

PART – A.1

**Technical Specification**  
**For**  
**33 kV Gas Insulated Switchgear (GIS)**  
**(ADDENDUM)**

## **TECHNICAL SPECIFICATION FOR 33kV GAS INSULATED SWITCHGEAR**

### **1.0 SCOPE :**

This specification covers the technical requirements of design, manufacture, testing at manufacturer's works, packing, forwarding of 33kV Gas Insulated Indoor switchgear complete with all accessories for trouble free and efficient performance including supply, design, manufacture, and factory production, testing, supervision of installation and commissioning of SF<sub>6</sub> gas-insulated vacuum circuit breaker switchgear and associated equipment.

### **2.0 STANDARDS:**

Switchgear	IEC 62271-200 / EN 62271-200
Switchgear	IEC 60694 / EN 60694
Behaviour in the event of internal faults	IEC 62271-200 / EN 62271-200
Three-position disconnectors and disconnectors	IEC 62271-102 / EN 62271-102
Busbar earthing switch	IEC 62271-102 / EN 62271-102
Circuit-breaker	IEC62271-100/EN 62271-100
Current transformer	IEC 60044-1 / EN 60044-1
Voltage transformer	IEC 60044-2 / EN 60044-2
Voltage detection systems	IEC 61243-5
Protection against accidental contact, foreign objects and water	IEC 60529 / EN 60529
Installation	HD 637 S1

### **3.0 DESIGN CRITERIA:**

#### **3.1 OPERATING CONDITIONS:**

Operating Conditions according to	IEC 60694 / EN 60694
Temperature of ambient air:	
Maximum value	50 °C

#### **3.2 RATED NORMAL CURRENT:**

The rated normal currents of components are stated in the Technical data and shall be valid for design ambient temperature of 50° C.

#### **3.3 INTERNAL ARC FAULT:**

Classifications to IEC 62271-200

Partition class- PM  
 Internal arc classification - AFL (Authorised person access permitted from front & lateral side) for the panels with no rear access required.

### 3.4 INSULATING GAS:

Insulating gas Type Sulphur hexafluoride (SF6)

Design pressure at 20 °C For 36 kV Class - 0.05 MPa

## 4.0 TECHNICAL DATA

### 4.1 BUS RATING:

33 kV GIS, 25 kA 3s, Single Bus Bar 800 A @ max. 50 °C to 35°C average 24h

### 4.2 REQUIRED TECHNICAL PARAMETER:

Busbar System	Single busbar
<b>Electrical Data:</b>	
Rated voltage	36 kV
Rated operating voltage	33 kV
Rated frequency [Hz]	50
Rated power-frequency withstand voltage	70 kV
Rated lightning impulse withstand voltage	170 kV
Rated short-time withstand current	25 kA
Rated short-circuit duration	3 s
Rated peak current	62.5kA
Rated operating current busbar	800 A
<b>Degree of Protection:</b>	
Main circuits	IP 65
Drives	IP 3X
Cable connection compartment	IP 3X
Low voltage cabinet	IP 4X
<b>Auxiliary Voltage:</b>	
Control	48 V DC
Motor	48 V DC
Protection system	48 V DC
Remote control	48 V DC
Socket/lighting/heating	230 V AC
<b>IAC Classification acc. to IEC 62271-200</b>	
Classification IAC	AFL

Internal arc	25 kA 1 s
<b>Dimensions:</b>	
Cubicle width max.	800mm
Cubicle depth maximum	2000 mm
Cubicle height max.	2500 mm
<b>Properties:</b>	
Pressure relief duct	Not Required
SF6 pressure control	IDIS
Voltage Indication System	IVIS
Control panel	mechanical
Mech. Operation	Closed door Operation

## 5.0 DESIGN FEATURES OF SF<sub>6</sub> GAS INSULATED SWITCHGEAR:

### 5.1 GENERAL DESCRIPTION:

The SF<sub>6</sub> insulated switchgear shall be type-tested and of pre-fabricated metal construction.

**The offered Indoor GIS shall have VCB, Three Position Disconnecting Switch and Bus Bars shall be enclosed in SF<sub>6</sub> Gas**

Single panels, each built up from a modular range of separate functional units, can be combined to produce the specified switchgear configuration.

The modular units comprise:

#### **A) Standard basic module:**

Incorporating the vacuum circuit-breaker

#### **B) Floor-pan module, flange-mounted to the lower part of the basic module, with:**

- A wide range of cable connection options, appliance couplers for outer cone-type cable connection systems
- Current transformers (toroidal type)

#### **C) Cable compartment.**

A metal-enclosed, air insulated clad compartment, with:

- Cable support for single and multiple cable installation
- Sufficient space for installation of current

Circuit-breaker and three-position switch drives are to be designed with mechanical interrogation interlocks and shall include all necessary auxiliary devices (auxiliary switches, releases etc.)

The three-position disconnecter (ON-OFF-EARTH) is to be designed with separate manual and/or motorized drives for the disconnecter and earth switch functions.

All switching device drives shall be located outside of the gas compartments, for easy access. Under normal operating conditions for indoor switchgear units in accordance with IEC 50594 and when complying with the specified number of operations, no maintenance is required.

#### 5.2 FUNCTIONAL COMPARTMENT:

- Circuit-breaker compartment – Gas insulated
- Busbar compartment – Gas insulated
- Cable connection / transformer clad compartment are to be equipped with individual pressure relief devices - Air Insulated

#### 5.3 SWITCHGEAR OPERATOR INTERFACES REQUIREMENTS:

- A standard mechanical user interface, ergonomically Positioned at a convenient height. **It must be visible directly without opening of doors etc.**
- The user interface comprises all the mechanical, panel- related interfaces and continuous interrogating interlocks.
- **All the basic mechanical ON/OFF of CB, Isolator & earth switch operation, manual spring charge of CB must be possible without opening the door to ensure the operator safety.**
- **Mechanical mimic directly linked to mechanism should be provided at the panel front door.**
- The basic switchgear unit is to be designed for suitable free-standing installation within a switch room.
- The Interlocking shall be as per IEC.

## 5.4 FUNCTIONAL INTUITIVE OPERATOR INTERFACE DESIGN

The SF6 Gas insulated switchgear shall be characterized especially by the following operating features:

- Ergonomic operability
- Logical operation
- Logical function states
- Good visual communication of the overall function and operating states
- Optimum operator guidance
- All operations can be performed optionally via a motor-operated mechanism

The mechanical control panel is located at an optimum height for operation and arranged in a recessed position on the switchgear front. Thus, the operating area is clearly visible while no control elements protrude from the switchgear front. The position of the individual elements has been selected according to their function, i.e. according to their allocation to the corresponding device functions. The elements which form part of a switching device, such as position indicators, crank ports or mechanical push buttons, are visually linked by a specific pattern and integrated in a mimic diagram. Mechanical operation is performed the same way as with the habitual operation with stationary switching devices. Separate control elements and mechanical switch position indicators are available for the following functions:

- Circuit-breaker ON - OFF
- Disconnecter ON – OFF-EARTH

### 5.5. BUSBAR / PANEL CONNECTIONS:

The gas-insulated busbar sections of the single panels shall be connected via single-pole solid-insulated connection elements which allows for easy exchange of a cubicle without SF6 works. Busbar connection to be designed in such a way that no adjacent panels must be moved or opened for exchange of a panel.

Busbar couplings between adjacent panels should be designed with a minimized quantity of electrical sealing joints.

## 5.6 GAS COMPARTMENT TECHNOLOGY:

A Temperature Compensated Gas Monitoring Device shall be provided on the offered GIS to constantly monitor the Gas Pressure inside the Gas Tank.

**By design there should be no need for gas works during the whole time on site, not even for exchanging a centre panel or extending the switchgear at later stage, e.g. no gas handling shall be necessary during the anticipated service life of the switchgear, under normal operating conditions. (The gas-filled clad compartments are to be designed to be maintenance-free and hermetically sealed pressure systems in accordance with IEC 62271-200).**

The switchgear panels shall be filled with gas and checked for leakage in the factory. For a proper recycling / emergency replacement, a gas valve in gas compartment has to be provided. In addition, the standard tools for filling the SF6 Gas also have to be provided.

**All the live parts including the VCB, Three position Disconnecter, and main busbar shall be encapsulated in stainless steel enclosure filled with SF6 gas.**

## 5.7 INSTALLATION FACILITY:

The panels are to be delivered to site as factory assembled and routine tested units. After linking the panels (or panel assemblies) by the busbar connection system and connection of the power and control cables the system should be ready for operation. No gas filling is required at site during bus bar connection & installation.

## 6.0 CIRCUIT BREAKERS:

The three-pole vacuum circuit breaker with its maintenance-free vacuum interrupters is installed horizontally in the gas compartment.

The CB shall be spring operated, motor charged, and manually released spring closing mechanism with three pole simultaneous operations. The speed of closing operation shall be independent of the hand-operating lever. The indicating device shall be **mechanical type directly linked to the mechanism & shall show the OPEN and CLOSE position of breaker visible from front of the cubicle.** The spring charging time of the motor

shall not exceed **20sec** in case of Vacuum Circuit Breaker. The “TRIP” and “CLOSE” coils shall be of reliable design and low consumption.

The Breakers shall be capable of Making & Breaking the short time current in accordance with the requirement of IEC 62271-100 and latest amendment thereof. The continuous current rating of breaker shall not be less than 630 A for outgoing feeders and incomer feeders. **Ratings are IN-Panel at 50 Deg C design ambient.**

Comprehensive interlocking system to prevent any dangerous or inadvertent operation shall be provided. Two stage gas **density** alarm and lockout system with local and remote indication shall be provided.

Emergency **mechanical trip push button on each CB shall be provided on panel front & shall be accessible.**

Spring charge indication to be provided.

The vacuum circuit-breakers are to be equipped with

- Spring-stored-energy operating mechanism with motor, auto-reclosing
- Mechanical OPEN and CLOSE buttons
- 1 closing solenoid
- 1 shunt release
- Operating cycle counter
- Auxiliary switch with at least 6NO + 6NC available
- Auxiliary switch for "spring charged" signal

The circuit-breaker has to control at least **10,000 Make-Break cycles (One operating cycle of making & Breaking) operations at rated current or 100 breaking operations at rated short-circuit** breaking current without maintenance. The mechanical life of the vacuum interrupter has to comprise at least **20,000** operating cycles.

The operating mechanism must be maintenance-free without time limit up to 10,000 operating cycles.

## **7.0 ISOLATORS AND EARTHING SWITCHES:**

Isolators or isolators combined with earthing switches (3 position switches) shall be motor operated. In cases of emergency, manual operation must be possible.



The earthing position for all 3 phases must be visible via a mechanical position indicator (MIMIC) directly connected to the drive shaft on panel front Fascia.

The mechanical operation of isolator / 3 position disconnect switch must be possible with door closed for operator safety.

## **8.0 INSTRUMENT TRANSFORMERS:**

Only Conventional inductive voltage and current transformers according to IEC 60044-1 and IEC 60044-2 or electronic current and voltage transformers to IEC 60044-7 and IEC60044-8 or a combination of both are acceptable. Current & voltage Sensors are **not** acceptable.

### **8.1 CURRENT TRANSFORMERS:**

The **current transformers** shall be toroidal-current transformers. The Current Transformers shall be located outside the Gas Compartment.

The transformer ratio, the accuracy class and the performance load to be selected to suit the application requirements.

#### **Outgoing Feeder Variant**

Toroidal type Current Transformer

CT Primary Current: 400-200 A

CT Secondary Current: 1-1A

Core 1: CI-0.2 / 15 VA,

Core 2: CI-5P20 / 15 VA.

Core3: CI-5P20 / 15 VA

#### **Incomer Feeder Variant**

Toroidal type Current Transformer

CT Primary Current: 400-200 A

CT secondary Current: 1-1-1A

Core 1: CI-0.2 / 15 VA

Core 2: CI-5P20 / 15 VA

Core 3: CI-5P20 / 15 VA

(CT burden shall be provided as per relay and metering requirement and bidder to substantiate this with suitable calculations during detail engineering with CT/ VT Burden calculation)

## 9.0 MECHANICAL SAFETY INTERLOCKING FEATURES:

Internal mechanical interlocks of the panel

- With the circuit-breaker closed, the interrogation slide is locked for the disconnecter and the earthing switch. (Restriction to the insertion of Hand Crank for Disconnecter-Earth Switch when CB is ON)
- The interrogation slide always releases one insertion opening only (disconnecter or earthing switch), or both of them are locked. (To ensure that either Disconnecter- or Earth Switch operating at a time)
- The crank for the disconnecter and earthing switches can only be removed in its appropriate end position.
- When the crank on the disconnecter or earthing switch is still in place, or when the interrogation slide is open, the following components are locked:
  - ON push button of circuit breaker
  - ON pulse is interrupted

## 10.0 PROTECTION & CONTROL SYSTEM:

Following functions shall be available in the Protection Relay  
Incomer & Outgoing Feeders

Current protection (Directional & Non-directional feeder Protection)

- \* Over current instantaneous (50)
  - \* Over current IDMT (51)
  - \* Earth fault instantaneous (50N)
  - \* Earth fault IDMT (51N)
  - \* Directional Earth fault IDMT (67)
  - \* Directional over Current IDMT (67)
  - \* Auto Reclosure – 4 Shots
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### **BUS PT (IVT)**

33kV Bus PT (IVT) shall be housed in a separate Panel and it shall be air insulated.

Voltage protection (Bus VTs shall be Part of Feeder Protection relay)

- \* Overvoltage (59)

\* Under voltage (27)

\* Frequency Relay (81 O/U)

Outgoing Feeder (Separate Relays to be provided for Trafo Differential & Over Current & Earth fault)

Differential protection (For Transformer Feeders) in addition to the above

\* Differential protection for transformer (87T)

\* Restricted earth-fault for transformer (87N)

Other protections and related functions (Part of Numerical Relay)

\* Lock-out (86)

\* Trip circuit supervision (95)

#### 12.1 COMMUNICATION PROTOCOL:

The protection relay shall have communication protocol on IEC 61850 Protocol.

### 13.0 TESTS:

**All tests shall be carried out according to relevant IEC standards.**

#### 13.1 TYPE TESTS

The metal-enclosed switchgear is to be type tested at a recognized and internationally well-reputed test laboratory. Type test certificates shall be available for verification as evidence of successful completion of type tests.

The switchgear furnished under this specification shall be fully tested and documented by certified production test reports in accordance with IEC 62271-200.

#### 13.2 ROUTINE TESTS

Tests shall be carried out according to IEC requirements. The following minimum tests apply:

- Wiring and function tests
- Equipment verification tests
- Low voltage circuit insulation test
- High voltage power frequency test

#### 13.3 FACTORY INSPECTION TESTS

Notification for factory tests along with list of proposed tests shall be submitted as required.

#### 13.4 SITE TESTS

The site tests shall include the following:

- Power frequency withstand test (at 80% of the rated power frequency withstand voltage)
- Insulation resistance
- Functional test of the fully installed and wired equipment delivered.

### BASIC Technical REQUIREMENTS OF 33KV CUBICLE GIS.

Sl. No.	Particulars	33 kV GIS (Cubicle type)
1.		
a)	Type (Model No.)	To be specified by the bidder.
b)	Standard Applicable	IEC-62271-100 / IEC-62271-200
2.	Service	Indoor
3.a	Enclosure - Tank	Stainless steel
3.b	Enclosure - Panel	CRCA
4.	Nominal System Voltage	33 kV
5.	Highest System Voltage	36 kV
6.	No. of phases and frequency	3ph. 50 Hz
7.	Busbar material	Copper
8.	Bus Color code	RYB
9.	System Earthing	Solidly earthed
10.	Circuit Breaker Rating	
10.1	Continuous Current Rating at 50 Deg C	630A
10.2	Short Circuit Rating	25 kA
10.3	Short Circuit duration	3 sec
10.4	Internal Arc Rating	25kA
10.5	Internal Arc Duration	1 sec
11.	Rated making Current	As per IEC-62271
12	Operating duty	O-0.3sec-CO-3 minutes -CO
13	Leakage rate per year in gas compartment	Less than 0.2%
12.	Busbar rating	800A
13.	Outgoing feeder rating	630A
13.	Power Frequency Withstand voltage	70 kV for 1 minute
14.	Impulse withstand voltage (1.2/50 micro sec)	170 kV
15.	Control Voltage	48 V DC
16	Spring charge motor voltage	48 V DC
17.	CT Ratio	Secondary Current 1A (Ratio during detail engineering)
18.	PT ratio -STAR/ STAR/ Open delta	(33//3) / (.11//3) / (. 11/3)
19.	Aux. Contacts	6 NO + 6 NC
20.	Termination	
20.1	Incomers	XLPE Cables as specified
20.2	Outgoings	XLPE Cables as specified
21.	Degree of protection (HV equipment)	IP – 65 for Gas Compartment

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF 33KV GIS FOR BREAKERS / PANELS**

01.	Manufacturer's Name and Country of origin	
	Manufacturing Facilities for GIS in INDIA	
	Manufacturing Location	
02.	Manufacturer's Design / type Ref	
03.	Frequency	
04.	Rated Voltage	
05.	Highest system voltage	
06.	Rated current	
07.	Short Circuit current rating with duration	
08.	Certificate or report of short circuit type test	
09.	Rated operating duty cycle	
10.	Short Circuit Breaking Current : (a) Symmetrical (b) Symmetrical at rated voltage (c) Asymmetrical at rated voltage (i) Per Phase (ii) Average (iii) D.C.Component	
11	Arcing time (at rated breaking current) in ms.	
12	Opening time	
13	Total break time in milli sec.	
	(a) At 10% rated interrupting capacity (b) At rated interrupting capacity	
14.	Make time in ms.	
15.	Dry 1 minute power frequency withstand test voltage (a) Between line terminal and Earth KV rms (b) Between terminals with breaker contacts open	
16.	1.2/50 full wave impulse withstand test voltage (a) Between line terminal and Earth KVrms (b) Between terminals with breaker contacts open KVp	
17	Control Circuit Voltage DC	
18	Power required for Closing Coil at 48 V	
19	Power required for Tripping Coil at 48V	
20	Whether Trip free or not	
21	Whether all the interlocks provided	
22	Overall dimensions	
23	Total weight of one complete Breaker	

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 33KV CURRENT TRANSFORMERS**

01.	Manufacturer's Name and country of origin	
02.	Manufacturer's design Ref / Model	
03.	Applicable Standards	
04.	Type	
05.	Rated Primary current	
06.	Rated secondary current	
07.	Rated frequency	
08.	Transformation ratios	
09	Number of cores	
10	Rated output (Core wise)	
11	Class of insulation	
12	Class of accuracy (a) For metering (b) For Protection (c) PS Class	
13	Short circuit current rating and its duration	
14	One minute power frequency dry withstand voltage	
15	1.2/50 micro sec. impulse withstand test voltage	
16	One minute power frequency withstand test voltage on secondary	
17	Instrument safety factor	
18	Type of primary winding	

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 33KV POTENTIAL TRANSFORMERS**

01.	Manufacturer's Name and country of origin	
02.	Manufacturer's design reference	
03.	Applicable Standards	
04.	Type	
05.	Ratio	
06.	Rated Primary voltage	
07.	Rated secondary voltage	
08.	Rated frequency	
09.	Class of accuracy	
10.	No. of phase and method of connection	
11.	Burden	
12.	One min. power frequency dry flash over voltage	
13.	1.2/50 micro sec. impulse withstand test voltage	
14.	Class of insulation	

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR NUMERICAL RELAYS**

01.	Manufacturer's Name and country of origin	
02.	Manufacturer's design Ref / Type	
03.	Applicable Standards	
04.	Current setting range for	
	(a) Over current relay	IDMTL Instantaneous
	(b) Earth-fault relay	IDMTL Instantaneous
	(c) Contact Rating	
05.	Details on IDMTL characteristics	
06.	Whether High Set is Transient free	
07.	Whether separate Time setting for IDMTL / Instantaneous Elements available	
08.	Whether Relay senses True RMS Current	
09.	Accuracy for different settings and limits of errors	
10.	Whether settings site selectable and HMI provided	
11.	Whether Alpha Numeric LED display	
12.	Whether Compatible for 48 V DC	
13.	Whether Compatible for 1 A CT Secondary	
14.	Whether Self diagnostic features available	
15.	Whether Communication Port RS 485 Compatible for IEC 61850	
16.	Whether Blocking characteristics available for blocking the unscrupulous tripping of Upstream Breakers	
17.	a) Whether relay test block is provided b) Type of test block with literature	
18.	Whether draw out type unit or not	
19.	Types of case	
20.	Reset time	
21.	Burden of relay	
22.	Maximum and Minimum operating ambient air temperature	



## **15.0 Technical Specifications for CT console Box**

The Box should be made out of CRCA steel duly painted having 3mm thickness suitable for outdoor type & complying with IP: 55.

The details size of the Box is as follows:

Height = 900mm

Width = 450mm

Breadth = 300mm

The CT console box having facilities of door for opening.

There shall be 3rows of disconnecting type terminal blocks of Elmex / Connect well make, each row shall have minimum 15nos TB (should continuously carry minimum 20A & dia of the stud 6mm) with end plates.

There shall be provision of earth strips inside the Box (25x3mm thickness, Copper strips).

On the top of the Box, Connopy to be provided for easy drainage of water.

**PART - C**

**TECHNICAL SPECIFICATION**

**FOR**

**LT POWER CABLES**

## TECHNICAL SPECIFICATION FOR LT POWER CABLES

### 1.0 SCOPE :

The specification covers design, manufacture, shop testing, packing and delivery of 1100 Volts grade, Aluminium conductor, XLPE insulated multi core power cables.

### 2.0 SERVICE CONDITIONS:

Please refer Chapter-E3 of Technical Specification on climatic conditions.

### 3.0 STANDARDS :

- 3.1 Unless otherwise specified elsewhere in this specification, the rating as well as testing of the LT XLPE power cables shall conform to the latest revisions available at the time of placement of order of all the relevant standards as listed in, but not limited to the following:

#### **LIST OF STANDARDS** (All amended upto date)

<b>SL.NO.</b>	<b>STANDARD NO.</b>	<b>TITLE</b>
1.	IS: 7098( Part 1 )-1988	Specification for XLPE insulated , PVC sheathed for working voltages upto and including 1100 Volts.
2.	IS : 583 1-1984	Specification for PVC insulation and sheath of electric cables.
3.	IS: 8130-1984	Specification for conductors for insulated electric cables and flexible cords.
4.	IS: 3975-1988	Specification for Mild Steel wires, formed wires and tapes for armouring of cables.
5.	IS: 10462 ( Part I ) – 1983	Fictitious calculation method for determination of dimensionS of protective covering of cables.

### 4.0 GENERAL TECHNICAL REQUIREMENTS

#### 4.1 ARMoured CABLES

1100 Volts Grade L.T. cable with stranded H2/H4 grade **aluminium conductor** , XLPE insulated , colour coded , laid up , with fillers and/or binder tape where necessary provided with extruded PVC inner sheath , single galvanized round steel wire / strip armoured and provided with PVC outer sheath . Both inner and outer sheath shall be of Type ST-2 as per IS: 5831-1984 and cable shall be conforming to IS: 7098 (Part 1) - 1988 (amended upto date) and bearing ISI mark. In case of single core cable armouring shall be of aluminium.

#### 4.2 INSULATION, INNER SHEATH AND OUTER SHEATH :

Insulation, inner sheath and outer sheath shall be applied by separate extrusion. Inner sheath shall be applied by extrusion only. Bedding of

PVC tape for inner sheath is not acceptable. Colour of outer sheath shall be black.

The quality of insulation should be good and insulation should not be deteriorated when exposed to the climatic conditions.

#### 4.3 SEQUENTIAL MARKING OF LENGTH ON CABLE

Non erasable Sequential Marking of length shall be provided by embossing on outer sheath of the cable for each meter length.

#### 4.4 CONTINUOUS A.C. CURRENT CAPACITY:

Continuous a.c. current capacity shall be as per Table given below:

Conductor sizes in <u>sq.mm.</u>	Continuous A.C. current capacity in Amps.	
	When laid direct in the ground 30 deg.C.L1	When laid in air L140 deg.C.L1
70 <u>sq.mm</u>	165	175
95 sq mm	200	224
120 sq mm	225	240
150 sq mm	255	305
185 sq mm	285	315
240 sq mm	325	385
300 sq mm	370	410
300 sq mm	370	410
400 sq mm	425	470

#### 4.5 SHORT CIRCUIT CURRENT

Short circuit current of LT XLPE cable shall be as per Table given below.

Duration of Short Circuit in sec	Area of Al. conductor	Short circuit current in kA
T	A	$I=0.094 \times A/\text{sq.rt} (t)$
1	70 <u>sq.mm</u>	6.58
1	95 <u>sq.mm</u>	8.93
1	120 <u>sq.mm</u>	11.28
1	150	14.10
1	185	17.39
1	240	22.56
1	300	28.20
1	400	37.60

## **5.0 TESTS :**

### **5.1 TYPE TESTS:**

All the type tests in accordance with IS: 7098 (Part 1) - 1988 (amended upto date) shall have been performed on cable samples drawn by Owner.

Type tests are required to be carried out from the first lot of supply on a sample of any one size of cable ordered . In case facilities of any of the type tests are not available at the works of the supplier , then such type test shall be carried out by the supplier at the independent recognized laboratory at the cost of supplier. Sample for the type test will be drawn by the purchaser's representative and the type test will be witnessed by him.

### **5.2 ROUTINE TESTS:**

All the Routine tests as per IS: 7098 (Part 1) - 1988 amended upto date shall be carried out on each and every delivery length of cable. The result should be given in test report.

The details of facility available in the manufacturer's works in this connection should be given in the bid.

### **5.3 ACCEPTANCE TESTS:**

All Acceptance tests as per IS-7098 (Part-I) 1988 as amended upto date including the optional test as per clause no 15.4 and Flammability Test as per clause No. 16.3 shall be carried out on sample taken from the delivery lot.

5.4 The following additional acceptance test should be carried out on PVC compounds used for outer sheath , as per IS: 5831 – 1984 ( amended upto date )

1 .Hot Deformation Test.

## **6.0 PACKING AND MARKING :**

6.1 a) Upto 120 sq. mm. Size :

Cables shall be supplied in continuous standard length of 500 meters with plus minus 5% (five percent) tolerance wound on non-returnable wooden drums of good quality or on non-returnable steel drums without any extra cost to the purchaser.

b) Above 120 sq.mm. size:

Cables shall be supplied in continuous standard length of 250 meters with plus minus 5% ( five percent ) tolerance wound on non returnable wooden drums of good quality or on non-returnable steel drums without any extra cost to the purchaser.

6.2 Non standard length :

5% (five percent) of the ordered quantity of respective size shall be acceptable in non-standard length which shall not be less than 100 meters in length.

6.3 The following particulars shall be properly legible embossed on the cable sheath at the intervals of not exceeding one meter throughout the length of the cable. The cables with poor and illegible embossing shall be liable for rejection.

- a) Manufactures name.
- b) Voltage grade.
- c) Year of manufacture.
- d) Name of the Owner
- e) Successive Length.
- f) Size of cable
- g) ISI mark

6.4 Packing and marking shall be as per clause No. 18 of IS 7098 ( part I)/1988 amended up to date.

6.5 Supplier should provide statistical data regarding cables of all sizes viz.-

- 1) Weight of one meter of finished product of cable of various sizes and ratings.
- 2) Weight of one meter of bare conductor used for cables of various sizes and ratings.

**PART - B**

**TECHNICAL SPECIFICATION**

**FOR**

**ACSR - ZEBRA**

## **TECHNICAL SPECIFICATION OF ACSR “ZEBRA” CONDUCTORS**

### **1.0 SCOPE :-**

This specification provides for the manufacture, testing, supply and delivery at destination of the steel cored aluminum conductors as per Appendix-I attached.

### **2.0 STANDARDS :-**

The conductors shall comply in all respects to the clauses of this specification as indicated below & with the Indian Standard Specification, International standards with latest amendments. Some of the standards are :-

i) IS 398 - Specification for Aluminium Conductors for overhead transmission purposes

IS 398, Part-II-Aluminium conductors for overhead Transmission purpose - Specification

ii) IS 1521, 1972 - Method of tensile testing of steel

iii) IS 1778 -1989 – Reel & drums for bare conductors.

iv) IEC – 1098

### **3.0 MATERIALS :-**

3.1 The material offered shall be of best quality and workmanship. The steel Cored Aluminum conductor strands will consist of hard-drawn aluminum wire manufactured from 99.5% pure electrolytic aluminum rods of E.C. Grade. The steel wire shall be made from materials produced either by the acid or basic open hearth process or by electric process. No steel wire drawn from pressmen process shall be used. The steel wire shall not contain sulphur or phosphorus exceeding 0.05 percent, and the total of sulphur and phosphorus shall not exceed 0.085 percent.

3.2 The steel wires shall be evenly and uniformly coated with zinc complying with Indian Standard 4826-1979 specification for galvanized coatings on round steel wires. The uniformity of zinc coating and the weight of coating shall be in accordance with Appendix-II. The coating on the galvanized steel wires may be applied by the hot process or the electrolytic process.

### **4.0 SIZES :-**

4.1 The size of steel-cored Aluminum Conductors shall be as given in Appendix-I.

The resistance and weights shall be in accordance with the values given in the same appendix.

### **5.0 TOLERANCES :-**

5.1 The following tolerances shall be permitted on standard diameter of aluminum wires.

Tolerance on standard diameter of aluminum wire  $\pm 1$  percent wires.

Note :- The cross-section of any wire shall not depart from circularity by more than an amount corresponding to a tolerance of



2 percent on the standard diameter.

- 5.2 A tolerance of + 2 percent shall be permitted on the standard diameter of the galvanized steel wires. The variation from the approximate weights shall not be more than plus or minus 5 percent.

**6.0 MECHANICAL PROPERTIES :-**

- 6.1 The value of the final modulus of elasticity for steel cored aluminum conductor in the average of values obtained from actual stress strain tests. The coefficient of linear expansion for steel Cored Aluminum Conductors has been calculated on the basis of coefficient of linear expansion of  $23.0 \times 10^{-6}$  per degree centigrade of aluminum and  $11.5 \times 10^{-6}$  per degree centigrade for steel and represent only the average values. These values shall however, be given by the bidder under the guaranteed technical particulars.

**7.0 SURFACE CONDITIONS:-**

The wires shall be smooth and free from inequalities, spills and splits. The surface conductor shall be free from points, sharp-edges, abrasions or other departures from smoothness or uniformity of surface contour that would increase radio interference and corona losses. When subjected to tension up to 50% of the ultimate strength of the conductor, the surface shall not depart from its cylindrical form nor any part of the component, parts or strands, move relative to each other in such a way as to get out of place and disturb the longitudinal smoothness of the conductor.

**8.0 JOINTS IN WIRES :-**

- 8.1 Aluminium wires: No joints shall be permitted in the aluminium wires in the outermost layer of the ACSR conductor. Joints in the inner layers are permitted, in addition to those made in the base rod or wire before final drawing, but no two such joints shall be less than 15 meter apart in the complete stranded conductor. Such joints shall be made by cold pressure butt-welding.

Joints are not permitted in the outermost layer of the conductor in order to ensure a smooth conductor finish and reduce radio interference levels and corona losses on the extra high voltage lines.

- 8.2 Galvanized steel wires: - There shall be no joints except those in the base rod or wire before final drawing, in steel wires forming the core of the steel-reinforced aluminum conductor.

Joints have not been permitted in the steel wires after final drawing in order to avoid reduction in the breaking strength of the conductor that may occur as a result of failure of the joints.

**9.0 STRANDING :-**

- 9.1 The wires used in construction of a stranded conductor shall before stranding, satisfy all requirements of IS-398/ (part-II)1976 with latest amendments. For steel-cored aluminum conductors the lay ratio of the different layers shall be within the limits given under Appendix-I.

- 9.2 For all, constructions, each alternate layer shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the under laying wire or wires. The final layer of wires shall have a right hand lay.

## 10.0 **PACKING AND MARKING** :-

10.1 The conductor shall be wound in non-returnable reels or drums conforming to Indian Standard 1978-1961 specification for Reels and Drums for Bare Wire, or any other authoritative standard and marked with the following :-

- |                                       |  |
|---------------------------------------|--|
| a) Trade name, if any                 | b) Contract/Award letter Number        |
| c) Name of manufacturer               | d) Name & Address of Consignee         |
| e) Drum Number                        | f) Length of conductor                 |
| g) Size of conductor                  | h) Gross Weight of drum with conductor |
| i) Weight of empty drum with lagging. | j) Net and gross of conductor.         |
|                                       | k) Arrow marking of un-winding         |

10.2 The reel shall be of such construction as to assure delivery of conductor in the field from displacement and damage and should be able to withstand all stresses due to handling and the stringing operations so that conductor surface is not dented, scratched or damaged in any way during manufacture, transport and erection. The conductor shall be properly lagged on the drums and the method of lagging to be employed may be clearly stated in the tender. It should be stocked to suit the reel and held in place by steel strapping. Lagging shall not be nailed or bolted in place.

10.3 The conductor drum should be suitable for wheel mounting. Before reeling, the card-board or other suitable material shall be secured to the drum and inside flanges of the drums. After reeling the conductor, the exposed surfaces should be wrapped with suitable soft material to prevent the conductor from dirt and grit. Any space between the drum lagging and conductor should be suitably filled with soft filler material compactly packed. The conductor drum shall be made as per the relevant IS.

## 11.0 **LENGTHS**: -

11.1 The conductor shall be supplied in the standard lengths **as below** with a permitted variation of 5%. Not less than 90% of the total quantity of the conductor shall be supplied in the standard lengths. Thus the quantity of the conductor in lengths shorter than standard ones shall not exceed 10% of the total quantity to be supplied. Further no single conductor lengths in respect of such 10% (Maximum supply) in random lengths, shall be shorter than 50% of the standard lengths.

Type of conductor

ZEBRA ACSR

Length per drum.

1.1 K.M.or as suitable

## 12.0 **TESTS AND TEST CERTIFICATES** :-

The following type tests, (& any other tests if owner decides to do), shall be conducted on the conductor at any Govt. approved laboratory or CPRI, in presence of the representatives of OPTCL, on the samples collected and sealed by the representative of OPTCL from the manufactured & offered drums of conductor at random at free of cost to OPTCL or firm may quote their test charges which will be taken in to account during bid price evaluation. If test charges will not be quoted by the firm, it will be treated as nil during bid

price evaluation & firm have to do the type tests at free of cost to OPTCL. **Also the tenderer shall furnish valid type test reports, the tests are as per the IS 398 (part-2) conducted in any govt. approved laboratory or CPRI within last 5 years, from the date of opening of the bid (Techno-commercial) document, without which their bids will not be considered for evaluation.**

- 12.1 Individual wire and finished steel cored Aluminum Conductor shall be subjected to before dispatch from the works, to the tests as per the provision of the Indian standard Specification 398 (Part-II-1976) with the latest amendments & as per the tests indicated in this specification below.
- 12.2 Samples for individual wires for test shall be taken before stranding form not less than 10 percent of the spiels in the case of aluminum wire and ten percent of the wire coils in the case of steel wires. If samples are taken after stranding, they shall be obtained by cutting 5 meters from the outer end of the finished conductor from not more than 10 percent of the finished reels.
- 12.3 The mechanical tests shall be carried out on single wires only.
- 12.4 The Tensile test shall apply to wires of all diameters forming part of steel cored aluminum conductors. If it is not possible to test the component wires before stranding the test may be made on wires taken from stranded conductors. The tensile strength of any of the wires shall not be less than the minimum values given in Appendix-II.
- 12.5 A suitable tensile testing machine shall be used the accuracy of which can easily be checked and the machine adjusted if necessary. The test sample before being placed in the machine, shall be straightened, if necessary in such a way as to cause the minimum alteration in its physical properties.

The load shall be applied gradually and rate of separation of the Jaws of the testing machine shall not be greater than 10cm/min. and less than 2.5cm/min.

### **13.0 TYPE TESTS**

#### **13.1 Wrapping Test : -**

- 13.1.1 Samples of aluminium wires shall be wrapped round a wire of its own diameter to form a close helix of eight turns. Six turns shall then be unwrapped and again clearly wrapped in the same direction as before. The wire shall not break.
- 13.1.2 Samples of steel wires shall be closely wrapped eight times round a mandrel of diameter equal to four times the wire diameter. Six turns shall then be unwrapped and again closely wrapped in the same direction as before. The wire shall not break.

#### **13.2 Galvanizing Test : -**

- 13.2.1 The uniformity of zinc coating and the weight of coating shall be as given in Appendix-II and shall be determined according to Indian Standard Specification 4826-1979 with latest amendments.
- 13.2.3 This test shall be made whenever practicable, on wires before stranding and before the specimen has been bent, straightened or tested in any other way.

#### **13.3 Ductility Test : -**

This test shall be made on galvanized steel wires only by any of the proceedings given in 13.1.1 and 13.1.2.

- 13.4 **Torsion Test** : - One specimen cut from each of the sample shall be gripped at its ends in two vices, one of which shall be free to move longitudinally during the test. A small tensile bond not exceeding 2% of the breaking load of the wire, shall be applied to the sample during testing. The specimen shall be twisted by consisting one of the vices to revolve until fracture occurs and the number of twists shall be indicated by a counter or other suitable device. The rate of twisting shall not exceed 60 rev/min.

When tested before stranding, the number of complete twists before fracture occurs shall not be less than 18 on a length equal to 100 times the diameter of the wire. The fracture shall show a smooth surface at right angles, to the axis of the wire.

When tested after stranding, the number of complete twists before fracture occurs shall be not less than 16 on a length equal to 100 times the diameter of the wire. The fracture shall show a smooth surface at right angles to the axis of the wire.

- 13.5 **Elongation Test** : - The elongation of one specimen cut from each of the samples shall be determined. The specimen shall be straightened by hand and on original gauge length of 200 mm shall be marked on the wire. A tensile load shall be applied as described in 12.5 and the elongation shall be measured after the fractured ends fitted together. If the fracture occurs outside the gauge marks, or within 25mm of either mark and the required elongation is not obtained, the test shall be disregarded and another test made. When tested before stranding, the elongation shall be not less than 4 percent. When tested after stranding, the elongation shall be not less than 3.5 percent.

- 13.6 **Surface Condition Test**

A sample of the finished conductor having a minimum recommended length of 5 meters with compression type dead end clamps compressed on both ends in such a manner as to permit the conductor to take its normal straight line shape, shall be subject to a tension of 50% of the UTS of the conductor. The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of conductor. The measured diameter at any place shall be not less than the sum of the minimum specified diameters of the individual aluminum and steel strands.

- 13.7 **Ultimate Strength (UTS) Test on Stranded Conductor**

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5 m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate up to specified 50% of UTS and held for one minute. The circles drawn shall not be distorted due to Relative movement of strands. Thereafter the load shall be increased at a steady rate to the minimum UTS specified in Appendix-I and held for one minute. The applied load shall then be increased until the failing load is reached and the value recorded.

- 13.8 **Corona Extinction Voltage Test**

One sample of conductor of 5m length shall be strung. In case of twin conductor, two samples shall be arranged with the actual sub-conductor spacing between them. This sample assembly when subjected to power frequency voltage shall have a corona extinction voltage of not less than 320

KV (rms) for 400 KV and 176 KV (rms) for 220 KV system line to ground under dry condition. There shall be no evidence of corona on any part of sample when all possible sources of corona are photographed in a darkened room. The test shall be conducted without corona control rings. The voltage shall be corrected for standard atmospheric conditions.

### 13.9 Radio Interference Voltage Test

Under the conditions as specified in 12.1 above, the conductor samples shall have a radio interference voltage level below 1500 microvolts at one MHZ when subjected to 50HZ AC voltage of 1.1 times maximum line to ground voltage under dry condition. This test may be carried out with corona control rings and arcing horns.

### 13.10 D.C. Resistance Test on Stranded Conductor

On a conductor sample of minimum 5 m length two contact clamps shall be fixed with a pre-determined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20 degree centigrade as per clause No.12.8 of IS : 398 (part V). The resistance corrected at 20 degree centigrade shall conform to the requirements of this specification.

### 13.11 Stress-Strain Test

This test is contemplated only to collect the creep data of the conductor from the supplier. A sample of conductor of minimum 10 metres length shall be suitably compressed with dead end clamps.

### 13.12 Test Set-up

- (a) The test sample shall be supported in a trough over its full length and the trough adjusted so that the conductor will not be lifted by more than 10 mm under tension. This shall be ascertained by actual measurement.
- (b) The distance between the clamp and the sleeve mouth shall be monitored with callipers during the test to ensure that, after the test, it does not change by more than 1 mm +/-0.1mm from the value before the test.
- (c) The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which lock the steel and aluminum wires together. Target plates may be used with dial gauges or displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting the conductor, lifting it and moving it from side-to-side by the maximum amounts expected during the test should introduce no more than 0.3mm error in the reading.

### 13.13 Test Loads for Complete Conductor

The loading conditions for repeated stress-strain tests for complete conductor shall be as follows:

- (a) 1 KN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then the strain gauges are to be set at zero at zero tension.

- (b) For non-continuous stress-strain data, the strain reading at 1 KN intervals at lower tensions and 5KN intervals above 30% of UTS shall be recorded.
- (c) The sample shall be reloaded to 50% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released after the hold period.
- (d) Reloading up to 70% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45, and 60 minutes and then the load shall be released.
- (e) Reloading up to 85% of UTS shall be done and hold for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes and then the load shall be released.
- (f) Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongation shall be recorded up to 90 % of UTS at the intervals described under Clause (e).

#### **13.14 Test Loads for Steel core Only.**

The loading conditions for repeated stress-strain tests for the steel core of ACSR shall be as follows :

13.14.1 The test shall consist of successive application of load applied in a manner similar to that for the complete conductor at 30%, 50%, 70% and 85% of UTS.

13.14.2 The steel core shall be loaded until the elongation at the beginning of each hold period corresponds to that obtained on the complete conductor at 30%, 50%, 70% and 85% of UTS respectively.

#### **13.15 Stress Strain Curves**

The design stress-strain curve shall be obtained by drawing a smooth curve through the 0.5 and 1 hour points at 30%, 50%, and 70% of UTS loadings. The presence of any aluminum slack that can be related to any observed extrusion entering the span from the compression dead ends shall be removed from the lower ends of the design curves. Both the laboratory and design stress-strain curves shall be submitted to the purchaser along with test results. The stress-strain data obtained during the test shall be corrected to the standard temperature i.e. 20 degree centigrade.

#### **13.16 Chemical Analysis of Zinc**

Samples taken from the Zinc ingots shall be chemically/ spectrographically analyzed. The same shall be in conformity to the requirements stated in this specification.

#### **13.17 Chemical Analysis of Aluminum and Steel**

Samples taken from the Aluminum ingots/ coils/ strands shall be chemically/ spectrographically analyzed. The same shall be in conformity to the requirements stated in this specification.

### **14.0 ROUTINE/ACCEPTANCE TESTS**

#### **14.1 Visual and Dimensional Check on Drums**

The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this specification. Drum dimensions should

confirm to **IS: 1778**.The flange diameter, traverse width, barrel diameter and flange thickness are to be as per relevant standard.

**14.2 Visual Check for Joints, Scratches etc.**

Conductor drums shall be rewound in the presence of the inspector. The inspector shall visually check for scratches, joints, etc. and that the conductor generally conforms to the requirements of this specification.

**14.3 Dimensional Check of Steel and Aluminum Strands**

The individual strands shall be dimensionally checked to ensure that they conform to the requirements of this specification.

**14.4 Check for Lay-ratios of various Layers**

The lay-ratios of various layers shall be checked to ensure that they conform to the requirements of this specification.

**14.5 Breaking load test on welded Aluminum strand & Individual wires**

Two Aluminum wires shall be welded as per the approved quality plan and shall be subjected to tensile load. The welded point of the wire shall be able to withstand the minimum breaking load of the individual strand guaranteed by the supplier.

**14.6 Ductility Test**

**14.7 wrapping test**

**14.8 Resistance test**

**14.9 Galvanising Test**

**15.0 RETEST AND REJECTION : -**

15.1 Each coil or spool selected for testing shall be tested for compliance with the requirements of Indian Standard Specification 398 (part-II) 1976 with latest amendment if any selected coil or spool not fulfills any of the test requirements, that particular coil or spool shall be withdrawn. In respect of each failure, two test pieces shall be selected from two different coils in the lot and subjected to the test under which the failure occurred. If either of the two retest pieces fails to pass that test, the lot concerned shall be rejected.

If samples are taken for test after stranding and if any selected reel fails in the retest, the manufacturer may test each and every reel and submit them for further inspection. All rejected materials shall be suitably marked and segregated.

**16.0 GUARANTEED TECHNICAL PARTICULARS: -**

The bidder shall fill in the guaranteed technical particulars in the Performa at Appendix-IV and submit the same with his tender, without which bid will not be considered.

**17.0 SAG TENSION CHARTS AND SAG TEMPLATES : -**

The contractor shall supply each six copies of sag tension charts and sag templates in respect of each type of the steel core aluminum conductor. The Contractor shall also supply sag template in celluloid which shall be subject to the approval by the purchaser and without involving any extra charges. The design data of the lines on which these conductors will be used are given in **Appendix-III**.

## APPENDIX - I

### ACSR CONDUCTOR:

### ZEBRA

1.	Size of conductor:	54/7/3.18 mm
2.	Stranding and wire diameter	
	Aluminum	54/3.18 mm
	Steel	7/3.18 mm
3.	Sectional area of Aluminum (in mm <sup>2</sup> )	428.90
4.	Approximate total mass (in Kgs/KM)	1622
5.	Calculated resistance at 20°C Max.: (in Ohms/Km.)	0.06868
6.	Calculated breaking load of: composite conductor (in KN) (U.T.S.) (Min)	130.32 KN.
7.	<u>Lay Rating</u> :-	
	Steel core	Max- 28 Min-13
	<u>Aluminium Layers</u>	
	12 Wire Layer	Max-17
	(Innermost Layer)	Min - 10
	18 Wire Layer	Max - 16
	(Lay immediately beneath outside Layer:	Min - 10
	24 wire layer (outside layer)	Max - 14 Min - 10
8.	Modulus of elasticity (in Kg / mm <sup>2</sup> ):	8158  0.7036 x 10 <sup>6</sup> Kg x CM <sup>2</sup> ( 69 GN per Sq. meter )
9.	Co-efficient of linear expansion of conductor per degree centigrade.	-----19.3 x 10 <sup>-6</sup> -----
10.	Standard area of Cross Section in Sq. mm of conductor.	484.5 mm <sup>2</sup>
11.	Diameter of complete conductor in	28.62 mm



**Solid Steel and Aluminum Wires used in Steel cored**

**Aluminum Conductors**

**ZEBRA**

	Steel	Aluminum
1. Diameter		
Standard (in mm)	3.18	3.18
Maximum (in mm)	3.24	3.21
Minimum (in mm)	3.12	3.15
2. Cross Sectional Area of nominal Diameter Wire (in mm <sup>2</sup> )	7.942	7.942
3. Weight (in Kg/KM)	61.95	21.47
4. Minimum tensile strength:As per relevant ISS		
5. Minimum breaking load before stranding (in KN)	10.43	1.29
6. Minimum breaking load: after stranding (in KN)	9.91	1.23
7. Zinc coating of steel strands Number and duration: of dips Minimum Weight of : (A s per IS-4826 –1979)	3 dips of 1min	260 Coating (in gm/ m <sup>2</sup> )
8. Maximum resistance at: strands ( in Ohms / KM)	3.626	2.974 20°C of Aluminum
9. Minim Purity of aluminum rod:	-----99.5 %-----	

**ACSR CONDUCTOR:**

**ZEBRA**

1.	Conductor	-----Steel cored Aluminum-----
	(a) Copper equivalent: mm <sup>2</sup>	
	(b) Stranding (in mm)	54/7/3.18
2.	Normal Span.	320 Meters
	Wind Span.	320 Meters
	<u>Weight Span.</u>	
	(a) Max.	500 Meters
	(b) Min.	50 Meters
3.	Wind Pressure on full project area.	52 Kgf per M <sup>2</sup>
4.	Temperature	
	(a) Minimum	5 ° C
	(b) Maximum	67 ° C
	(c) Every day	32°C
5.	Factors of safety : Minimum	
	(i) Every day temperature and no wind.	4.00
	(ii) Minimum temperature and 2/3 maximum wind :	2.00
	(iii) Every day Temperature and full wind	2.00
	This is as per Indian Electricity Rules, 1956.	
6.	Relative Humidity.	
	Maximum.	100 Percent
	Minimum.	60 Percent
7.	Isoceramic level.	100/Years
8.	Number of rainy days per year.	100 days
9.	Average rainfall per year	1150 mm. approx.
10.	Altitude.	Less than 350 Metres.

**Guaranteed Technical Particulars for 11 KV Switchgear for Containerized Sub-Station**

		To be submitted by Bidder
	Product Architecture	
	Switching technology	Vacuum
	Disconnecting technology	
	Insulating technology	
	External Environment	
	Dimensions	
	Applicable standards	
	Ingress protection	
	Rated Voltage	
	Rated Current	630Amps
	Rated Busbar Current	800Amps
	Rated PF withstand voltage	
	Rated Lightning Impulse withstand voltage	
	Rated frequency	50Hz
	SC withstand current ( Main & earth)	Max 25KA for 3 sec
	Service continuity	
	Functional units- Switch	
	Functional unit- Circuit breaker	
	Operating sequence	
	Functional Unit- Compact metering	
	Protection relay	
	Bushings	
	Cable boxes	Air insulated suitable for dry cable termination.

**Guaranteed Technical Particulars for 33 KV Gas Insulated Switchgear for  
Containerized Sub-Station**

		To be filled by the Bidder
Product Architecture		
Switching technology		Vacuum
Disconnecting technology		Vacuum and SF6 in sealed-for-life tank
Insulating technology		SF6 in a sealed tank for HV circuits
External Environment		
Dimensions		
Applicable standards		
Ingress protection		
Rated Voltage		36KV
Rated Current		630Amps
Rated Busbar Current		800Amps
Rated PF withstand voltage		62.5KV
Rated Lightning Impulse withstand voltage		170KV
Rated frequency		50Hz
SC withstand current ( Main & earth)		Max 25KA for 3 sec
Service continuity		
Functional units- Switch		
Functional unit- Circuit breaker		
Operating sequence		O-0.3 s-CO-3min-CO
Functional Unit- Compact metering		
Protection relay		
Bushings		
Cable Clamps		
Duty Class		<b>M2, C2 &amp; E2 duty class.</b>

**Outline Project Schedule under ODSSP For Lines**

SI No	Description	Months														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1	Signing of Contract Agreement	■														
2	Submission of Project Schedule by Contractor	■														
3	Approval of Project Schedule	■														
4	Mobilization Advance		■													
5	Preliminary Survey/Check Survey (Land Schedule and Profile Plotting if necessary)		■													
6	Submission and approval of Sub Vendor	■														
7	Drawing Submission	■														
8	Drawing Approval		■													
9	Submission of Inspection schedule		■													
10	Supply of Line Materials															
10.1	Poles, Joints, Cross Arms				■											
10.2	Insulators and Hardware						■									
10.3	Conductors and Accessories							■								
11	Erection Activities															
11.1	Foundation					■										
11.2	Erection of Pole with V-cross arms								■							
12	Stringing								■							
13	Couping of poles						■									

**Outline Project Schedule under ODSSP For Lines**

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
14	Statutory Inspection of Line										—————				
15	Rectification of Defects noticed during Inspection												—————		
16	Testing										—————				
17	Charging of line												—————		
18	Reconcillation of material and final handiong over												—————		

**Outline Project Schedule under ODSSP For Sub-Station**

SI No	Description	Months													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Signing of Contract Agreement with ODSSP under OPTCL.	■													
2	Submission of detail Project Schedule by Contractor	■													
3	Approval of Project Schedule		■												
4	Handing over Land to Contractor	■													
5	Mobilization Advance		■												
6	Submission and approval of Sub Vendor		■												
7	Levelling of Land		■												
8	Soil Investigation		■												
9	Submission of Drawing		■												
10	Drawing Approval		■												
11	Submission and approval of Inspection schedule		■												
12	Inspection of materials				■										
13	Despatch of materials				■										
14	Construction of Power and water Supply		■												
15	Construction of Boundary wall, Site Store, Site Office & Security shed etc.			■											
16	Control Room With Office Building				■										
17	Erection & Foundation of structure and Outdoor equipment					■									

