Rating system**

Rated voltage between phase	400 V AC
Connection type	3ph 4wire
Rated voltage between phase to earth	230 V AC
Grounding system	Solid
Frequency	50 HZ
Voltage variation	+/-10%
Frequency variation	+/-2%
Power frequency 1 min, Test Voltage	3 kV
Thermal rating of conductors	120 % of load
Rated short-circuit Current	12.5 KA 1 sec

The AC supply shall be used for power circuit and for lighting, indication, motor controls and similar small power circuits.

Unless otherwise specified, the equipment provided under this tender is to be capable of reliable operation at voltages as low as 80% of the rated voltage, and to withstand continuously up to 110% supply voltage above the rated value of 230V or 400V AC.

b) DC Auxiliary Supply Rating

Equipment/Device Rated voltage	110V DC
Connection type	2 wire
Voltage variation	..... V DC

1)The auxiliary dc supply shall be used for controls, indication, alarm, protection relays, and circuit breaker tripping and closing circuit, etc.

2)All equipment and apparatus including the circuit breakers, protective relays, control devices and accessories, measuring and indicating instruments and electronic equipment shall be capable of satisfactory operation at 80% to 125% of the rated dc supply voltage. All tripping coils shall be capable of operating at 70% to 125% of rated DC supply voltage.

Design data for Medium voltage plant and equipment

The rating and design criteria for the MV plant and equipment shall be as follows:

Item	Parameters	SYSTEM PARAMETER
1	System description	50 Hz, 3 phase, 3 wire
2	Neutral point earthing	Solid earthed

**15.6 Medium Voltage Switchgear Specification Table**

Description	Unit	Required Value
Quantity Required	Each	1 (One) Set
Type		Indoor Class, Metal-Clad, MV, Draw-out type Vacuum Circuit breakers, Single bus,50Hz
Switchgear		
Nominal System Voltage	Kv	20kV
Maximum Nominal System Voltage	kV	24kV
BIL rated	kV	125kV
Continuous current (feeder breakers & auxiliary transformer)	A	630A
Continuous current (incomers and Bus section)	A	1250A

Continuous current Bus Bar	A	2000A
Closing and latching capability(Making)	kA	62.5 kA
Short circuit withstand for 3 seconds	kA	25 kA
Enclosure Type		IP 41 for Switch gear compartment & IP 51 for Control & Relay compartment
Rated breaking time	msec	Less than 80 msec.
Surge Arrester		
Highest System Voltage Um		24 KV
MCOV		13.9KV
Potential Transformers		
BIL	kV	125kV
Primary Voltage	kV	20/ $\sqrt{3}$ kV
Secondary Voltage	V	110/ $\sqrt{3}$ V
Transformer Type		epoxy enclosed
Metering Accuracy Class		0.2 at rated burden
Circuit Breakers		
Continuous current (feeder breakers)	A	630A
Continuous current ( incoming & bus Section breakers)	A	1250A
Type		Vacuum
Charge Motor Voltage	DC V	110
Control Voltage	DC V	110
Auxiliary Contacts		10a & 10b
Current Transformers		
Secondary Current	A	1
Thermal Rating	%	200%
Burden	VA	Not less than 15VA
Accuracy		Class 0.2 For metering, Class X for Transformer REF, Differential and for others 5P.

## 15.7 Basic Requirements for Electrical Equipment

All materials supplied under this contract shall be new and of the best quality and of the class most suitable for working under the conditions specified. They shall withstand the variations of temperature and atmospheric conditions arising under working conditions without distortion, deterioration or undue stresses in any parts and also without affecting the suitability of the various parts of the Works for which they were designed.

### 15.7.1 Electrical controls, auxiliaries and power supplies

**(a) Responsibility for electrical control and auxiliaries.**

The manufacturer shall provide all control, indication, alarm and protection devices and all auxiliary equipment with wiring and interconnecting cable which are integral parts of or are directly associated with or mounted on the switchgear panels to be supplied under this tender. The design of protection and control schemes for the switchgear panels shall be subject to approval by the employer.

**b) Operation and control.**

Interlocking devices shall be incorporated in the control circuit to ensure safety, and proper sequence and correct operation of the equipment.

**15.7.2 Corona and radio interference**

a) Switchgear shall electrically be designed to avoid local corona formation and discharge likely to cause radio interference.

b) The design of jointing of adjacent metal parts and surfaces shall be such as to prevent corrosion of the contact surfaces and to maintain good electrical contact under service conditions.

c) Particular care shall be taken during manufacture of Busbars and fittings and during subsequent handling to ensure smooth surface free from abrasion. All joints on the Busbars and the circuit within the switchgear board shall be silver or tin-plated to ensure good electrical connection.

**15.7.3 Switchgear Panels**

(a) The switchgear panels shall be dead-front, floor-standing, rigid welded steel frames, completely enclosed by metal sheets and suitable for indoor installation.

(b) The floor-standing switchgear panel shall have provision for bolting to the floor.

(c) Suitable terminal blocks shall be provided for all outgoing power and control cables. All cable terminals shall generally be located for bottom entry and connections.

(d) The Switchgear panels shall be painted to RAL 7032 color.

(e) Enclosures for the switchgear panel and for other electrical equipment shall have the following degree of protection (ref IEC 60034, IEC 60529 and IEC 60947):

Equipment	Degree of protection
Medium voltage enclosed switchgear	IP 41
Indoor control and relaying equipment	IP 51

(f) Interior illumination lamps operated by door switches shall be provided for each switchgear control compartment. The Lamps should be easily available in the local market for future replacements. One 230V socket outlet of 3-point square terminals shall be provided for each switchgear panel in the control compartment.

(g) Space heaters for 230V AC shall be provided inside the switchgear panel, circuit breaker and control compartments to prevent moisture condensation. A hygrostat control unit with variable temperature and humidity control setting shall be installed to control the heater.

#### **15.7.4 Measuring instruments**

a) All measuring instruments, including energy meters, shall be of flush-mounted, back- connected, dust-proof and heavy-duty switchboard type. Each measuring instrument shall have a removable cover, either transparent or with a transparent window. Each instrument shall be suitable for operation with the instrument transformers detailed in these specifications, under both normal and short-circuit conditions.

b) For  
analog type instruments, scale plates shall be of a permanent white circular or rectangular finish with black pointer and markings. The scale range shall be determined from the current transformer and voltage transformer ratios and is given in the detailed specifications for each instrument.

c) All  
measuring instruments of analog type shall be approximately 110mm<sup>2</sup> enclosures and shall be provided with clearly readable long scale, approximately 240 degrees. The maximum error shall be not more than one and a half (1.5) percent of full-scale range.

#### **15.7.5 Indicating lamps**

a) Indicating lamp assemblies shall be of the switchboard type, insulated for 110 V DC service, with appropriately colored lens. The lens shall be made of a material, which will not be softened by the heat from the lamps.

b) For the circuit breakers, red indicating lamps shall be used for "ON" position, green lamps for "OFF" position indication and amber for circuit breaker auto trip.

#### **15.7.5 Nameplates**

a) Nameplates

Each cubicle, panel, meter, switch and device shall be provided with a nameplate or escutcheon plate for identification with English description and also where appropriate the IEC number on the front of the panel directly below each device as appropriate. On the inside of the control compartment of the switchgear panel, a white label, engraved in Black Letters and Numbers shall be fixed on or below each device. The device name/number fixed on the inside of the control compartment shall correspond to the name/number used in the drawings. Each equipment shall be provided with a rating plate containing the required information as specified in the relevant IEC standards.

b) The  
plates shall be made of stainless steel and shall not be deformed under the service conditions at the site. The entries on the plates shall be indelibly marked by engraving with black letter on a white background or vice versa as specified.

#### 15.7.6 Wiring

a) **General**

i) All  
wiring inside the switchgear panel shall be done with PVC insulated wire not less than 2.5 sq.mm, flexible cable. A suitable wiring duct system firmly fixed on the panel and having covers shall be installed for all inter-panel and front-to-rear panel wiring as well as for wiring within the panels, which will provide easy access for inspection and replacement of the wires.

ii) Wiring between terminals of the various devices shall be point to point. Splices or tee connection will not be acceptable. Wire runs from the duct to the device shall be neatly trucked or clamped.

iii) Exposed wiring shall be kept to a minimum, but where used, shall be formed into compact groups suitably bound together and properly supported.

iv) Instrument transformer secondary circuits shall be grounded only on the terminal block in the control compartment. Facilities for short circuiting the current transformers secondary windings while the switchgear panel is in service shall be provided.

v) Cable supports and clamp type terminal lugs shall be provided for all incoming and outgoing power wiring terminated at each panel. All wiring conductors (wires) shall be marked at each point of termination onto the terminal block or device. These wire markers



shall be of an approved type and permanently attached to the conductor insulation. The method of ferruling shall be subject to approval by the employer; it is however preferred that the wire marker (ferrule) correspond to the device number or terminal block number and the number of the terminal where it is connected. All the devices and the terminal blocks must therefore have unique numbers.

**b) Phase arrangement**

The standard phase arrangement when facing the front of the panel shall be R-Y-B-N, and P-N from the left to right, from top to bottom, and front to back for A.C three-phase and single-phase circuits. For DC circuit it shall be N-P from left to right, P-N from top to bottom and front to back. All relays, instruments, other devices, buses and equipment involving three-phase circuit shall be arranged and connected in accordance with the standard phase arrangement wherever possible.

**(c) Wiring color code**

All wires shall have ferrules at all terminations to distinguish each wire and terminal. In addition, the wire shall have the following colors:

Circuit	Color
Voltage transformers/ Current Transformers	R, Y, B, BLK
Auxiliary A.C. supply connection cable/bus-wires	Brown and Black
D.C. control wiring within the panel	Grey
Grounding/earthing cable/wire	Green with yellow stripe

**(d) Phase and polarity color code**

Following colored ferrules shall be provided on each wire in order to identify phase and polarity.

Phase and Polarity		Color
A.C., three-phase, for CT and VT secondary Wiring	First phase	Red
	Second phase	Yellow
	Third phase	Blue
	Neutral	Black

A.C, single-phase,	First phase	Red
	Neutral	Black
	Ground	Green with yellow stripe
DC auxiliary Supply Connection	Positive	Brown
	Negative	Black

Cable markers and wire numbers system must be submitted to the employer for approval before commencing the detailed design works for protection and control.

#### **15.7.8 Terminal blocks**

a) Terminal blocks for control wiring shall be rated not less than 600V AC.

b)

White

or other light-colored marking strips, fitted to each block, shall be provided for circuit designation.

c) The terminal arrangement, including the terminal blocks for VT and CT circuit connections, shall be subject to the employer's approval. A Total of not less than 20 spare terminals shall be provided for future use.

d) Shorting Links shall be provided on the current transformer (CT) circuits on the terminal block.

It shall be possible to short the CTs under live system conditions without open-circuiting the CTs.

e) Isolation links (sliding Links) shall be provided on the trip circuits, alarm and on the VT circuits to allow easy isolation of these circuits without disconnecting the wires from the terminal block.

f) Each individual terminal block shall be marked with a distinctive number, which shall be the same number used in the drawings, for identification purposes. The TB number shall be engraved in black numbers in white background and shall be durable so as to last the life time of the switchgear board.

g) Each set of terminal block shall be identified by a label to distinguish it from another set of terminal block. The numbers used to mark the terminals on the terminal blocks shall be unique.

The labels used will match those used in the drawings.

#### **15.8 Equipment and switchgear Earthing**

## **GENERAL**

All the Compartments including the hinged doors of the Switchgear

Panels and all the earthing points of the equipment installed/mounted in the Switchgear panels shall be connected to the grounding conductor at the bottom of the panel for external connection to the substation earthing system.

Earthing conductors shall be of annealed high conductivity copper stranded in accordance with Table 4 in BS.6346 and protected with an extruded PVC sheath of 1000 volts grade. The earthing conductor on the primary equipment such as the Earth Switch and also for inter-panel earth- bonding as well as for external connection to the substation Earthing - grid shall be adequate to carry the rated switchgear short-circuit current.

### **15.9 Materials and Workmanship**

#### **General**

- a) Materials shall be new; the best quality of their respective kinds and such as are usual and suitable for work of like character. All materials shall comply with the latest issues of the specified standard unless otherwise specified or permitted by the employer.
- b) Workmanship shall be of the highest class throughout to ensure reliable and vibrations Free operations. The design, dimensions and materials of all parts shall be such that the stresses to which they may be subjected shall not cause distortion, undue wear, or damage under the most severe conditions encountered in service.
- c) All parts shall conform to the dimensions shown and shall be built in accordance with approved drawings. All joints, datum surfaces and meeting components shall be machined and all castings shall be spot faced for nuts. All machined finishes shall be shown on the drawings. All screw, bolts, studs and nuts and threads for pipe shall conform to the latest standards of the International Organization for Standardization covering these components and shall all conform to the standards for metric sizes
- d) All materials and works that have cracks, flaws or other defects or inferior workmanship will be rejected by the employer.

#### **Assembly**

Necessary items of equipment shall be assembled in the factory prior to shipment and routine tests shall be performed by the manufacturer as per the requirements of the latest issue of IEC as specified under each equipment in these specifications to demonstrate to the satisfaction of

the employer that the switchgear panels comply with the requirements of the relevant IEC standards.

### **Casting**

- a) Casting shall be true to pattern, of workman like finish and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, shall be satisfactorily cleaned for their intended purpose.

### **Cutwld joint:**

An isotherm joint for a substation grounding system is a device that allows for the connection of two or more ground electrodes of different materials or types. The following are the technical specifications for an isotherm joint in a substation grounding system:

1. Material: The isotherm joint should be made of high-quality, durable materials such as copper or stainless steel to ensure long-lasting service life.
2. Size: The size of the isotherm joint should be determined based on the size of the ground electrodes that are to be connected.
3. Electrical resistance: The isotherm joint should have a low electrical resistance to maximize the efficiency of the grounding system.
4. Corrosion resistance: The isotherm joint should be resistant to corrosion, as it will be exposed to various environmental conditions over time.
5. Compatibility: The isotherm joint should be compatible with the types of ground electrodes that are to be connected, including metallic and non-metallic electrodes.
6. Installation: The isotherm joint should be easy to install and should require minimal maintenance over its service life.
7. Testing: The isotherm joint should be tested to ensure that it meets all relevant industry standards and is capable of withstanding a range of environmental conditions and ground fault currents.

Overall, the isotherm joint plays a critical role in ensuring the proper functioning of a substation grounding system

### **Color standard**

The final color of each item shall be as described under each item.

### **Operational Details**

Instructions shall be engraved on the switchgear panel, on the circuit breaker compartment describing in simple steps how to carry out correct and safe isolation, racking-in and racking-out switching operations on the circuit breaker. Similar details should be provided for the operation of the earth switch.

#### Protection, Cleaning and Painting Embedded steel work

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All parts to ultimately be buried in concrete shall be cleaned and protected before leaving the manufacturer's plant by cement wash or other approved method. Before being installed they shall be thoroughly desiccated and cleared of all rust and adherent matter, or be treated according to a method approved by the Employer. Such cleaning or treatment shall not detrimentally affect the strength or final operation and function of the equipment.

#### **Steel exposed to atmosphere**

- a) All machined parts or bearing surfaces shall be cleaned and protected from corrosion before leaving the manufacturer's plant by the application of an approved rust preventive coating, or a peel able plastic film. Where the latter is impracticable, such parts shall be heavily covered with high melting point grease after erection such parts shall be cleaned with solvent and lapped or polished bright.
- b) All parts, other than machined parts, which will be exposed after erection shall be thoroughly cleaned and galvanized or given with two coats of best quality approved primer and one coat of best quality approved finish paint before leaving the manufacturer's plant and a further one coat of paint of an approved quality and color after erection and touching up on the site, except such apparatus as panels and instruments which shall be finished painted under approved procedures.
- c) All outside panel surfaces shall be primed, filed where necessary, and given not less than two coats of synthetic undercoat. The finishing coat for the outdoor and indoor installations shall be a gloss paint.
- d) Primer shall be applied to surfaces prepared in accordance with the plant manufacturer's instructions. The surface shall be wiped clean immediately prior to applying the paint. The primer and finish coats of paint shall be applied using the methods and equipment recommended by the manufacturer.

- e) The internal surface of all pipelines shall be cleaned out by the approved methods before installation and again prior to commissioning, to ensure freedom from dirt, rust, scale, welding slag, etc. all exposed pipes shall be painted with an identifying color after erection is completed. The color code system shall be approved by the employer.
- f) All steel surfaces, which are in permanent contact with oil, shall be given three coats of approved oil resistant.
- g) No painting or protection is required for finished or unfinished stainless steel parts.
- h) The final color of all equipments, frames for meters and relays, and switch handle shall be as described under each particular item.
- i) The humid and desert conditions shall be taken into account on selection of the paints and painting procedure.

#### Drawings

a) Before starting manufacture of the switchgear panels, dimensioned drawings and data showing all significant details of the equipment and materials to be used shall be submitted to the employer for approval. Where the drawings are not approved, the manufacturer shall modify the drawings as per the Employers comments and in line with the specifications and re-submit to the Employer for review.

b) The manufacture of the switchgear shall then proceed strictly in accordance with the approved drawings and also in accordance with the detailed specifications as contained herein.

Where conflict may arise between the specifications and the approved drawings, the specifications will take precedence, unless it's specifically indicated in writing on the approved drawings that the conflicting clause in the specifications is superseded, or where following discussions between the manufacturer and the employer, the employer gives approval in writing to supersede the conflicting clause in the specifications.

c) All drawings submitted for approval or sent to the Employer for any other reason shall be in hard copy form and shall be sent by courier.

d) On successful completion of the initial FATs and following completion of the manufacture of the complete switchgear panels, the manufacturer shall carry out all the tests listed under section 2.5 for the completed switch board and for current transformers, voltage transformers,

circuit breakers and for protection relays. The above tests shall be carried out on each and every switchgear panel. Any problems noted will be rectified and the Employer will only be invited to the factory when all the tests are successful. This will ensure that the employer does not spend time in the factory waiting for the manufacturer to fix problems that arise during the FATs, while such anomaly would have been detected and rectified by the manufacturer beforehand after conducting the above routine tests.

e) Upon testing of the panels as in d) above the drawings will be edited to capture any minor wiring errors detected in order to produce the final as built drawings. A copy of the final As Built drawings and Routine test results for each panel, signed by the Manufacturer shall be sent by courier to the employer before attendance of the FATs.

f) Each individual switchgear panel shall have its own separate drawing, with the name of the panel included on the drawing for identification.

g) Before Approval of shipment of the switchgear panels, Four (4) copies of bound As Built drawings (A4 size) in Hard Copy shall be forwarded to the employer in Durable Hard cover Box Files. The files shall have a tag with the following Inscription.

Da Afghanistan Breshna Sherkat (DABS)

Also three (3) software copies (in CD ROM) of the As Built drawings in AutoCAD Electrical 2010SLM or later version shall be sent to the employer via courier. The CD ROM will have the same label as above. The drawings provided on soft copy shall be freely editable to allow the employer to incorporate any changes made in future. All protection and control drawings shall be done on A4 - size paper. The function of each drawing shall be clearly indicated. Related drawings shall be arranged sequentially, and have the same drawing number/name but different sheet numbers. The drawings shall include the following;

**Drawings:**

□ AC single line drawing

□□□□□A

C

Schematic

s

□ DC Schematics

- Functional Drawings
- Panel wiring, including inter-panel bus-wiring List
- Panel device layout drawing
- General layout drawings for the switchgear panels
- Relays and device list (bill of quantities) for each type of panel.

## **15.10 MANUFACTURE OF PANELS**

Upon manufacture of the panels, the manufacturer shall invite the Employer to inspect and conduct factory acceptance tests (FATs) on the panels. The manufacturer shall then rectify any minor defects noted during FATs.

### **15.10.1 Operating and Maintenance Instructions**

a) The manufacturer shall supply detailed instruction manuals concerning the correct manner of assembling/installing, configuring, setting, testing and commissioning, operating and maintaining the equipment and devices constituting the switchgear board, including the board itself. The maintenance details of each component shall also be described, including the frequency of inspections and lubrication.

The instruction manual shall include a separate and complete section describing the normal and emergency operating procedures for the switchgear, and shall include explanatory diagrammatic drawings to facilitate understanding of the instructions.

b) The manufacturer shall, in preparing the instruction manuals, take into account the lack of experience and familiarity of the operators with this type of equipment.

c) One complete set of the operating and maintenance manuals for all the plant, equipment and accessories to be installed/mounted in the switchgear panels shall be sent to the employer together with the drawings for approval. The operating and maintenance manuals shall be original copies printed and bound by the manufacturer. Any illegible copies of the operating and maintenance manuals submitted shall be rejected by the employer.

d) Before approval of shipment of the switchgear panels, Five (5) Copies of the operating and maintenance instructions/manuals shall be sent to the employer by courier. The operating and maintenance manuals shall be original copies printed by the manufacturer. Any illegible copies of the operating and maintenance manuals submitted shall be rejected by the employer. In addition, three (3) softcopies of the manuals in CD Rom shall be delivered to the employer.



### **15.10.2 Testing at Place of Manufacture**

- a) The manufacturer shall be responsible for performing or for having performed all the required tests listed under the specification for the switchgear and all the current transformers, voltage transformers, protection relays, energy meter, measuring and indicating instruments.
- b) The tenderer shall confirm the manufacturer's capabilities in this regard when submitting tenders.

Any limitations shall be clearly specified.

- c) Tender documents shall be accompanied by copies of Type test and Routine test reports & certificates for similar rated equipment for the purpose of tender evaluation. Type test reports & certificates shall be certified by the National Standards and Testing Authority (NSTA) of the country of origin or by a third party Reputable Testing Authority. Where a body other than NSTA is used to certify the type-test reports, a copy of the certificate of accreditation shall be attached. Current contact information of the testing and certification authority shall be provided.

- d) Upon completion of the manufacturing process, routine tests shall be carried out as per the respective IEC standards of each equipment as follows:-

1. Circuit Breaker IEC 62271-100 & IEC 60298
2. Switchgear panels, IEC 60294
3. Current Transformers, IEC 60044-1
4. Voltage Transformer, IEC 60044-2
5. Protection Relays and Measuring and Indicating Instruments, IEC 60255

- e) The contractor at his expense shall arrange for (two) 2 engineers from the employer attend Factory Acceptance Tests(FATs) on the Switchgear panels, where all routine tests as per the IEC standard listed above and other special tests listed in this specifications shall be carried out in their presence. The duration of the FATs shall be adequate to test all the offered switchgear boards. Testing shall strictly be carried out during working hours from 8.00 am to 5.00 pm.

The employer's engineers will only sign the Tests Reports/certificates only when the tests are conducted in their presence in accordance with the relevant IEC standard or the procedure agreed beforehand between the employer and the manufacturer.

f) Only upon receipt of authentic certified copies of the FATs Routine Test Reports/certificates and special tests and satisfactory report from the engineers, shall the employer give clearance for shipment of the switchgear boards once all the other listed requirements on drawings, operation and maintenance manuals and software have been met.

#### **15.10.3 Software Requirement**

Three (3) copies of each different type of software in a CD Rom, for the protection relays, energy meters, transducers and other measuring devices whose configuration and settings is software based shall be supplied with the board. Two sets of connection cable for each type of device shall also be supplied with the switchgear board.

Before approval for shipment of the switchgear board is granted by the employer, all the software indicated in the completed technical schedules shall be supplied.

The software shall be for configuration, parameter setting and for data download and analysis.

It shall be possible to load the software into at least (1) laptop computers without requirement for additional licenses. Where additional licenses are required, the cost shall be considered to have been included in the bid.

Four (4) sets of hard cover manuals for each type of software supplied providing detailed instructions for programming settings and configuration of the relays and other devices and downloading of data, shall be supplied with the switchgear.

#### **Spare Parts:**

The manufacturer (bidder) shall furnish spare parts for MV Switchgear as listed below and included in the price schedules:

a)The spare parts supplied shall be packed or treated in such a manner as to be suitable for storage under the climate conditions at the site for a period of not less than Three years, and each part shall be clearly marked with the description and purpose on the outside of the package. The manner of Storage shall be recommended by the manufacturer.

b)Spare parts so provided shall be delivered with the switchgear to the employer's stores. Delivery of spare parts will not be deemed to be complete until the packages have been opened and their contents checked and verified by a representative of the employer.

## Packing

a) The switchgear panels and spares shall be packed properly and protected for shipment from the place of manufacture to the employer's stores.

b) Each crate of package shall contain a packing list in a waterproof envelope and a copy in triplicate shall be forwarded to the employer prior to dispatch. All items of material shall be clearly marked for easy of identification against the packing list.

c) All cases, packages, etc, shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating them to the appropriate shipping documents.

d) Bolts, nuts, washers and fillers shall be bagged in sealed vinyl and packed in steel cans. The cans shall bear the contents and be crated together.

e) The Employer shall reserve the right to inspect and approve the equipment and the packing before the items are dispatched. However the manufacturer shall be entirely responsible for ensuring that the packing is suitable for transit and such inspection will not relieve the manufacturer from responsibility for any loss or damage due to faulty packing.

(a) Consignee: Da Afghanistan Breshna Sherkat (DABS)

(b) Name \_\_\_\_\_ of \_\_\_\_\_ Project,  
- - - - -

(c) Contract \_\_\_\_\_ No:  
- - - - -

(d) Port of destination: - - - - -

(e) Item Number, if  
applicable,  
Package number  
in sequence,  
And quantity per package: - - - - -

(f) Description of Contents: - - - - -

Net and gross weight, cubic measure: - - - - - The shipping mark is finally subject to the Employer's approval.

Delivery As specified elsewhere.

#### **15.11 Detailed Technical specifications for 20 kV Metal Clad Indoor Switchgear Panels.**

##### Scope

This specification is for 20kV Indoor, three pole, metal clad switchgear with vertical or horizontal isolation, horizontal draw out with circuit breaker employing vacuum circuit Breaker.

##### References

The following documents were referred to during the preparation of this specification, and may be referred to; however in case of conflict, the provision of this specification shall take precedence.

Unless otherwise specified, the latest revision, edition and amendments of the standard shall apply

IEC 60298: AC metal - enclosed switchgear and control gear for rated voltages above 1kV and up to 72.5 kV

IEC 60051 Direct acting indicating analogue electrical measuring instruments and their accessories.

IEC 62271-100 High-voltage alternating circuit breakers.

IEC 60044-1: Current transformers

IEC 60044-2: Voltage transformers

IEC 60255: Electrical Relays

ANSI 37: Medium voltage AC metal - enclosed switchgear and control gear

##### Construction of Each Panel:

a)The whole switchgear equipment and components shall be designed and constructed in accordance with IEC 60298. The board shall be complete with all the relevant components including, Bus bars, circuit breaker, cable compartment, instrument transformers, protection relays, instruments and controls.

b)The switchgear board, shall be constructed to IP41 degree of protection in accordance with IEC 60529. A type test report for the degree of protection of the switchgear panels

from a third party reputable testing laboratory or certified by the national standards and testing authority (NSTA) or a laboratory accredited to the NSTA shall be submitted with the tender for evaluation purposes.

c) For panels in the scope of supply only: The panels shall have restricted dimensions suitable for installation in limited spaces. In particular and without compromising the insulation level, bus - bar current rating and short circuit current performances, the width of the panels shall not exceed 800mm.

The LV compartment shall not be less than 650 mm in height, to ensure adequate space for mounting the relays and other devices and accessories and adequate space for the cable trucks, terminal blocks and wiring.

The depth of the switchgear, i.e., from the front to the back shall be kept to the minimum and in any case not exceeding 1800 mm.

d) The switchgear panel or cubicle shall be built up of separate metal clad-compartmented cubicles with earthed metal partitions. The compartments shall be for Busbar, cable connection, circuit breaker, current transformer and control (LV) compartments. A drawing showing the layout and dimensions of each of the compartments of the switchgear panel and the devices/components installed in the compartment shall be submitted with the bid for tender evaluation. Also a drawing showing the arrangement and dimensions of a complete switchgear board, comprising one incomers, 4 outgoing feeder panels and one Axillary assembled together shall be included with the bid for tender evaluation. The drawing shall also include the arc venting chamber to be supplied with the switchgear board. Different drawings shall be provided for the switchgear board rated 25 kA respectively.

e)The circuit breakers shall be mounted on an inbuilt carriage to facilitate isolation and withdrawal of the circuit breaker. Where the carriage is fixed in the compartment and does not allow complete withdraw of the circuit breaker outside it's compartment, then a purposely built trolley shall be provided equipped with a lowering/raising gear to lower the circuit breaker to the floor, and to raise the circuit breaker to its compartment by one person. This requirement shall be demonstrated during FATs

f)The complete switchgear shall be such that the complete switchboard is of flush-front design.

g) Each of the switchgear panels shall have four separate compartments as follows:-

- i) LV compartment
- ii) Circuit Breaker compartment
- iii) Bus bars compartment
- iv) Cable, CTs, VTs and Earth Switch compartment

The circuit breaker, bus bars and cable compartments shall be provided with arc venting outlet to the top of the switchgear board. The top of the complete switchgear board shall be equipped with arc by-products venting chamber to direct the arc by products outside the switchgear room. The design of the arc chamber shall be adequate to handle arc by products at the withstand level of the switchgear board of 25 kA, 3 seconds. The design of the arc chamber shall be complete in every way with provision of connection to the switchgear wall at least at two points and the terminal explosion flaps to be fitted on the switch gear wall.

h) The low voltage section shall be completely separate from the high voltage section. All the protection relays, auxiliary relays, energy meters indication lamps, instruments, control and selection switches and any other associated accessories will be mounted in this compartment.

i) The switchgear shall be designed for erection with the rear side close to a wall as well as for free standing erection. The manufacturer shall provide a single line layout drawings giving the required minimum dimensions of the switchgear room, including arc by-products venting requirements to be provided (built into) in the switchgear room.

j) The switchgear shall be of arc resistant design as per IEEE/ANSI c 37.20 and hence ensure complete safety for a switching personnel standing in-front or at the rear of the switchgear board. A copy of the type test report shall submitted with the bid for tender evaluation purposes.

k) Where the venting is intended to penetrate an external wall, the vent shall be covered such that it meets all environmental conditions (e.g. rain-proof, dust-proof, vermin-proof, etc.).

l) The cable compartment should have an ant vermin guard plate giving protection against rats, rodents etc.

m) The circuit breaker compartment door shall be provided with provisions for padlocking.

n) The doors shall be capable of withstanding the effects of maximum internal arcing fault without being blown off and causing danger to personnel and other equipment. This should be proven by successful testing, as per ANSI c37.20.7 or equivalent IEC standards. Type test report shall accompany the bid.

o) The Bulbar shall be single, three phase, air insulated. The primary Bus bars and connections shall be of high conductivity and electrolytic material, high grade copper, and shall be in unit lengths. The Busbars shall preferably have a PVC cover to prevent accidental short-circuits

p) Busbars, connections and their support shall be rated 2000 A as required continuously under ambient conditions and capable of carrying the short-time current associated with the short circuit ratings of the circuit breakers, for 3 Seconds.

q) Busbars shall be extensible at both ends, such extension shall entail the minimum possible disturbance to the existing Busbar.

r) Provision shall be made for locking busbar and circuit shutters separately in the circuit breaker compartment. These shutters shall open and close automatically during the racking in and racking out of the circuit breaker.

s) Provision shall be made for integral circuit earthing and for Busbar earthing. Means of earthing shall be by circuit breaker or purposely built earth switch. Mechanical interlocks to ensure correct switching operation shall then be provided. It shall not be possible to close the earth switch on the incomer panel, when the incoming 20kV cable is live.

t) The earth switch shall be easy to operate by one operator and be spring loaded to ensure effective make operation independent of the operator action. The earth switch shall be rated to make and carry for 3 seconds, the rated short-circuit current of 25 KA.

The Status of the earth Switch shall be visible from the front of the Panel. It shall not be possible to rack-in the circuit breaker into the service position with the earth switch in closed position. The mechanical interlock between the circuit breaker and the earth switch shall be strong enough to guarantee safety of the switching personnel and the switchgear. The earth switch shall be equipped with auxiliary contacts for local and supervisory indication of the status of the earth switch. The earth switch operating lever shall be

covered by a shutter and shall only be accessible when it is permitted to operate the earth switch.

u)The operation of the Earth Switch shall be set in such a way that during both the close and open operations, a clearance of at least 9 inches shall be maintained between the operating handle and the bottom of the switchgear panel.

v)It shall not be possible to insert the earth switch operating handle into position except when the circuit breaker is in the test or isolated position. The earth switch shall be equipped with pad- locking facilities when in the closed position

w)All earthing facilities shall be rated for fault making at the rated switchgear short - circuit current.

x)Earthing switches shall be provided for earthing each of the Busbar Sections separately. All the interlocks required to ensure safe operation of the busbar earth switch shall be built into the switchgear board. In particular it shall not be possible to close the earth switch when any of the circuit breakers on that part of the busbar is in service position, i.e., all the circuit breakers shall be withdrawn for the Busbar earth to be closed. Once the Busbar earth has been closed, it shall not be possible to rack-in any circuit breaker.

Indications for busbars earth ON and OFF shall be provided and visible from the front of the board.

The Panel wiring for protection, instruments, indication and metering circuits and other control accessories shall be completely done. All circuits for connection to external cables such DC & AC auxiliary supplies, external tripping, supervisory control and indications shall be wired up to the terminal Block at the Back of the panel where external cables shall be connected. At least 12 spare terminals shall be provided on the terminal board for any future requirements.

y)It is emphasized that Each Switchgear panel will have a terminal block at the back of the panel where all external cables such as for 110V DC supply, 230V AC supply, connection of SCADA, positions/ measurements/commands and alarms shall be made.

z)110V DC, 110V AC and 230V AC supplies for circuit breaker control, alarm circuits, protection relays, metering and motor supply for each panel, shall be controlled by suitably rated miniature circuit breakers.



AA) the switchgear panels shall be vermin proof. The plates shall be of high quality mild steel of at least 2mm thickness thoroughly cleaned by shot blasting or other approved methods. They shall then be given a primary coat and two coats of contrasting color of durable and weather resisting paint. The final coat shall be gloss and of RAL 7032. The final thickness of the paint shall not be less than 80 Microns at any point within the switchgear panel. The paint thickness shall be measured during the Factory Acceptance Tests.

bb) Anti-condensation heaters shall be provided inside each switchgear panel. They shall be located so as not to cause injury to personnel or damage to equipment. The heaters shall be controlled by a hygostat with a variable humidity and temperature setting. The heaters shall be dimensioned to ensure that condensation cannot occur within the switchgear panel. Heaters of adequate rating shall be provided for the circuit breaker, cable and LV compartments.

The 230V AC supply, for the heaters shall be controlled by a suitably rated single pole miniature circuit Breaker.

cc) The circuit breaker cubicle shall have a limit switch which shall be wired to provide SCADA indications on whether the breaker is fully racked in or fully racked out(withdrawn).

dd) All the switchgear panels shall be rodent and vermin proof.

ee) Suitable means shall be provided to monitor the status of the HV cable, i.e., whether it is live or dead. The monitoring device shall be a three phase device with illumination in red color for live status visible from the front of the panel without opening any compartment doors. The indications shall be labeled R, Y & B or L1, L2 & L3. The device shall meet the requirements of IEC 61243-5.

ff) Each switchgear panel shall be provided with Tinned copper earth bar of adequate cross section area to be able to withstand the rated short-circuit current of 25 kA for 3 seconds, and arranged so that the bars of adjacent panels are joined together to form a common earth Busbar. Provision shall be made at either end of the assembled switchgear board for connection of the earthing bar to the substation earthing grid.

gg) Manual close & open push buttons shall be provided on the circuit breaker compartment door for manual close and open of the circuit breaker both in the service

and in the test(withdrawn) position. The manual close and open push buttons shall be clearly labeled with CLOSE and OPEN Labels and with I (red) and O (Green) Symbols and color codes as per the IEC standard.

#### **16. 20 Kv Circuit Beakers**

- a) The circuit breaker shall be three pole operated, indoor type, employing Vacuum

Interrupter with air or solid Insulation and shall comply with the requirement of IEC 62271-100 in respect of design, type tests, service operation and the making and breaking of faulty currents.

- b) The moving portion of each circuit breaker shall consist of a three-pole circuit breaker, operating mechanism, primary and secondary disconnecting devices, auxiliary switches, position indicators and necessary control wiring. The Auxiliary switches shall be of the plug-in type, with the male contacts mounted on the breaker carriage and the female contacts on the plug-in cable connected to the panel wiring. Other options may be considered where there is adequate proof that the auxiliary contacts will always be making firmly without miss-alignment. Finger contacts will however not be acceptable.
- c) The circuit breakers of the same current and voltage ratings shall be fully interchangeable, both electrically and mechanically.
- d) Name plate for the circuit breaker shall be provided with all the required details as per IEC standards, including:-
- i) Circuit Breaker  
type
  - ii) Applicable IEC  
standard
  - iii) Total Weight
  - iv) Rated  
Voltage
  - v) Lightning impulse withstand voltage
  - vi) 1 minute Power frequency withstand  
voltage

- vii) Rated frequency
- viii) Rated Current
- ix) Breaking capacity
- x) Short time current
- xi) Making capacity
- xii) Operating sequence
- xiii) Rated voltage of closing and opening coil
- xiv) Rated voltage of spring charging motor

e)The circuit breaker operating mechanism shall be motor wound spring operated, power closing with electrical release and with provision for hand spring charge.

f)Mechanical indication shall be provided to indicate the state of the spring. This shall be visible without opening the circuit breaker compartment door. Also two pairs of Auxiliary contacts, which are open, when the springs are charged shall be provided for local and supervisory indication.

g)A spare set of 4 normally open and 4 normally closed auxiliary contacts of the circuit breaker shall be provided and shall be wired to a terminal block (box), for connection to SCADA equipment, etc.

h)The control circuits for the circuit breaker shall automatically be connected when inserting the breakers into the cubicle. Alternatively a single plug-in cable for all auxiliary contacts shall be provided. It will not be possible to rack-in the circuit breaker without connecting the plug in cable first.

i) The operating mechanism shall be completely trip free both mechanically and electrically.

j) The circuit breaker shall have a mechanical operations counter

k) One mechanical ON/OFF indicator, with inscription "ON" white letters on red background and inscription "OFF" white letters on green background shall be provided for the circuit breaker.

Alternatively approved IEC indications for circuit breaker ON and OFF shall be used.

m) The breaker controls shall have anti-pumping facilities

n) Where the Circuit Breaker is used for circuit or busbar integral earthing, the control wiring of the breaker housing should be such that when the breaker is in circuit earth or busbar earth positions it shall only be operated mechanically and not electrically.

o) Circuit breaker poles between the interrupters and the primary plug-in contacts shall be fully insulated with durable material.

p) The circuit breaker maintenance and operations manual shall contain clear instructions on the maintenance requirements of the circuit breaker (if any), to prevent switchgear failure in service, due to excessive fault current clearance or any other cause .

## **17. CURRENT TRANSFORMERS**

a) Current transformers shall be cast Resin Type and shall be accommodated inside the cubicle, in a separate compartment or in the same compartment as the cable.

b) The current transformers shall be in accordance with the requirements of IEC 60044-1 and IEC 60044-6 and shall have the specified accuracy under load and short-circuit conditions and shall be able to withstand the effect of short-circuit fault current rating of the switchgear, of 25 kA for 3 seconds.

c) Current transformers shall have a rated burden as specified, sufficient for the connected Numerical Protection relays and Energy meters and instruments. The CT rated burden shall however not be less than 20 VA.

d) The Manufacturer of the CTs shall be identified at the time of tender. Copies of Type Test certificates and routine Test Reports/certificates as per IEC 60044-1 of CTs of similar rating and class verifying the class and accuracy as well as the limits of error for the declared class similar to those of the specified CTs shall be submitted with the bid for tender evaluation purposes. The specified CTs must be within the product range of the manufacturer. A catalogue of the CT manufacturer shall be supplied with the bid.

e)The current transformer shall have markings on the secondary and primary terminals as per requirements of the IEC 60044-1 standard. The markings shall be indelibly made. The secondary terminals shall have screw terminals.

f) Name plate for the current transformer shall be provided with all the required details as per IEC 60044-1 Standards, including:-

- i) The manufacturer's name
- ii) Serial number and a type designation
- iii) Rated primary and secondary current
- iv) Rated frequency
- v) Rated output and corresponding accuracy class for each secondary winding, including the rated accuracy limit factor and Instrument security factor for protection and metering secondary windings respectively.
- vi) The highest voltage of the equipment
- vii) The rated Insulation level
- viii) The rated short-time thermal current (I<sub>th</sub>) and the rated dynamic current
- ix) Class of Insulation
- x) Rated continuous thermal current

## **18 Voltage Transformers**

a) The VT shall be of Cast resin, indoor, type mounted within the 20kV incomer panel. The VT shall be three (3) Single phase units.

b) Voltage transformers shall be suitable for operation of the protection relays, metering and transformer voltage-regulating relay and shall be in accordance with the requirement of IEC 60044-2.

c)Each voltage transformer shall be star/star connected and complete HV links.

d)The Manufacturer of the VTs shall be identified at the time of tender. Copies of Type Test certificates and routine Test Reports/Certificates as per IEC 60044-2, of VTs of similar rating and class as the specified VTs shall be submitted with the tender for evaluation purposes. The

Specified VTs must be within the product range of the manufacturer.

e) Name plate for the voltage transformer shall be provided with all the required details as per IEC60044-2 Standards, including:-

- i) The manufacturer's name
- ii) Serial number and a type designation
- iii) Rated primary and secondary voltage
- iv) Rated frequency
- v) Rated output and corresponding accuracy class for each secondary winding,
- vi) The highest voltage of the equipment
- vii) The rated Insulation level
- ix) Class of Insulation for the equipment
- x) Rated voltage factor and corresponding rated time.
- xi) The use each secondary winding and its corresponding terminals

Protection Relays (must be read together with particular technical specifications control and protection)

- a) The LV compartment terminal block shall include a test switch (block), which enables the CTs circuits to be isolated from the relay and shorted without open circuiting the CT, to facilitate relay testing in situ and to allow for isolation of VT circuits, alarm and trip circuits without disconnecting wires at the terminal block.
- b) The Measurement relays shall be Flush mounted and of Numeric Design, with event recording, Fault recording, power measurement, and shall be in accordance to IEC 60255.
- c) Besides the communication port, the relays shall have a human - machine interface facility (MMI) with and LCD Screen where one can easily access relay information.
- d) Relay contacts shall be suitable for making and breaking the maximum currents, which they are required to control in normal service. Where contacts of the protective relays are not sufficient for circuit breaker tripping, auxiliary trip relays shall be provided, in order to prevent damage to output contacts of the measuring relay.
- e) Operating time for auxiliary tripping relays shall not significantly affect the overall fault clearance time, i.e., the auxiliary trip relays must have short pick up time of less than 30 ms.
- f) Relay contacts shall make firmly without bounce and the relay mechanism shall not be affected by Panel vibration or external magnetic fields.

- g) Relays shall be provided with clearly inscribed labels describing their functions and IEC Device Function numbers. The labels shall be to the approval of the Employer.
- h) Relays shall be suitable for operation on the station D.C. supply without use of dropping resistors or diodes.
- i) To reduce the effect of electrolysis, relay coils operating on DC shall be so connected such that they are not continuously connected from the positive pole of the station battery.
- j) The relay Thermal rating shall be such that the fault clearance times on any combination of current and time multiplier settings shall not exceed the thermal withstand capability of the relay. (Max. fault current = 25 kA).
- k) The relays shall be EMC 89/336/EEC compliant. And communication protocol shall comply with IEC 61850 standard

#### **18.1 Indications and Instruments:**

All instruments shall be flush mounted and shall be in accordance with the requirement of IEC 51. Each cubicle shall have the following indications.

- One indicator lamp to show the breaker in closed position - RED color.
- One indicator lamp to show the breaker in open position - GREEN color.
- One indicator lamp to show breaker Auto-trip - Amber color.

The instruments shall be supplied as described under each panel in the subsequent sections.

#### **18.2 Power Cable Termination**

Cable compartment design shall be suitable for heat shrinkable (or equivalent) jointing application termination. The following provisions shall be made:-

- i) Single core, nine gland fabricated sheet steel cable box, complete with gland and armor clamp, suitable for receiving single core 20kV, XLPE copper cable of size up to 300mm<sup>2</sup>, for Incomer type panels.
- ii) Single core six gland fabricated sheet steel cable boxes complete with gland and armor clamp suitable for receiving single core 20kV cable of size up to 300mm<sup>2</sup> 20kV XLPE copper cable, for feeders and auxiliary transformer type panels.

iv) The cable connection terminals shall be located at least 300 mm from the CT Primary terminals.

v) The Breaker cubicle shall have top entry facility for the control and protection cables

### **18.3 Outdoor Cable termination 300mm<sup>2</sup>.**

1. Voltage rating: 20kV AC
2. Cable size: 300mm<sup>2</sup>
3. Type of termination: Outdoor, heat shrinkable
4. Material: EPDM rubber or silicone rubber sheds, aluminum or copper conductors, stainless steel or galvanized steel fasteners
5. Insulation resistance: Should be greater than 1 GΩ at 10 kV DC
6. Partial discharge level: Should be less than 5 pC at the rated voltage
7. Operating temperature range: -40°C to +90°C
8. Cable preparation: Cable core should be cleaned, lubricated, and provided with semiconducting screens before termination
9. Installation: Should be carried out by trained and qualified personnel following the manufacturer's instructions and the applicable standards and regulations
10. Testing: The termination should undergo various tests, including AC withstand voltage test, partial discharge test, insulation resistance test, and heat cycle test, before and after installation to ensure its proper working.
11. Compliance: The termination should comply with the relevant international standards such as IEC, IEEE, etc., and the local standards and regulations.

### **18.4 Outdoor Cable termination 300mm<sup>2</sup>.**

1. Voltage rating: 20kV
2. Cable cross-section: 300mm<sup>2</sup>
3. Type of cable termination: indoor
4. Material of construction: The termination should be made of high-quality materials that are resistant to heat and fire. Typical materials used in indoor terminations include silicone rubber, EPDM rubber, and cold shrink material.
5. Insulation resistance: The termination should have a minimum insulation resistance of 500 Megohms at 1000 V DC.



6. Withstand voltage: The termination should be able to withstand a specified amount of voltage without any breakdown or flashover. Generally, terminations are tested at 1.2 times their rated voltage for one minute.
7. Temperature range: The termination should be able to operate over a wide temperature range, typically from -20°C to +90°C.
8. Sealant: The termination should be sealed with a high-quality sealant to protect the connection from moisture and other contaminants.
9. Mechanical strength: The termination should be designed to withstand mechanical stress, such as bending and twisting, without compromising the electrical connection.

### 18.5 Labelling of the Switchgear Panels:

NB1: For Each Switchgear Board the panels shall be assigned a distinct numerical number for identification starting with number one (1) on the left hand side. The number will be embedded on a stainless steel plate of width not less than 5 cm. The size of the number shall be at least 3 cm high. The stainless steel plate shall be fixed to the panel using stainless steel bolts.

### 18.6 Ratings of Switchgear Equipment's

#### a) 20kV Incomer, Bus-section and Feeder Circuit Breakers:

Interrupting Medium	Vacuum
Number of poles	3
Highest equipment Voltage	24kV
One minute power frequency withstand voltage	50 kVrms
Impulse withstand voltage peak (dry)	125kV
Frequency	50 Hz
making current (peak)	62.5kA
Short circuit current withstand	25 kA, 3 Seconds
Operating sequence	O-0.3sec-CO-3min.-CO
Auxiliary D.C voltage for closing and tripping	110V
Auxiliary A.C. voltage	230V AC, 50Hz
Tripping/closing coil auxiliary voltage	110 V DC
Spring charging motor supply	130 V DC
Rated normal Current – Incomers	To be specify
Rated normal Current – Feeder	630 A
Rated normal Current – Bus Bar	2000 A

b) Current Transformers for Incomer, and Feeder Panels

Ratings:

Rated Short time current (ST) withstand 25 kA for 3 seconds at Rated Voltage of the CT

Rated maximum continuous current:-

- ☐ Incomer : 1250 A
- ☐
- ☐ -Outgoing Feeder : 630 A

20KV Incomer panels.

Core 1: C.T Ratio : 600-1200/1A (Turns Ratio)  
Class : 5P20

Core 2: C.T Ratio : 600-1200/1A  
Class : 0.2 :

Core 3: C.T Ratio : 600-1200/1 A  
Class : PX

i i ) 20KV Outgoing feeder panel

Core 1: C.T Ratio : 300 /600//1A  
Class : 5P10

Core 2: C.T Ratio : 300/600/1A  
Class : 0.2

iii) CT Ratio for Auxiliary Transformer:

Core 1: C.T Ratio : 25/50/1 A  
Class : 5P10

Core 2: C.T Ratio : 25/50/1 A  
Class (Metering) : 0.2

iv) Voltage Transformers:

Ratings:

Rated Voltage of the VT 20 KV

Ratio: Core1, Core 2 :  $20000/\sqrt{3}$ :  $110/\sqrt{3}$ :  $110/\sqrt{3}$

Accuracy : 3P&0.2

## **19 Factory Acceptance Tests (FATs) (see clause 1.10 also)**

All the switchgear panels shall be tested in accordance with the requirement of IEC 60298. Tests shall be carried out on the circuit breakers as per the requirement of IEC 62271-100. Current transformers and Voltage transformers shall be tested in accordance with the requirement of IEC 60044-1 and IEC 6044-2 respectively.

The manufacturer in presence of shall carry out the following tests during the FATs  
The employer's engineers.

### **1) Complete Switchgear Board**

- a) Dimensional checks
- b) Operational Tests
- c) Primary Injection Tests
- d) calibration Tests on Relays and Instruments Power frequency Withstand
- a) Test
- b) Contact resistance test of Primary joints
- c) Lightning Impulse withstand test
- d) Power frequency Withstand Test on secondary Wiring

Breaker

Routine tests.

- a) Operation test.
- b) High Voltage test, dry.
- c) Voltage tests on controls and auxiliary circuits.
- d) Measurement of resistance of the main circuit.

Type Tests: Submit copies of Type test Reports and Certificate.

- e) Mechanical endurance test
- f) Temperature rise test. g) Impulse voltage test
- h) Interrupting Capacity

NB: Copies of Type Test certificates for similar rated Circuit Breakers and certified by National Standards and Testing Authority body or Reputable Third Party Test Laboratory shall be submitted with the Tender for Evaluation Purposes.

### **19.1 Current Transformer**

Routine tests shall be carried out at the manufacturer's plant as per the requirement of IEC 60044-1, as listed below, in the presence of DABS Engineers.

- i. Polarity test and verification of terminal markings test

- ii. Ratio and phase angle error test (accuracy class composite error test)
- iii. Power frequency tests on primary and secondary windings
- iv. Power frequency withstand tests between sections (windings)
- v. Inter-turn over voltage tests
- vi. Partial discharge measurement

Type Test report for the following type tests shall be provided during the FATs:-

- I. Lightning Impulse withstand voltage test
- ii. Temperature rise test
- iii. Short time current test
- iv. Determination of Errors
- v. Radio Interference voltage measurement (RIV)

## **19.2 Voltage Transformer**

Routine tests shall be carried out at the manufacturer's plant during FATs as per the requirement of IEC 60044-2, as listed below:-

- (a) Polarity tests and verification of terminals
- (b) Power frequency withstand tests on Primary windings
- (c) Power frequency withstand tests on secondary windings
- (d) Power frequency withstand tests between sections
- (e) Determination of errors
- (f) Partial discharges measurement

Certificates and type test report for the following type tests shall be provided during the

## **19.3 FATs:-**

- (a) Temperature rise test
- (b) Lightning Impulse Test
- (C) Determination of errors
- (d) Short-circuit withstand test capability
- (e) Measurement of the radio interference voltage (RIV)

### **5. Protection Relay Tests**

- a. Relay Pick-up test for all functions and phases
- b. Relay timing test for all functions and phases

## **20 Training at the Manufacturer's Place**

During the FATs the manufacturer shall conduct complete training for the following equipment for at least Two DABS Engineers:-

- (a) Feeder Protection and Control relay

The Training shall include:-

- (i) Theory on application of all the functions included in the relay
- (ii) Complete configuration of the relay using software including creation and editing of the switchgear Mimic
- (iv) Relay parameter setting
- (v) Downloading and analysis of all the data including disturbance recording
- (vi) Installation and testing
- (vii) Trouble-shooting and repair
- (viii) Complete testing of all the relay functions
  - (a) Feeder Protection and Control relay

The Training shall include:-

- (i) Theory on application of all the functions included in the relay
- (ii) Complete Configuration of the relay using software including creation and editing of the switchgear Mimic
- (ix) Relay parameter setting
- (x) Downloading and analysis of all the data including disturbance recording
- (xi) Installation and testing
- (xii) Trouble-shooting and repair
- (xiii) Complete Testing of all the relay functions

**(b) Energy Meter.**

The training shall include:-

- (i) Theory on application of all the functions included in the meter
- (ii) Complete configuration and parameter setting of the meter using software including creation and editing of the switchgear Mimic
- (xiv) Downloading and analysis of all the data including events
- (xv) Installation and testing
- (xvi) Trouble-shooting and repair

The Training shall be considered to have been successful once the engineers/Technicians are able to carry out all the above activities on their own. The

manufacturer shall conduct evaluation tests and give a feedback report on the Training to the employer for each of the engineers/technicians.

## **20 Protection Relays, Controls and Measuring Devices Requirements for Switchgear Panels**

### **20.1 General Requirements**

- a) The equipment for the control system shall be highly reliable, long - lived and suitable for continuous operation.
- b) All instrument scales, coils, relay contacts and other features shall be suitable for the Apparatus controlled or the purpose intended
- c) It shall be the manufacturer's responsibility to properly design the electrical control, protective relaying, and alarm and indication schemes related to the 20kV switchgear panels.
- d) The Manufacturer shall prepare arrangement and detailed drawings, equipment lists and wiring diagrams based on the requirements for meters, relays, control switches, indicating lamps and other devices including those to be supplied under other subsections
- e) Protection against electrical faults and abnormal conditions on 20kV switchboard and the Incoming & outgoing 20kV feeders shall be conducted by the protective relays and associated switchgear.

### **20.2 Feeder Panels Requirements**

The overhead feeder panels shall be equipped with the following protection relays, measuring and indicating devices, controls and other accessories.

- (i) Feeder protection and control relay. The relay must fully meet the requirements of the detailed specifications included in this specifications.
- (ii) Trip circuit supervision relay visible from front of panel without having to open any panel compartment door. The TCS Relay shall be offered as a separate relay and NOT as a function of the feeder protection relay. Alternatively, the trip circuit supervisory function may be included in the feeder protection and control relay provided that it meets all the requirements of the specifications.

- (iii) Auto reclose ON/OFF mechanical selector switch mounted on the panel and indelibly labeled.
- (v) A single power measurement unit shall be provided for each feeder panel to capture instantaneous and maximum demand values for the following parameters; I, kV, MW, MVAR and p.f.
- (vi) Tariff Energy Meter
- vii) Current Transducer; output 0-20mA, for input current of 0 - 1 Amp
- viii) Circuit breaker control switch (Close, Open & Neutral), with a mechanical Lock
- ix) Circuit Breaker ON (red), OFF (green) and auto-trip (amber) indication lamps
- x) Anti-condensation heaters for the Circuit Breaker and the LV compartment
- xi) Hygrostat with separate humidity and temperature control setting to control the heater.
- xii) DC supply under voltage relay on the feeder panels at the two ends of the switchgear board when assembled
- xiii) AC supply under voltage relay on the feeder panels at the two ends of the switchgear board when assembled
- xiv) Door switch operated lighting point and bulb
- xv) 3 Pin - square power socket outlet with red neon indicator
- xvi) Suitably rated MCBs for auxiliary 110V DC for control, 230 V AC for motor, 230 V AC for heaters and illumination and VT 110 V AC supplies shall be fitted

## **21 Incomer Panel Requirements**

The Incomer Panels shall be equipped with the following Protection Relays, Measuring and indicating devices, Controls and other Accessories.

- (i) Feeder protection and control relay. The relay must fully meet the requirements of the detailed specifications included in this specifications.
- (ii) Three phase overcurrent and earth fault relay
- (iii) Trip relay with a push button for electrical reset
- (iv) Trip circuit supervision relay visible from front of panel without opening relay compartment door. The TCS shall be offered as a separate Relay and NOT as a

function of the feeder protection relay. Alternatively, the trip circuit supervisory function may be included in the feeder protection relay if it can be cleared and annunciated and meets the requirements of the specifications.

- (vi) A single power measurement unit shall be provided for each feeder panel to capture instantaneous and maximum demand values for the following parameters ; I, kV, MW, MVAR and p.f.
- (vii) Tariff Energy Meter
- (viii) MW Transducer, -20 0 +20 mA
- (x) MVAR Transducer, -20 0 +20 mA
- (xi) Current Transducer, 0 - 20mA, for current input of 0 - 1Amp.
- (xii) Voltage Transducer, 0 - 20 mA, for voltage input 0-110V AC
- (xiii) Circuit breaker control switch (Close, Open & Neutral) with mechanical locking to prevent un-intended operation.
- (xiv) Circuit Breaker status ON (red) and OFF (green) Indication lamps
- (xv) Heater ON/OFF switch, for anti-condensation heater.
- xvi) Anti-condensation Heater
- xvii) Hygrostat with separate Humidity and Temperature control Setting.
- xviii) DC Supply Under-voltage Relay
- xix) AC Voltage Under voltage Relay
- xx) Door switch operated lighting point and bulb
- xxi) 3 Pin - square power pocket outlet with neon indicator.
- xxii) Suitably rated MCBs for Auxiliary 110V DC for control, 230 V AC for motor, 230 V AC for heaters and illumination and VT 110 V AC supplies shall be fitted

## **21.1 Protection Relays**

### **2.8.3.1 References**

IEC 60255: Electrical Relays

## **21.2 General Requirements**

- a) The electrical measuring protective relays shall be of Numeric design.



b)Auxiliary relays, of Static or electromechanical design, with mechanical flag indicators are acceptable.

c) The protective relays and auxiliary relays shall operate successfully for any value of the

DC supply voltage between 85% and 125% of the rated voltage of 110V DC without exceeding the temperature rise limits for the operating coils.

d)Each Measuring protection relay shall be of the panel flush mounted, back connected, type with rectangular case. Each relay shall have a removable transparent cover or cover with a transparent window making the front of the relay visible. It is preferred that each measuring relay shall be of a withdrawable type from the front of the panel with sliding contacts, without opening the current transformer secondary circuits, disturbing external circuits or requiring disconnection of leads on the rear of the panels.e) Each

protection relay shall be equipped with adequate electrically independent contacts, of adequate rating for Trip and alarm functions. The relay shall also have adequate number of LEDs to assign each of the available protection functions. The number of LEDs shall not be less than eight (8).

f)Test facilities for each AC current Transformer secondary circuit so as to provide access for testing of the protective relay and its associated circuits. This shall be provided on the terminal block and will consist of isolation links on the current transformer and voltage transformer circuits and suitable terminals for insertion of test leads banana terminals for injection of secondary current and voltage.

g) Each current transformer circuit shall be earthed through a removable link at one point only in the control compartment's terminal block. The protection trip and alarm circuit for each panel shall be provided with an isolation link to facilitate isolation of the trip or alarm circuit for testing and trouble-shooting of the circuits.

h)Relays contacts shall be suitable for making and breaking the maximum currents, which they may be required to control in normal service. Where contacts of the protective relays are unable to deal directly with the tripping currents, Auxiliary Trip relays shall be provided. This will ensure safety for the protection relays output contacts.

i)Relays contacts shall make firmly without bounce and the whole of the relay mechanism shall be as far as possible unaffected by vibration or external magnetic fields.

j) Relays shall be provided with clearly inscribed labels on the surface of the panel describing their application in words e.g., "Three overcurrent & earth Fault relay" in addition to the IEC numbering.

k) To minimize the effects of electrolysis, relay coils operating on DC shall be so connected that the coils are not continuously connected from the positive pole of the battery.

l) The relay thermal rating should be such that the fault current clearance times on any combination of current and time multiplier setting shall not exceed the thermal withstand capability of the relay (Maximum Fault current = 40 kA).

m) The numerical relays will be equipped with an RS232 communication port to facilitate connection to a Laptop computer for configuration and parameter setting. Also a communication port shall be provided on each numerical relay for interface into a substation control and monitoring system and for remote interrogation and programming of the protection relays.

n) The relays will also have an MMI with LCD screen and keypad to facilitate manual relay programming and data access.

o) Relay operation due to system fault, shall be indicated by a Red L.E.D. and the fault details (flags) shall be displayed on the MMI. Both the relay fault flags and red L.E.D shall be reset via reset push buttons without opening the relay cover.

## **22 DETAILED SPECIFICATIONS FOR RELAYS, MEASURING AND INDICATING INSTRUMENTS, CONTROL SWITCHES AND OTHER ACCESSORIES.**

These specifications indicate the required performance characteristics for each of the Protection

Relays and are in accordance with IEC 60255.

### **a) The Outgoing Feeder Protection and Control Relay 1:**

This relay shall be installed on the feeder and bus-section switchgear panels and shall as a minimum meet the following requirements.

☐ The Feeder protection and control relay shall be of numeric design

☐ The Relay will have a large LCD screen measuring at least 7 cm x 7 cm where a mimic of the switchgear arrangement and status of the switchgear for the bay shall be displayed. The position of the circuit breaker, i.e., racked-in or withdrawn shall

be indicated. Circuit breaker close and open key buttons with symbols and color codes as per the IEC standards shall be provided on the relay as well as switchgear selection key. A local/remote key selector switch shall be provided on the relay and the selected status of the selector switch indicated by means of an LED.

- ☐ the relay shall be equipped with a keypad for manual configuration and parameter settings and for access of settings, fault and event records.

- ☐ The relay offered shall have at least the following protection functions;- three phase overcurrent and earth fault to be installed in the switchgear panels. Other protection functions include;, Auto reclose function, breaker failure protection, under and over frequency as well as over and under voltage functions. All the protection functions shall meet the requirements of each function as included in this specifications.

- ☐ the relay shall monitor, measure and display on the screen the following parameters; I, V, P, Q and p.f. Also the circuit breaker wear shall be monitored and stored. The relay shall store at least 20 fault records, 20 events and 6 oscillography fault records.

- ☐ it shall be possible to display instantaneous measurands on the screen alongside the Bay Mimic.

- ☐ the unit shall have a green L.E.D to indicate healthy status and a red L.E.D to indicate operation (Trip) of the protection functions.

- ☐ it shall be equipped with a red L.E.D indicator to indicate relay failure as well as output

- ☐ The Relay terminals shall be screw type terminals large enough to accommodate at least 4 mm<sup>2</sup> cable and shall be located at the back of the Relay.

- ☐ It shall be Equipped with an RS232 serial port for connection to a laptop computer for configuration and setting of relay and control functions and also for access of the relay data.

Also a communication port for connection to local area network shall be provided. Seven (7) laptop to relay connection cables shall be provided

- ☐ Seven (7) sets of Installation, commissioning, operation and maintenance manuals shall be provided.

☐ Software for relay configuration, parameter settings and data download shall be supplied in CD ROM with the switchgear boards. Seven (7) copies (CD ROMs) of Software shall be supplied.

b) The Incomer feeder Protection and Control Relay:

This relay shall be installed on the incomer switchgear panels and shall as a minimum meet the following requirements.

☐ the feeder protection and control relay shall be of numeric design

☐ The relay will have a large LCD screen measuring at least 7cm x 7cm where a mimic of the switchgear arrangement and status of the switchgear for the bay shall be displayed. The position of the circuit breaker, i.e., racked-in or withdrawn shall be indicated. Circuit Breaker close and open key buttons with symbols and color codes as per the IEC standards shall be provided on the relay as well as switchgear selection key. A local/remote key selector switch shall be provided on the relay and the selected status of the selector switch indicated by means of an LED.

☐ The relay offered shall have at least the following protection functions;- three phase overcurrent and earth fault, directional three phase overcurrent and earth fault relay. Other protection functions include breaker failure protection, under and over frequency as well as over and under voltage functions. All the protection functions shall meet the requirements of each function as included in this specifications.

☐ The Relay shall monitor, measure and display on the screen the following parameters; I, V, P, Q and p.f... Also the circuit breaker wear shall be monitored and stored. The relay shall store at least 20 fault records, 20 events and 6 oscillographic fault records.

☐ It shall be possible to display instantaneous measured on the screen alongside the bay mimic.

☐ the unit shall have a green L.E.D to indicate healthy status and a red L.E.D to indicate operation (trip) of the protection functions.

☐ it shall be equipped with a red L.E.D Indicator to indicate relay failure as well as output contacts to signal relay failure.

☐ the relay shall have at least eight (8) programmable LEDs for displaying protection and other alarms.

☐ The relay terminals shall be screw type terminals large enough to accommodate at least 4 mm<sup>2</sup> cable and shall be located at the back of the relay.

☐ it shall be equipped with an RS232 serial port for connection to a laptop computer for configuration and setting of relay and control functions and also for access of the relay data.

☐ the relay shall be equipped with a keypad for manual configuration and parameter settings and for access of settings, fault and event records and other data.

☐ Software for relay configuration, parameter settings and data download shall be supplied in CD ROM with the switchgear boards. Seven (7) copies (CD ROMs) of Software shall be supplied.

NB: The Protection Functions Offered in the feeder protection and control relay shall satisfy the detailed specifications for each of the functions, detailed below:-

(i) Three phase overcurrent and earth fault relay for outgoing feeders

Should incorporate the following Features;

- ☐ Relay must be of Numerical Design
- ☐ shall be suitable for mounting on the panel front.
- ☐ Current setting range for overcurrent relay 0.5In-2.4In
- ☐ Current setting range for earth fault relay 0.05In-0.8In
- ☐ I.D.M.T characteristics according to BS142 or IEC255 i.e. SI, VI, EI, LTI, including definite time for the high-set Elements.
- ☐ Time setting multiplier 0.05 - 1.0
- ☐ Broken conductor protection feature
- ☐ Highest Element for both overcurrent and earth fault with.

Protection, with a setting range of 1-30In and a definite time delay setting of 0 – 60 Seconds.

- ☐ Circuit breaker maintenance
- ☐ Fault records and event records
- ☐ Trip and start contacts shall be freely configurable to the output relays.
- ☐ Drop off /pickup ratio >90%
- ☐ Low transient overreach < 10%

(ii) Three- Phase Overcurrent and Earth Fault Relay for incomer should incorporate the following Features; ☐ Relay must be of Numerical design.

- ☐ Current setting range for overcurrent relay  $0.5I_n$ - $2.4I_n$
- ☐ Current setting range for earth fault relay  $0.05I_n$ - $0.8I_n$
- ☐ Quadrature connection for polarizing voltage
- ☐ Applicable on the LV side of a ..... transformer
- ☐ High set Element, with a setting range of  $1-32I_n$
- ☐ all stages of the phase and earth Fault elements shall be freely assigned the directional feature.
- ☐ shall have the ability to program the directional feature forward or reverse for each setting stage
- ☐ I.D.M.T characteristics according to BS 142 or IEC 255 and definite time characteristic
- ☐ The normal operating boundary shall be  $\pm 90$  degrees from relay characteristic angle.
- ☐ Relay sensitivity should be 1% of rated value of current and polarizing voltage at an angle equal to the relay characteristic angle.
- ☐ Time setting multiplier 0.05 - 1.0.
- ☐ High set element for both overcurrent and earth fault protection, with a setting range of  $1-20I_n$  and a definite time delay setting 0 to 60 Sec.
- ☐ Circuit breaker maintenance.
- ☐ incorporate fault records, event records.
- ☐ Configurable output relays with ability to output starting elements to control tripping of other upstream protection relays.

iii) Trip relay

- ☐ High burden tripping relay, immune to capacitance discharge currents and leakage currents.
- ☐ At least 7 pairs of outputs contacts two of which should be NO contacts.
- ☐ Instantaneous operation,  $t < 15\text{ms}$ .
- ☐ Flag or target shall be a red L.E.D, durable bulb or red mechanical flag.
- ☐ The relay shall be suitable for flush mounting.

☐ the relay shall be electrically reset, the reset button shall be inbuilt on the relay and accessible without opening the relay cover OR shall be supplied separately for panel surface mounting.

☐ Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm<sup>2</sup> cable and shall be located at the back of the relay

☐ Relay terminals shall be clearly marked

Relay contacts configuration shall preferably be drawn on the relay casing

(iv) Trip circuit supervision Relay

The relay shall have the following features

☐ Continuous supervision of trip circuit for circuit breaker in both OPEN & CLOSED positions

☐ Trip circuit fail - Red L.E.D or Flag

☐ Trip circuit healthy - green L.E.D or no flag

☐ Suitable for panel surface mounting; However if mounted inside the control compartment, then the relay must be visible from the front.

☐ Two (2) normally closed (NC) and two (2) normally open (NO) or 2NO/NC output contacts

☐ Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm<sup>2</sup> cable and shall be located at the back of the relay

☐ Relay terminals shall be clearly marked

☐ Relay contacts configuration shall preferably be drawn on the relay casing

(v) Annunciator Relay Unit

☐ shall have Silence, Accept and Reset, push buttons, to control the Alarms

☐ shall be equipped with at Least 16 separate alarm Elements

☐ Each of the elements shall be freely assigned to one of two common output alarms; urgent and non-urgent alarm.

☐ Each alarm element shall have a red L.E.D. to indicate ON status. It shall also have provision for fixing of identification label changeable on site. A flashing alarm element shall be clearly visible.

☐ The urgent and non-urgent common alarms shall be freely configurable to the output relays.

☐ High immunity against electrical interference.

☐ Relay output for audible alarm and for self-supervision shall be provided

☐ Integrated event register to provide analysis of the latest sixteen (16) events

☐ Each of the elements shall be freely assigned to one of two common output Alarms; Urgent and NON-urgent Alarm.

☐ Relay Terminals-shall be screw type terminals large enough to accommodate at least 2.5 mm<sup>2</sup> cable and shall be located at the back of the relay

☐ Relay terminals shall be clearly marked

☐ Relay contacts configuration shall preferably be drawn on the relay casing

☐ At least two output relays one for urgent and the other for non-urgent alarm

☐ At least two (2) pairs of NO pair of out-put contacts for each out-put relay

(vi) Circuit breaker Close/Open control Switch

☐ The switch shall have a mechanical interlock to prevent accidental operation of the switch.

☐ It shall have a close, neutral and open positions engraved on the switch, black letters on white background. After an operation, the switch shall return to the neutral position by spring action.

☐ The terminals of the switch shall be screw type and shall be indelibly marked.

Autoreclose relay Function in the Feeder Protection Relay.

This auto reclose function shall be housed within the feeder protection relay

☐ Selectable 1 - 3 auto reclose shots

☐ independently set dead time for each shot

☐ Auto reclose inhibit after manual close

☐ Each auto reclose shot shall be initiated by the selected protection function(s).

Operation of protection function not selected to initiate a particular shot of autoreclose shall lead to lock-out of the relay.

☐ Auto reclose inhibition for over current high set element.

(vii) Transducers:



a) MW Transducer:

- ☐ Connection shall be 3-Phase, 4-Wire
- ☐ Inputs 110V AC and 1Amp
- ☐ Programmable output characteristic
- ☐ Output shall be 0 - 20 mA
- ☐ Auxiliary power supply shall be 230 V Ac and 110V Dc
- ☐ the transducer terminals shall be of screw type, large enough to accommodate 4 mm<sup>2</sup> cable and shall be indelibly marked.

b) MVAr Transducer:

- ☐ Connection shall be 3-Phase 4-Wire
- ☐ Inputs 110V AC and 1Amp
- ☐ Programmable output characteristic
- ☐ Output shall be 0 - 20 mA
- ☐ Auxiliary power supply shall be 230 V AC/ 110 V DC
- ☐ the transducer terminals shall be of screw type, large enough to accommodate 4mm<sup>2</sup> cable and shall be indelibly marked.

c) Current Transducer:

- ☐ Input 0- 1Amp
- ☐ Output 0 - 20 mA
- ☐ Auxiliary power supply shall be 230 V AC /110 V DC
- ☐ Transducer terminals shall be screw type, large enough to accommodate 4mm<sup>2</sup> cable and indelibly marked.

d) Voltage Transducer:

- ☐ Input 0- 110 V AC
- ☐ Output 0 - 20 mA
- ☐ Programmable output characteristic
- ☐ Auxiliary power supply shall be 230 V AC, separately connected.
- ☐ Transducer terminals shall be screw type, large enough to accommodate 4mm<sup>2</sup> cable and indelibly marked.

NB: A single transducer unit with all of the above listed functionality in one casing is acceptable.

(viii) Moulded Case Circuit Breakers:

- ☐ Three phase unit with Auxiliary contact
- ☐ Rated operating voltage, 400V AC
- ☐ Rated Insulation voltage 1000V / 600V AC
- ☐ Rated frequency 50 HZ
- ☐ Setting value of thermally delayed Overload release, 3 A
- ☐ Auxiliary switch should have 1 NC & 1 NO contact.
- ☐ Suitable for fixing on a DIN rail
- ☐ Terminals suitable for connection of at least 4 mm<sup>2</sup> cable

(ix) Signaling Hooter:

- ☐ The actuator system shall consist of a strong, non-polarized electromagnet with an impact resistance sturdy casing.
- ☐ Rated frequency 50 HZ.
- ☐ Rated voltage shall be 230V AC; +6/-10 %
- ☐ Protection degree shall be IP 55
- ☐ Operating mode continuous
- ☐ Volume approximately 108 dB(A) 1 ¼ m
- ☐ Hooter terminals shall be large enough to accommodate 4 mm<sup>2</sup> cable and indelibly marked.

(x) Anti-condensation Heater:

- ☐ The heater should be suitable for mounting inside the circuit breaker, the cable and the LV compartment.
- ☐ The Heater for each compartment shall be adequately rated to preventing condensation within the respective compartment.

(xi) DC supply under voltage Relay.

- ☐ shall have a settable range for under-voltage pick up, of 30-80% of the rated DC voltage
- ☐ shall be of electromechanical or electronic design
- ☐ shall have an accuracy of < 4%
- ☐ shall be self-reset when the voltage returns to normal level

- ☐ shall have a built in indication LED (green) and a built in operation LED (red)
- ☐ shall have at least 2 NC auxiliary contacts (contacts close for under voltage conditions)
- ☐ the relay shall be rated for continuous operation at the rated DC voltage.
- ☐ shall be suitable for mounting on DIN rail.
- ☐ Relay terminals shall be screw type, large enough to accommodate 4mm<sup>2</sup> cable and indelibly marked.

(xii) Indicating Lamps:

- ☐ shall be suitable for mounting on the front of the panel.
- ☐ The Lamp Indicators should be rated for 110V DC.
- ☐ the lamp indicators should be designed for continuous operation and give a long life of at least 10 Years.
- ☐ The bulb shall be easily replaceable without using a special tool.
- ☐ The Lamp Indicators shall be of LED design.

NB: LED Indicators are preferred

(xiii) Power Measurement Unit:

- ☐ This is a power monitoring meter for panel mounting
- ☐ The unit shall be of numerical design
- ☐ The unit shall have a large LCD display for displaying the measurements
- ☐ The unit shall measure instantaneous values of; rms voltage, both phase - phase and phase to ground, currents, active reactive and apparent power, energy, frequency, power factor and phase angle per phase
- ☐ The unit shall the following input ratings, 1A and 110V AC phase to phase.
- ☐ The unit shall be for flush mounting on the front of the panel
- ☐ The unit shall be for 3 phase, 4 -wire connection on the secondary of current and voltage transformers
- ☐ The unit shall be equipped with an RS232 port for programming the unit to ensure correct measurement and display of the parameters. The CT and VT ratios shall be programmable.
- ☐ The accuracy of measurement shall be at least class 0.2

- ☐ It shall be possible to display all the measured parameters on the screen through the pre-programmed display screen. The screen to be displayed shall be selectable using the keys on the front of the unit
- ☐ The software and the PC to measurement unit connection cable shall be supplied with the unit.
- ☐ The LCD screen shall be large enough to accommodate at least three measurands simultaneously
- ☐ All the terminals shall be clearly marked
- ☐ The measurement range for power shall at least be up to 20 MVA.
- ☐ The measurement unit terminals shall be screw type, large enough to accommodate 4mm<sup>2</sup> cable and indelibly marked.

### **22.1 Detailed Specifications for Energy Meters:**

Specifications for High Tension (HT) Voltage and Current Transformer (CT) Connected Static Meters for Energy Metering on the Incomers and Feeders.

### **22.2 Scope**

- (a) This specification is for newly manufactured High voltage current transformer connected static meters for measurement of alternating current active energy in 50 Hz networks.
- (b) The meters are for use in Distribution and Transmission networks.

### **22.3 Requirements**

2.10.2.1 Meters shall meet requirements of IEC 62052-11:2003 and IEC 62053-21:2003.

2.10.2.2 Meters shall be suitable for operation in desert climate where temperatures may vary from -20 to +45 degrees Celsius and Average Annual Relative humidity reaching 90% and altitude of up to 2,200m.

2.10.2.3 The meters shall be constructed as 3 phase 4-wire meters but may be wired as 3 phase 4-wire or 3 phase 4-wire meters.

2.10.2.4 The meters shall have terminals with bottom entry for cables and the arrangement shall be

L1V1L1: L2V2L2: L3V3L3: N for 3 phase 4-wire meters.

2.10.2.5 The meters shall conform to the degree of protection IP 51 as given in IEC 60529:1989

Degrees of protection provided by enclosures (IP Code) Amendment 1:1999.

2.10.2.6 The meters terminal holes and screws shall be made of brass or nickel-plated brass for high strength and high conductivity. Terminal holes shall be of sufficient size to accommodate the cables of at least 6mm diameter.

2.10.2.7 The meters shall have LED indicators for testing and indication of kWh and kvarh- meter operation.

2.10.2.8 The meters shall be equipped with auxiliary terminals for inputs and outputs.

2.10.2.9 The meters shall have a real-time clock controlled by a quartz crystal oscillator and a backup power supply to run the calendar clock for a minimum of 1 year without mains voltage.

2.10.2.10 the meters shall have a non-volatile memory capable of data storage.

2.10.2.11 The meters shall be capable of storing load profiles for at least 150 days on four channels with 20 minutes integration for the following parameters namely Import watts, Export watts, Export VA, Import VA, 4-quadrant Reactive energy Q1, Q2, Q3 & Q4, Phase voltages, Phase currents and Power factor.

2.10.2.12 The meters shall be capable of measuring the following parameters: Active, reactive and apparent energy and demand in export and import modes; Maximum demand in kVA and kW; Four quadrant power measurement; Multi-tariff metering; Accurate measurement for incorrect phase sequence; and Instrumentation data (V, I, Pf, Phase angles, Power etc.).

2.10.2.13 Additional operational and security features of meters: Meter sealing provisions; Meter software with enhanced access levels; Logging of loss of voltage, over-current, over-voltage, date of last programming; at least 8 and 6 registers for energy and demand respectively; Programmable billing dates; Non resettable billing registers and a minimum of 12 months; LCD with 8 digit ID codes that are EDIS compliant; No mains supply reading facility; RS485 and optical ports for communication; Primary metering for Demand and Energy

2.10.2.14 Meters rating: 3 x 63.5/110 V, 3 x 1 A and at 50 Hz.

2.10.2.15 Meter Type and other tests: Meters to pass tests on Power consumption, Influence of short-time over-currents, Influence of self-heating, Ac voltage test, Limits of errors due to variation of the current, Limits of error due to influence quantities, Test of starting and no - load condition and EMC tests.

Note: all outgoing feeders must have own energy meters.

2.10.2.16 Name plate marking requirements: Each meter marked legibly and indelibly in English with the following information: Name or trade mark of the manufacturer, country of origin, Type/model, Meter number up to ten digits, the inscription "Property of Da Afghanistan Breshna Sherkat , Standard(s) to which the meter complies and Year of manufacture.

2.10.2.17 Warranty requirements: 12 months from date of energization.

## 22.4 Schedule of Technical data

Standard and type tests	
General requirements and tests	IEC 62052-11:2003
Particular requirements for static meters	IEC 62053-21:2003
Power consumption and voltage	IEC 62053-21:2003
Shock test	IEC 62052-11:2003
Plastic-determination of temperature	IEC 62052-11:2003
Degree of protection	IP51
Measurement Base	Active I Reactive energy, 3 element, 4 quadrant
Network type	3phase 3 or 3 phase 4-wire
Connection type	VT and CT connected
Accuracy	kWh class 0.2
Humidity:	Reaching 90%
Altitude	Up to 1780m
Temperature range (operating)	-20 to+45 0C
Voltage measurement (Un)	3x 63.5/110 V 50Hz, 3 or 4 wire
Voltage range	0.8 Un to 1.15 Un
Voltage circuit burden	≤2 W and 10 VA
Burst test	4 Kv
Impulse voltage	6 kV, 1.2/50 μs
Current measurement	In =1 A; I <sub>max</sub> ≥ 6 A
Short circuit current	20 I <sub>max</sub> for 0.5 s

Starting current	0.001In
Current circuit burden	≤1VA
LCD	7 Measurement and 5 ID (EDIS) digits
Load profile	≥180 days -4-channel capacity at 20 minute
Dielectric strength	4 kV, 50 Hz., 1 min.

NB: The bidder should read through the document thoroughly and submit with the bid all the required test certificates, manuals and drawings, etc.

## **23 .Station auxiliary transformers**

These technical requirements shall be considered together with the specified drawings which are listed above.

### **23.1 Required Technical data**

The technical data for the station auxiliary transformers are specified in the technical data

### **23.2 Test requirements**

The test requirements for the station auxiliary transformers are specified in the schedule of technical data sheet.

### **23.3 Technical requirements**

#### **23.3.1 Magnetic core**

Cores shall be constructed from non-aging, cold-rolled, grain-oriented silicon steel sheets. Each lamination shall be insulated with high quality insulation coating. The sheets shall be clamped strongly enough to prevent displacement by short-circuit or other stresses during shipment or installation.

The magnetic circuit shall be insulated from all structural parts, and shall be capable of withstanding a test voltage to core bolts and to the frame of 2,500 V r.m.s. for one minute.

#### **23.3 .2 Cooling**

The transformers shall be provided with a self- cooled type of cooling system (as per SLD).

#### **23.3.3 Windings**

Windings shall have uniform insulation. The secondary neutral shall be brought out and shall be insulated to withstand applied voltage tests as specified.

Electrolytic copper of a high conductivity (class A, in accordance with IEC) and insulation material of high quality shall be used.

The transformers shall be supplied according to IEC insulation class I. The insulation shall be treated against attack by moulds and other tropical effects as to be 'tropical' according with DIN 40040.

The winding shall be thoroughly seasoned during manufacture by the application of axial pressure at a high temperature for such a time as will ensure that further shrinkage is unlikely to occur in service.

The windings and their connection leads shall be braced to withstand the shocks which may occur through rough handling and vibration during transport, switching and other adverse service conditions.

#### **23.3.4 Tank**

The transformer tank shall be of the upper flange type with bolted cover and shall be equipped with corrugated sheet steel type radiators incorporated with the tank or welded-on radiators.

Lifting lugs shall be provided on the cover.

Two earthing terminals of adequate size shall be provided, installed diagonally at the bottom of the transformer tank.

#### **23.3.5 Bushings**

The transformers shall be equipped with top quality, electrical grade porcelain bushings on both the primary and secondary side, in compliance with specified standard. The bushings shall be arranged on the tank cover in an upright position and must be easily exchangeable without lifting of the cover plate.

The MV bushings of all transformers shall be fitted with detachable and adjustable protective gaps (arcing horns).

#### **23.3.6 Off load tap changer**



The station auxiliary transformers shall be equipped with manually operated off-load tap-changers on the MV winding. A dial-type indicator, with numbers of the selected tap position, shall be so fitted and arranged as to be easily visible from the side of the transformer.

#### **23.3.7 Transformer oil**

The transformers shall be supplied and shipped with their initial oil filling.

The Contractor is held responsible to prove the dryness and all other properties of the oil before utilization.

#### **23.3.8 Noise level**

The transformers shall be so designed and constructed that harmful vibrations are eliminated and that minimum noise will occur at any operating conditions. The transformers shall pass a noise test according to IEC.

### **23.4 Measuring, Protection and monitoring equipment**

The transformers shall be monitored by the following devices:

Oil level indicator

Spring-loaded pressure relief device.

All aforementioned protection schemes shall trip the incoming load-break switch.

Furthermore following standard accessories shall be provided for the transformers.

1 (one) dial type thermometer for top oil temperature with radial type main and maximum pointer and 2 (two) adjustable contacts. Thermometers shall be of protection category IP54 and shall be provided with sight glasses of laminated security glass.

1 (one) marshalling box (protection class IP54) for connection of measuring and monitoring devices, equipped with cable glands for bottom entrance of multi-core cables, terminal blocks of single insertion type terminals with isolating facilities and test connectors (Phoenix or equivalent) with ten percent spare terminals.

### **23.5 Corrosion protection and painting**

Particular attention should be given to the protection of all ironwork.

All surfaces shall be thoroughly cleaned of rust, scale, grease and dirt and other foreign matter and all imperfections shall be removed by means of approved methods.

The following treatments shall be applied:

The main tank shall be spray galvanized and painted. The conservator tank and any cabinet shall be hot-dip galvanized and shall be treated externally and internally with an oil-resistant coat of paint. The external paint shall consist of 4 - 5 painting layers with a total minimum thickness of 200 micrometer.

The equipment must be so designed that any features which may encourage the formation of rust, are avoided.

### **23.6 Transportation**

The auxiliary transformers shall be completely assembled and filled with oil before transportation.

The step voltage regulators shall be transported either filled with oil or with nitrogen, according to the transportation arrangements of the Supplier, in consideration of the access road conditions.

In order to facilitate handling and shipping and avoid damages of the transformer external accessories shall be protected properly.

### **23.7 Auxiliaries**

Transformers shall be provided with:

Earthing terminals of adequate size capable of carrying the maximum possible earth fault current.

The terminals shall be positioned diagonally at a convenient location near the base of the frame wheels

drain valve and plug ridges

oil level indicator

lifting lugs

tap change switch

filler cap

rating plate

contact thermometer

### **23.8 Transformer losses**

A guarantee must be given that the transformer losses to be indicated in the Schedule of technical data are not exceeded. For the guarantee data mentioned hereinafter the tolerances in accordance with specified IEC shall apply and only if these tolerances are exceeded a penalty shall be applied as follows:

### **23.9 Losses**

If, the no-load losses of the power transformer exceed the guaranteed value, the no-load losses in excess of the tolerances will be considered and an amount of US\$ 7,180.00 for each full kW in excess will be deducted from the Contract Price.

If the load losses of the power transformer exceed the guaranteed value, the load losses in excess of the tolerances will be considered and an amount of US\$ 1,230.00 for each full kW in excess will be deducted from the Contract Price.

It is thereby understood that values of 0.5 kW and above will be rounded up to the next full kW.

### **23.10 Rejection**

The Employer shall have the right to reject any transformer if, the actual values are in excess of the guaranteed values, including the tolerances according to IEC 60076.

### **23.11 Indicating plates**

The following plates shall be mounted on the low voltage side of the transformer tank:

Rating plate as specified in IEC 60076, including also a space for the

Employer's serial number,

Diagram plate with the internal connections of the windings and the voltage ratios for each tap,

General plan of the transformer covering the locations of terminals, control devices, lifting points and valves.

Inscription shall be written in English language.

### **23.12 Marking and labeling**

All parts of the transformer shall be provided with complete labeling. The labels shall provide the operating personnel with easily understood and unmistakable information and shall be clearly legible at all times.

Terminals shall be marked in accordance with VDE 0532 or similar standard. Labels attached to transformer exposed to the weather must be in the form of enamel labels. Labels fitted in control and terminal cabinets and not exposed directly to the influence of weather may also be made of different materials. However, they must be light resistant, must not fade and must be scratch-resistant.

All labels and markings must be in English language. The labels must be secured by means of corrosion-resistant materials or a weather-resi

**Table: Technical Data for Distribution Transformer 250 kVA, 20/0.4 kV**

Manufacturer's Name		To be specified	
Type / Model		Oil-immersed	
		With oil conservator	
Installation		outdoor	
Dielectric		oil, without PCB	
Oil type		to be specified	
Rated frequency	Hz	50	
Rated power	kVA	250	
Number of phases		3	
Rated voltage:			
- High voltage side	kV	20	
- Low voltage side	kV	0.4	
Taps on HV side	%	±2x2.5%, off load	
Rated currents			
- High voltage side	A	to be specified	
- Low voltage side	A	to be specified	
Impedance voltage	%	4	
Vector group		Dyn5	
Treatment of neutral (LV side)		Solidly earthed	
Losses:			
- No-load	W	To be specified	
- Load	W	To be specified	
Insulation level HV-winding			
Lightning-impulse test voltage	kV	125	
Power-frequency test voltage	kV	50	
Insulation level LV-winding			
Lightning-impulse test voltage	kV	30	
Power-frequency test voltage	kV	10	

Resistance per phase:			
- HV winding	$\Omega$	to be specified	
- LV winding	$\Omega$	to be specified	
Sound pressure level	dB(A)	52	
Max. temperature rise at 45° C ambient temperature and at full load:			
- Winding	°C	to be specified	
- Iron core	°C	to be specified	
- Oil at top level	°C	to be specified	
Max. ambient temperature	°C	45	
Cooling system		ONAN	
Conductor material		Copper	
Insulating material of windings		to be specified	
Insulation class		yes	
Standard bushings			
<b>Accessories:</b>			
- Dial type contactor thermometer transformer	pcs.	1	
- Oil level indicator	pcs.	1	
- Pocket thermometer	pcs.	1	
- Grounding terminals	pcs.	2	
- Filter pipe	pcs.	1	
- Oil drain plug	pcs.	1	
- Rating plate	pcs.	1	
- Towing eye	pcs.	1	
<b>Weights:</b>			
- Total	kg	to be specified	
- Oil	kg	to be specified	
<b>Dimensions:</b>			
- Length	mm	to be specified	
- Width	mm	to be specified	
- Height	mm	to be specified	
- Distance between wheels centers	mm	to be specified	
Standard specifications		IEC 60076-7 IEC 60354	

## **24. Battery and Battery Charger.**

### **24.1 Type**

1. Batteries shall comply with IEC 60086-1. The DC Batteries shall be Lead-Acid Plant type and shall be Normal Discharge type. These shall be suitable for a long life under continuous float operations and occasional discharges. The 110 VDC system is unearthed.
2. 1.2.2. Constructional Requirements the design of battery shall be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity is not permitted. Protective transparent front covers with each module shall be provided to prevent accidental contact with live module/electrical connections.
3. 2. 1.2.3. Cell covers the cell covers shall be made of suitable material compatible with the container material and permanently fixed with the container. It shall be capable to withstand internal pressure without bulging or cracking. It shall also be fire retardant. Fixing of Pressure Regulation Valve & terminal posts in the cover shall be such that the seepage of electrolyte, gas escapes and entry of electro-static spark are prevented.
4. 3. 1.2.4. Separators the separators used in manufacturing of battery cells, shall be of glass mat or synthetic material having high acid absorption capability, resistant to Sulphur acid and good insulating properties. The design of separators shall ensure that there is no misalignment during normal operation and handling.
5. 4. 1.2.5. Terminal Posts both the +ve and –ve terminals of the cells shall be capable of proper termination and shall ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolt hole shall be coated with an acid resistant and corrosion retarding material. Terminal posts or any other metal part which is in contact with the electrolyte shall be made of the same alloy as that of the plates or of 22 a proven material that does not have any harmful effect on cell performance. Both +ve and –ve posts shall be clearly and unambiguously identifiable. 5. 1.2.6. Flame Arrestors each cell shall be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge. Material of the flame arrestor shall not affect the performance of the cell. 6. 1.2.8. Capacity Requirements When the battery is discharged at 10 hour rate, it shall deliver 80% of C (rated capacity, corrected at 27° Celsius) before any

of the cells in the battery bank reaches 1.85V/cell. The battery shall be capable of being recharged from the fully exhausted condition (1.75V/cell) within 10 hrs. up to 90% state of charge. All the cells in a battery shall be designed for continuous float operation at the specified float voltage throughout the life. The capacity (corrected at 27°Celsius) shall also not be less than C and not more than 120% of C before any cell in the battery bank reaches 1.75V/cell. The battery voltage shall not be less than the following values, when a fully charged battery is put to discharge at C/10 rate: (a) After Six minutes of discharge : 1.98V/cell (b) After Six hours of discharge : 1.92V/cell (c) After 8 hours of discharge : 1.85V/cell (d) After 10 hours of discharge : 1.75V/cell Loss in capacity during storage at an average ambient temperature of 35° Celsius for a period of 6 months shall not be more than 60% and the cell/battery shall achieve 85% of its rated capacity within 3 charge/discharge cycles and full rated capacity within 5 cycles, after the storage period of 6 months. Voltage of each cell in the battery set shall be within 0.05V of the average voltage throughout the storage period. Ampere-hour efficiency shall be better than 90% and watt-hour efficiency shall be better than 80%.

23 7. 1.2.9. Expected Battery Life The battery shall be capable of giving 1200 or more charge/discharge cycles at 80% Depth of discharge (DOD) at an average temperature of 27° Celsius. DOD (Depth of Discharge) is defined as the ratio of the quantity of electricity (in Ampere-hour) removed from a cell or battery on discharge to its rated capacity. The battery sets shall have a minimum expected life of 20 years at float operation.

8. 1.2.10 Routine Maintenance of Battery system for routine maintenance of battery system, the contractor shall supply 1 set of following tools: a) Torque wrench. b) Cell test voltmeter (-3-0-+3) volts with least count of 0.01 Volt.

9. 1.2.11. Type Test of Battery 1. Contractor shall submit type test reports of following tests as per IEC 60896-21 & IEC 60896- 22, 2004. The type test reports shall be submitted in accordance with the requirements stipulated in clause no. 9.2 of Technical Specification, Section: GTR except that the requirement of tests having been conducted within last five years as mentioned therein shall not be applicable.

Sr. No.	Description of test
1.	Gas emission
2.	High current tolerance
3.	Short circuit current and D.C internal resistance
4.	Protection against internal ignition from external spark sources
5.	Protection against ground short propensity
6.	Content & durability of required markings
7.	Material identification
8.	Valve operation
9.	Flammability rating of materials
10.	Inter cell connector



performance 11. Discharge Capacity 24 12. Charge retention during storage 13. Float service with daily discharges for reliable mains power 14. Recharge behavior 15. Service life at an operating temperature of 400 C for brief duration exposure time. 16. Impact of a stress temperature of 600 C for brief duration exposure time with 3 h rate discharge test. 17. Abusive over-discharge 18. Thermal runaway sensitivity 19. Low temperature sensitivity 20. Dimensional sensitivity at elevated internal pressure and temperature 21. Stability against mechanical abuse of units during installation Tests shall be conducted in accordance with IEC 60896-21 & IEC 60896-22, 2004 2. List of Factory & Site Tests for Battery S. No. Test Factory Tests Site Tests 1. Physical Verification ✓ 2. C/10 Capacity test on the cell ✓ 3. 8 Hrs. Charge and 15 minutes discharge test rated load at full ✓ 25 Item No. Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation. Schedule of Technical Data Unit Required Offered Data

6. 1.2.24 110 VDC Batteries Applicable standard IEC 60086-1 Manufacturer To be Specified Type lead acid sealed Voltage per cell VDC To be Specified Number of cells # To be Specified Nominal voltage of the battery VDC To be Specified Installed on wooden rack yes Capacity AH 200 Set of maintenance tools yes Dimensions of the battery rack To be Specified Length x width x height mm To be Specified Weight of the battery kg To be Specified Test requirements To be indicated by the Bidder 26 8. 1.3. Battery Charger the battery chargers shall comply with IEC 60146. The DC system for 110 VDC is unearthed. The Battery Chargers as well as their automatic regulators shall be of static type All battery chargers shall be capable of continuous operation at the respective rated load in float charging mode, i.e. float charging the associated Lead-Acid Batteries at 2.13 to 2.27 Volts per cell while supplying the DC load. The chargers shall also be capable of Boost charging the associated DC Battery at 2.28 to 2.32 volts per cell at the desired rate. Charger shall regulate the float/boost voltage in case of prescribed temperature rise of battery as per manufacturer's recommendation to avoid thermal runaway. Necessary temperature sensors shall be provided in mid location of battery banks and facility shall be provided for wirings up to the respective charger for feedback control. The manufacturer shall demonstrate this feature during testing of each charger.
7. 1. All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the

mode of output voltage/current control, whether automatic or manual. When on automatic control mode during Float charging, the Charger output voltage shall remain within +1% of the set value, for AC input voltage variation of +10%, frequency variation of +5%, a combined voltage and frequency variation of +10%, and a DC load variation from zero to full load.

8. 2. All battery chargers shall have constant voltage characteristics throughout the range (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.
9. 3. All chargers shall have load limiters having drooping characteristic, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the Load limiter setting of the Charger. The Load-limiter characteristics shall be such that any sustained overload or short circuit in DC System shall not damage the Charger, nor shall it cause blowing of any of the Charger fuses. The Charger shall not trip on overload or external short circuit.
10. 4. Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire float charging output range specified. Step less adjustments of the Load-limiter setting shall also be possible from 80% to 100% of the rated output current for charging mode.
11. 5. During Boost Charging, the Battery Charger shall operate on constant current mode (when 27 automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode.
12. 6. The Charger output voltage shall automatically go on rising, when it is operating on Boost mode, as the Battery charges up. For limiting the output voltage of the Charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for Boost Charging mode.
13. 7. The Charger manufacturer may offer an arrangement in which the voltage setting device for Float charging mode is also used as output voltage limit setting device for Boost

charging mode and the Load-limiter of Float charging mode is used as current setting device in boost charging mode.

14. 8. Suitable filter circuits shall be provided in all the chargers to limit the ripple content (Peak to Peak) in the output voltage to 1%, irrespective of the DC load level, when they are not connected to a Battery.
15. 1. 1.3.1. MCCB All Battery Chargers shall have 2 Nos. MCCBs on the input side to receive cables from two sources. Mechanical interlock should be provided such that only one shall be closed at a time. It shall be of P2 duty and suitable for continuous duty. MCCB's should have auxiliary contacts for annunciation.
16. 2. 1.3.2. Rectifier Transformer The rectifier transformer shall be continuously rated, dry air cooled (A.N) and of class F insulation type. The rating of the rectifier transformer shall have 10% overload capacity.
17. 3. 1.3.3. Rectifier Assembly The rectifier assembly shall be fully/half-controlled bridge type and shall be designed to meet the duty as required by the respective Charger. The rectifier shall be provided with heat sink having their own heat dissipation arrangements with natural air-cooling. Necessary surge protection devices and rectifier type fast acting HRC fuses shall be provided in each arm of the rectifier connections. 28 4. 1.3.4. Instruments One AC voltmeter and one AC ammeter along with selector switches shall be provided for all chargers. One DC voltmeter and DC ammeter (with shunt) shall be provided for all Chargers. The instruments shall be flush type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. The instruments shall be of 1.5 accuracy classes. In addition to the above a center zero voltmeter with selector switch shall also be provided for 220 V chargers for testing purpose.
18. 5. 1.3.5. Air Break Switches One DC output switch shall be provided in all chargers. They shall be air break type suitable for 500 volts AC/ 110 DC. The contacts of the switches shall open and close with a snap action. The operating handle of the switch shall be fully insulated from circuit. 'ON' and 'OFF' position on the switch shall be clearly indicated. Rating of switches shall be suitable for their continuous load. Alternatively, MCCB's of suitable ratings shall also acceptable in place of Air Break Switch.

19. 6. 1.3.6. Fuses All fuses shall be HRC Link type. Fuses shall be mounted on fuse carriers which are in turn mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type base. In such case one insulated fuse pulling handle shall be supplied for each charger. The Bidder depending on the circuit requirement shall choose fuse rating. All fuses in the chargers shall be monitored. Fuse failure annunciation shall be provided on the failure of any fuse. .
20. 7. 1.3.7. Blocking Diode Blocking diode shall be provided in the positive pole of the output circuit of each charger to prevent current flow from the DC Battery into the Charger.
21. 8. 1.3.8. Annunciation System Audio-visual indications through bright LEDs shall be provided in all Chargers for the following abnormalities: a) AC power failure b) Rectifier/chargers fuse blown. c) Over voltage across the battery when boost charging. d) Abnormal voltage (High/Low) e) any other annunciation if required. Potential free NO Contacts of above abnormal conditions shall also be provided for common remote indication "CHARGER TROUBLE" in Owner's Control Board. Indication for 29 charger in float mode and boost mode through indication lamps shall be provided for chargers. A potential free contact for float/boost mode shall be provided for external interlocks.
22. 9. 1.3.9. Name Plates and Marking The name plates shall be white with black engraved letters. On top of each Charger, on front as well as rear sides, larger and bold name plates shall be provided to identify the Charger. Name plates with full and clear inscriptions shall also be provided on and inside of the panels for identification of the various equipment's and ease of operation and maintenance.
23. 10. 1.3.10. Charger Construction the Chargers shall be indoor, floor-mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Chargers shall be fabricated from 2.0mm cold rolled sheet steel and shall have folded type of construction. Removable gland plates for all cables and lugs for power cables shall be supplied by the Contractor. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be suitable for lugs and drilling of gland plates. The Charger shall be tropicalized and vermin proof. Ventilation louvers, if provided shall be backed with screens. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers shall have hinged double leaf doors

provided on front and on backside for adequate access to the Charger's internals. All the charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42 as per relevant international standard 1. All indicating instruments, control switches and indicating lamps shall be mounted on the front side of the Charger. 2. Each Charger shall be furnished completely wired up to power cable lugs and terminal blocks and ready for external connections. The control wiring shall be carried out with PVC insulated, 1.5 sq. mm. Stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5 sq. mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 20% spare terminals shall be provided for control circuits.

24. 3. The insulation of all circuits, except the low voltage electronic circuits shall withstand test voltage of 2 KV AC for one minute. An air clearance of at least ten (10) mm shall be maintained throughout for such circuits, right up to the terminal lugs. Whenever this clearance is not available, the live parts shall be insulated or shrouded.

25. 30 11. 1.3.11. Painting all sheet steel work shall be pre-treated, in tanks, in accordance with relevant international standard. Alkaline cleaning shall do degreasing. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be 'Class-C' as specified in relevant international standard. Welding shall not be done after phosphating. The phosphating surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint as per relevant international standard shall be applied, unless required otherwise by the Owner. The inside of the chargers shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly staved. The paint thickness shall not be less than fifty (50) microns.

26. 12. 1.3.12. TESTS 1. The Contractor shall present for inspection, the type and routine test certificates for the following components whenever required by the OWNER. (i) Switches. (ii) Relays/MCCBs. (iii) Instruments. (iv) DC fuses. (v) SCR. (vi) Diodes. (vii) Condensers. (viii) Potentiometers. (ix) Semiconductor (x) Annunciator. (xi) Control wiring

Push buttons and contactors. Makes of above equipment shall be subject to Owner's approval. 31 Item No. Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation. Schedule of Technical Data Unit Required Offered Data 1.2.20 110 VDC Battery chargers Applicable standard IEC 60146 Manufacturer To be Specified Type indoor Type of controls thyristor control Type of cooling Self ventilating Rated voltage primary V 400 Rated voltage secondary DCV 110+/-20% Rated current A As Per Design Rated capacity kVA As Per Design IP protection IP 43 Mounted in metal cabinet yes Charging characteristics To be Specified Constant voltage range V To be Specified Continuous charging voltage per cell and tolerances V +/- To be Specified Mode of operation To be Specified Noise level d(B)A To be Specified Main dimensions Height x Width x depth mm To be Specified Weight kg To be Specified Test requirements To be indicated by the Bidder 32 9. AC Panel 1. 1.2.1 0.4 kV switchgear the 0.4 kV switchgear shall comply with IEC 61439-1 and 2 (2009). The switchgear shall be designed and manufactured as a test verified assembly. The 0.4 kV indoor switchgear shall be provided in metal-clad and compartment design with fix mounted units. In the individual switch units the necessary instruments, control switches and switch drives are to be fitted on the front panel. The 0.4 kV distributions will be fed from the LV system of the auxiliary supply. The complete installation shall be designed for continuous operation at 50°C Ambient temperature. The Contractor must ensure that, after handing-over of the plant, a minimum of 5% of fully equipped reserve capacity is available in the switchgear installation.

27. 2. 1.2.2 Switchgear minimum requirements The switchgear must consist of the following as a minimum requirement: Switchgear cabinets, metal-clad and partitioned; Single busbar system with the necessary current transformers; Busbar earthing pins, including earthing fittings; Compartments for bus bars, breaking units and cable connections, each separately partitioned; Fire bulkheads below switchgear cabinets; Numerical protection relays shall use with the incoming circuit breaker, for monitoring the circuit breaker, position indicators, warning and control devices, mimic diagram, complete terminal strips shall be installed; For different consumers MCB's with auxiliary contacts shall be used in Order to enable signaling in case of MCB failure. 33 A heating system for each cabinet which must be controlled by temperature and humidity; All CB's, isolators, MCB's with minimum spare auxiliary contacts: 2 "on" and 2 "off". 3. 1.2.3 Basic equipment The 0.4 kV switchgear

shall incorporate the following basic equipment: Circuit breaker unit for in feed; The necessary outgoing MCB, thermal trips, control voltage, instrument transformers, measuring instruments, etc. The necessary current transformers; Relay recess with protection and monitoring relays, complete terminal strips, meters, etc.; In the partitioned cable connection cabinet, the necessary cable connection fittings protected against accidental contact, including the Necessary attachment components for the cable end fittings; One 230 V/10 A single-phase three-pin convenience outlet; Ventilation slots.

4. 1.2.4 Mimic diagram the mimic diagram must contain the following as a minimum requirement: Auxiliary transformer symbol or connection to power plant installation; 0.4 kV circuit breaker position indicator and the necessary actuating components; 0.4 kV busbar. All circuit breakers shall be designed for local control with the necessary control and position indicating contacts. The switchgear cabinet is to be installed with the rear side to the wall and a sufficiently large gangway must be provided at the front for operating purposes.

28. 5. 1.2.5 Current transformers Accuracy for measurement class 1.5 M 5 34 Accuracy for protection class 10P10 Transformers with cast-resin insulation are to be used. The current transformers must withstand dynamic and thermal short-circuit stresses. Intermediate transformers are to be avoided. Separate cores are to be provided for protection and measurement. Three single-phase current transformers shall be provided in the in feed.

29. 6. 1.2.6 Terminals and cabling

30. 7. 1.2.6.1 Connection terminal for outgoing to motors and consumers circuits For motors and consumers with the following outputs, suitable connection terminals are to be provided: Terminals at the contactor tee-off for motors and consumers up to 5.5 kW Must be suitable for cable cross-sections of 4 mm<sup>2</sup> Ditto, for motors and consumers from 7.5 - 11.0 kW = 10 mm<sup>2</sup>

31. 8. 1.2.6.2 Cabling and wiring inside the switchgear cabinets Plug connections are to be provided for all auxiliary contacts. Plug contacts are to be so allocated that the circuit breakers are universally interchangeable without altering the wiring. The following cable connections must be possible as a minimum requirement: For control and annunciation circuits 2.5 mm<sup>2</sup> for instrument transformer circuits 4 x 4 mm<sup>2</sup> the individual instrument

transformer secondary circuits must be wired to the circuit breaker cubicle terminal strip. In the case of current transformers the necessary terminals must be fitted with shortcircuit bridges. If the voltage is used for various purposes (e.g. measurement, metering), separate MCB's with auxiliary contacts shall be provided. Tripping of the MCB's shall be indicated in the control room by a group signal 35

32. 9. 1.2.7 Auxiliary relays and measuring instruments In the case of measuring instruments, only square shapes may be used. All incoming feeders fitted with circuit breakers are to be equipped with a triple moving iron ammeter and with single voltmeter with four-way change-over switch for measurements between phases and phase to neutral.

33. 10. 1.2.8 Control The circuit breaker operation will be by commands given at the front panel of the distributor by "on off" buttons covered in normal operation.

34. 11. 1.2.9 signaling all signaling, monitoring and other contacts must be wired to the associated terminal strip of the switch unit and are to be processed by the Contractor in the control system used. Each 0.4 kV circuit breaker shall be equipped with three indicator lamps or position indicators to show the following switching conditions, which shall be indicated on the cubicle and in the control system. Circuit breaker "off"-open position; Circuit breaker "off"-due to fault; Circuit breaker "on"-operating position. For MCBs a summary alarm shall be shown on the cubicle and in the control system. 12. 1.2.11 Technical data the technical data for the switchgear are specified in Technical Data in Below Sheet.

35. 13. 1.2.12 Test requirements Test requirements have been specified as per compliance to Technical Data Sheet.

36. 14. 1.2.13 Proof of compliance The Bidders shall submit the schedule of technical data duly filled in. Instruction manuals for the distribution facility shall be supplied with the bid. 36 Item No. Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation. Schedule of Technical Data Unit Required Offered Data 1.2.11 0.4 kV switchgear Applicable standard IEC 61439-1 and 2 Assembly Manufacturer To be Specified Type of switchgear - Indoor Number of phases # 3 Number of bus bars # 1 Nominal voltage kV 0.4 Rated voltage kV 1 Rated frequency Hz 50 Rated power frequency withstand voltage kV r.m.s To be Specified Rated lightning impulse withstand voltage (1.2/50  $\mu$ s) kV peak To be Specified



Rated short-time current, 3s kA 10 Rated peak withstand current kA 25 Rated current for busbar A 300 Rated current for distribution feeders A 300 Type of drive - spring, wound-up by electric motor or manual Power supply for drive V 110 DC Power supply for auxiliary contacts V 110 DC Power supply for heaters VAC 230 Current transformer Rated primary current A 300 Rated primary current A 300 Secondary currents A 1 Number of secondary windings # 2 Accuracy class 1.5M5/10P 10 37 Dimensions of the individual panels L x W x H mm To be Specified Weight of the panels kg To be Specified 1.2.12 Test Requirements Standard applied IEC 61439-1,2 Verifying tests Strength of material and parts according to Clause 10.2 yes Verification of the degree protection of the enclosure according to Clause 10.3 yes Verification of creepage distances according to Clause 10.4 yes Effective continuity between parts and PE according to Clause 10.5.2 yes Effectiveness of the assembly for external faults according to Clause 10.5.3 yes Power frequency withstand voltage test according to Clause 10.9.2 yes Impulse withstand voltage test according to Clause 10.9.3 yes Temperature rise test according to Clause 10.10 yes Short circuit withstand test according to Clause 10.11 yes Electromagnetic compatibility test according to Clause 10.12 yes Mechanical operation tests according to Clause 10.13 yes Routine verifying tests Dielectric tests on main circuit yes Tests on auxiliary and control circuits yes Design and visual check yes Mechanical operations tests yes 38 10. DC Panel

37. 1. 1.2.15 DC distribution cubicles The DC distribution cubicles shall comply with IEC 61439-1 2 (2004-04). The DC cubicles shall be designed and manufactured as test verified assemblies. The DC distribution cubicle and the battery chargers are to be installed in metal-clad, partitioned cabinets with fixed equipment and a single busbar system, in the substation control building. The necessary instruments and control switches are to be fitted on the front of the individual circuit breaker and equipment compartments. In the lower part of the switchgear cabinet the terminal strips and the attachment components for the cable end fittings are to be arranged. The main distribution cubicle will be fed by a lead-acid battery (100%) and one charger (1 x 100%), by means of parallel connection of the battery and battery charger to the consumers. The in feed switch is to be fitted as manually operated circuit breaker. The output switches as MCBs. The busbar is to be fitted with a voltmeter. The complete equipment, such as manual load switches, fuses, contactors, shunts and measuring instruments, are to be neatly arranged and fixed in the appropriate

switch or instrument compartment. The cable connections from the charger and batteries respectively shall be single-phase cables. The complete installation shall be designed considering the existing ambient conditions. Suitable heaters arranged in the switch cabinets must prevent any condense formation. The Contractor must ensure that after handing over, each switchgear installation still has a minimum of 5% fully equipped reserve capacity and 15% for the terminal strips of the switchgear. Considering that the 110 V DC system is an insulated network it should be equipped with an insulation control device installed in the main distribution board.

38. 2. 1.2.16 Technical data The technical data are as per the attached Technical Data in bellow Sheets.

39. 3. 1.2.17 Test requirements Test requirements shall be as per compliance to Technical Data Sheets in Bellow

40. 4. 1.2.18 Proof of compliance The Bidders shall submit with their Bid The schedule of technical data duly filled in. Instruction manuals for the distribution facility shall be supplied with the bid. Item No. Da Afghanistan Breshna Sherkat (DABS) Aqcha Substation. Schedule of Technical Data Unit Required Offered Data 1.2.16 DC distribution panels Applicable standard IEC 61439-1 and 2 Assembly Manufacturer To be Specified Type of switchgear - Indoor Number of phases # 2 Number of bus bars # 1 Nominal voltage DCV 110 Rated power frequency withstand voltage kV rms 2.5 Rated short-time current, 3s kA 6 Rated peak withstand current kA 15 Rated current for busbar A As per Design Rated current for distribution feeders A As per Design Power supply for heaters VAC 230 Insulation resistance mOhm >125 1.2.17 Test Requirements Standard applied IEC 61439-1,2 Verifying tests Strength of material and parts according to Clause 10.2 yes Verification of the degree protection of the enclosure according to Clause 10.3 yes Verification of creep age distances according to Clause 10.4 yes Effective continuity between parts and PE according to Clause 10.5.2 yes Effectiveness of the assembly for external faults according to Clause 10.5.3 yes Power frequency withstand voltage test according to Clause 10.9.2 yes Impulse withstand voltage test according to Clause 10.9.3 yes 40 Temperature rise test according to Clause 10.10 yes Short circuit withstand test according to Clause 10.11 yes Electromagnetic compatibility test according to Clause 10.12 yes Mechanical operation

tests according to Clause 10.13 yes Routine verifying tests Dielectric tests on main circuit  
yes Tests on auxiliary and control circuits yes Design and visual check yes Mechanical  
operations tests Yes .

## **25 AC DC System**

### **25.1 General**

This specification covers the design, manufacture, acceptance testing in the Contractor's workshops as well as the supply, delivery, and trial operation of the AC DC for the 220/20 kV Aqcha substation, complete in every respect and suitable for satisfactory operation.

### **25.2 Technical Requirements**

The drawing with details of the 0.4 kV distribution Drawing (XX)

XX auxiliary system shall be considered as well.

### **25.3 0.4 kV switchgear**

The 0.4 kV switchgear shall comply with IEC 61439-1 and 2 (2009). The switchgear shall be designed and manufactured as a test verified assembly.

The 0.4 kV indoor switchgear shall be provided in metal-clad and compartment design with fix-mounted units.

In the individual switch units the necessary instruments, control switches and switch drives are to be fitted on the front panel.

The 0.4 kV distributions will be fed from the LV system of the auxiliary supply.

The complete installation shall be designed for continuous operation at 50°C ambient temperature.

The Contractor must ensure that, after handing-over of the plant, a minimum of 5% of fully equipped reserve capacity is available in the switchgear installation.

### **25.4 Switchgear minimum requirements**

The switchgear must consist of the following as a minimum requirement:

- ☐ switchgear cabinets, metal-clad and partitioned;
- ☐ Single busbar system with the necessary current transformers;

- ☐ Busbar earthing pins, including earthing fittings;
- ☐ Compartments for busbars, breaking units and cable connections, each separately partitioned;
- ☐ Fire bulkheads below switchgear cabinets;
- ☐ Numerical protection relays shall use with the incoming circuit breaker, for monitoring the circuit breaker, position indicators, warning and control devices, mimic diagram, complete terminal strips shall be installed;
- ☐ for different consumers MCB's with auxiliary contacts shall be used in

Order to enable signaling in case of MCB failure.

- ☐ A heating system for each cabinet which must be controlled by temperature and humidity;
- ☐ All CB's, isolators, MCB's with minimum spare auxiliary contacts: 2 "on" and 2 "off".

## **25.5 Basic equipment**

The 0.4 kV switchgear shall incorporate the following basic equipment:

- ☐ Circuit breaker unit for infeed;
- ☐ The necessary outgoing MCB, thermal trips, control voltage, instrument transformers, measuring instruments, etc.
- ☐ the necessary current transformers;
- ☐ Relay recess with protection and monitoring relays, complete terminal strips, meters, etc.;
- ☐ in the partitioned cable connection cabinet, the necessary cable connection fittings protected against accidental contact, including the necessary attachment components for the cable end fittings;
- ☐ One 230 V/10 A single-phase three-pin convenience outlet;
- ☐ Ventilation slots.

## **25.6 Mimic diagram**

1) The mimic diagram must contain the following as a minimum requirement:

- ☐ Auxiliary transformer symbol or connection to power plant installation;
- ☐ 0.4 kV circuit breaker position indicator and the necessary actuating components;
- ☐ 0.4 kV busbar.

All circuit breakers shall be designed for local control with the necessary control and position indicating contacts.

The switchgear cabinet is to be installed with the rear side to the wall and a sufficiently large gangway must be provided at the front for operating purposes.

### **25.7 Current transformers**

- ☐ Accuracy for measurement class 1.5 M 5
- ☐ Accuracy for protection class 10P10

Transformers with cast-resin insulation are to be used. The current transformers must withstand dynamic and thermal short-circuit stresses.

- 1) Intermediate transformers are to be avoided.

Separate cores are to be provided for protection and measurement. Three single-phase current transformers shall be provided in the infeed.

### **25.8 Terminals and cabling**

#### **25.9 Connection terminal for outgoings to motors and consumers circuits**

For motors and consumers with the following outputs, suitable connection terminals are to be provided:

- ☐ Terminals at the contactor tee-off for motors and consumers up to 5.5 kW

Must be suitable for cable cross-sections of 4 mm<sup>2</sup>

- ☐ ditto, for motors and consumers from 7.5 - 11.0 kW = 10 mm<sup>2</sup>

#### **25.10 Cabling and wiring inside the switchgear cabinets**

Plug connections are to be provided for all auxiliary contacts. Plug contacts are to be so allocated that the circuit breakers are universally interchangeable without altering the wiring.

The following cable connections must be possible as a minimum requirement:

- ☐ for control and annunciation circuits 2.5 mm<sup>2</sup>
- ☐ for instrument transformer circuits 4 x 4 mm<sup>2</sup>

The individual instrument transformer secondary circuits must be wired to the circuit breaker cubicle terminal strip. In the case of current transformers the necessary terminals must be fitted with short-circuit bridges.

If the voltage is used for various purposes (e.g. measurement, metering), separate MCB's with auxiliary contacts shall be provided. Tripping of the MCB's shall be indicated in the control room by a group signal.

#### **25.11 Auxiliary relays and measuring instruments**

In the case of measuring instruments, only square shapes may be used. All incoming feeders fitted with circuit breakers are to be equipped with a triple moving iron ammeter and with single

voltmeter with four-way change-over switch for measurements between phases and phase to neutral.

### **25.12 Control**

The circuit breaker operation will be by commands given at the front panel of the distributor by "on-off" buttons covered in normal operation.

#### **25.12.1 Signaling**

All signaling, monitoring and other contacts must be wired to the associated terminal strip of the switch unit and are to be processed by the Contractor in the control system used.

Each 0.4 kV circuit breaker shall be equipped with three indicator lamps or position indicators to show the following switching conditions, which shall be indicated on the cubicle and in the control system.

- ☐ circuit breaker "off"-open position;
- ☐ Circuit breaker "off"-due to fault;
- ☐ Circuit breaker "on"-operating position.

For MCBs a summary alarm shall be shown on the cubicle and in the control system.

#### **25.12.3 Technical data**

The technical data for the switchgear are specified in Technical Data Sheets.

#### **25.12.4 Test requirements**

Test requirements have been specified as per compliance to Technical Data Sheets

#### **25.12.5 Proof of compliance**

The Bidders shall submit the schedule of technical data duly filled in. Instruction manuals for the distribution facility shall be supplied.

### **25.13.1 DC distribution cubicles**

The DC distribution cubicles shall comply with IEC 61439-1 2 (2004-04). The DC cubicles shall be designed and manufactured as test verified assemblies.

The DC distribution cubicle and the battery chargers to be installed in metal-clad, partitioned cabinets with fixed equipment and a single busbar system, in the substation control building.

The necessary instruments and control switches are to be fitted on the front of the individual circuit breaker and equipment compartments.

In the lower part of the switchgear cabinet the terminal strips and the attachment components for the cable end fittings are to be arranged.

The main distribution cubicle will be fed by a lead-acid battery (100%) and one charger (1 x 100%), by means of parallel connection of the battery and battery charger to the consumers.

The infeed switch is to be fitted as manually operated circuit breaker. The output switches as MCBs. The busbar is to be fitted with a voltmeter.

The complete equipment, such as manual load switches, fuses, contactors, shunts and measuring instruments, are to be neatly arranged and fixed in the appropriate switch or instrument compartment. The cable connections from the charger and batteries respectively shall be single-phase cables.

The complete installation shall be designed considering the existing ambient conditions.

Suitable heaters arranged in the switch cabinets must prevent any condense formation.

The Contractor must ensure that after handing over, each switchgear installation still has a minimum of 5% fully equipped reserve capacity and

15% for the terminal strips of the switchgear.

Considering that the 110 V DC system is an insulated network it should be equipped with an insulation control device installed in the main distribution board.

#### **25.13.2 Technical data**

The technical data are as per the attached Technical Data Sheets

#### **25.13.3 Test requirements**

Test requirements shall be as per compliance to Technical Data Sheets