		For inplant power distribution panel miniature version shall be provided.
iv)	Synchronising	120 deg, 4-position (OFF/INCOMER-1/BUS selector switch SECTION/INCOMER-2),stay put type, pistol grip handle

NOTES: The above switches and any other type, if found necessary during detail engineering, shall be subject to approval of the purchaser.

l. **Push Buttons**

- Push buttons shall be oil tight, heavy duty, push to actuate type, with coloured button and inscription plate marked with its function. The colour of ON and OFF push buttons shall be RED And GREEN respectively. All RESET push buttons shall be black.
- Each push button shall have minimum 2 NO + 2 NC contacts, rated 10A at operating voltage.
- Push button shall be shrouded type except for emergency trip button which shall be mushroom type for easy identification.

m. **Lamps**

- LED lamp shall be made in accordance with InP Technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd.

n. **Operating Range**

Generally, all instruments and relays shall be suitable for operation on 1A or 5A C.T. secondary circuits and/or 110V V.T. secondary circuit.

o. **Meters**

- All indicating instruments shall be switchboard type, back-connected, suitable for flush mounting, with 240 Deg. scale, antiglare glass, and accuracy class of maximum ± 2% of

the full scale. The dials shall be made of such material as to ensure freedom from warping, fading, and discolouring during the lifetime of the instruments.

- All indicating instruments shall be enclosed in dust-tight cases suitable for tropical use.
- Meters shall be 96 mm x 96 mm (face dimensions) and shall have provision for zero-adjustment from front of the panel. For inplant power distribution panel miniature meters shall be provided.
- Meters shall be compensated for temperature errors and factory calibrated to read the primary quantities directly without using a multiplying factor.
- DC ammeters, wherever required, shall be provided with external shunt if the current exceeds 5A. The rated voltage drop for the shunts shall be 75 mV.
- The range of frequency meters shall be from 45 to 55 HZ, with 50 HZ. at the centre of the scale.
- The range of power factor meters shall be from 0.5 lag to 0.5 lead, with unity power factor being at the centre of the scale.

p. **Integrating Meters**

- Integrating meters such as Watt-hour Meters, VAR Meters, Polyvector Meters, Maximum Demand Indicating (MDI) Meters etc shall be static type, 2 element type, suitable for 3 phase, 3 wire connection, CT & VT operated. These meters shall preferably be furnished in draw-out type cases. If furnished in non-draw out cases necessary test blocks with CT - shorting and CT/VT isolation facilities shall be furnished. All watt hour meter shall be provided with pulse output for SAS/DCS interfacing.

q. **Recorders**

- Recording meters shall be switchboard type, back connected, suitable for flush mounting, and mounted on a withdrawable or

swing-down carriage for easy access. All recorders shall be furnished in dust tight casing suitable for tropical use.

- Provision shall be made for automatic shorting of C.T. leads, wherever applicable, if and when the recorders are drawn out.
- The chart drive shall be supplied from Uninterrupted Power Supply (UPS) feeder.
- Recorders shall be multi-pen/multi-point microprocessor based with chart speed adjustable in a wide range with minimum of 25 mm/hr and chart width shall not be less than 100 mm.
- Recorders shall be provided with indicating scales graduated 0-100% with a printing of actual value of primary quantity every hour (or cyclically after a programmable duration). High & low alarm contacts with programmable set points shall also be furnished.
- Recorders shall be furnished with required transducers, accessories, charts, ink and spares for six (6) months service at 25 mm/hr speed.

r. Relays

- Relays shall be furnished in rectangular /square dust tight, drawout or rugged plug in type, flash /semi flash mounting cases.
- The hardware design for protection and associated equipment shall use latest state–of–the-art technology and shall generally be integrated numerical, modular in nature. Relay shall be designed by n microprocessor with adequate self testing/monitoring/diagnostic facilities and network connectivity.
- The design of the protections shall be based on numerical techniques. All the analogue signals will be converted into digital data, using analogue-to- digital conversion circuit. The data will be processed by a microprocessor, which will perform digital signal processing and executes various protection algorithms.

The relay shall be provided with one no. Laptop-PC (latest version) for user interfaces, monitoring, testing facility etc

- The relay shall be designed to perform satisfactorily under highly noisy electrical environment. Sufficient degree of high frequency disturbance immunity and impulse voltage withstand capacity shall be built into electronic designs as stipulated in relevant standards.
- Relay characteristics shall be coordinated for proper functioning in conjunction with associated relays. The Contractor shall co-ordinate the characteristics of all relays to suit the system and equipment parameters. Relays and timers shall have appropriate setting ranges, accuracy, resetting ratio, transient over reach and other characteristics to provide required sensitivity satisfaction to the owner. Some of the relays for generator and generator transformer protection may be back-up for switchyard relays and the settings of these relays shall be properly co-ordinated with the settings of the later.
- In supplied panels numerical protection to be provided which should be IEC61850 compliant.
- The relays shall be suitable for function satisfactorily in non-AC physical environment. The numerical relays shall have continuous self-monitoring and cyclical test facilities. The internal clock of the system shall be synchronized through the GPS Time Synchronizing System.
- All protections shall be furnished compete with necessary auxiliary, supervisory, lock out, timers, interlocking, alarm, logging etc, relays. Suitably separate sets of single phase auxiliary C.T with multiple taps shall be provided with relay whenever required.
- Visual and audible alarm annunciation shall be initiated in the event of operation of protective/supervisory relay.

s. **D.C circuits shall be supervised by relays.**

- Tripping shall be done through separate potential free contacts. High speed lock out relays shall be used. No control relay, which shall trip the circuit breaker when relay is de-energized, shall be employed in the circuits.
- The relay shall have all the features as specified elsewhere in the specification.

- Required protections have been generally been indicated in Annexure for Bidder's reference.
- The numerical relays offered shall have self-diagnostic features to reduce the down time of the relay and to provide useful diagnostic information upon detection of an internal fault so as to speed up the maintenance. The necessary support documentation explaining in detail the self-diagnostic features of the numerical relays shall be furnished for the purchaser's use.

t. **Energy Metering**

- Metering of energy imported and exported from switchyard through individual feeder are to be provided. Accuracy class of meters and associated core/winding of instrument transformers shall have accuracy class 0.2 or better. Meters shall be microprocessor based Tri-Vector meters with provisions for interfacing with Switchyard SAS.

u. **Auxiliary Devices**

- The Contractor shall furnish, install, and wire-up all auxiliary devices such as interposing current or voltage transformers, timing/switching/lockout/auxiliary relays , synchro check relay as required for the proper functioning of the schemes offered.

v. **Annunciation System**

- Each control panel shall be provided with an annunciator window board. The annunciator boards shall be back-connected and suitable for semi-flush mounting.
- The annunciation system shall be solid state type with optical isolation for input signals.

- Each annunciator group shall be independent, complete with its own power supply, audible alarms, acknowledge-reset-test buttons and other necessary accessories.

- The annunciator shall be non-integral type with hardware box mounted separately for easy access and maintenance.
- Hooters with distinctly different tones shall be used for trip, non-trip, and ring back annunciations.
- The window size shall be same as existing control panel. The Character height shall be 5 mm.
- The annunciation system shall be suitable for operation from both NO and NC type initiating contacts.
- Minimum 10% annunciation channels and window facia shall be provided as spare on each panel, with a minimum of two (2).
- The annunciations to be provided on each control board shall be as per enclosed annexures and subject to approval of the Purchaser.

w. **Transducers**

- Current/voltage/power/frequency transducers with dual output of 4-20 mA DC shall be provided for input to SAS, Data Acquisition System (DAS), recorders etc.

5.13.7.2.4 TESTS

Each Control Board shall be completely assembled, wired, adjusted, and tested at the factory prior to shipment.

- **Routine Tests**
- The tests shall include wiring continuity tests, insulation tests before and after high voltage test, and functional tests to ensure operation of the control/protection/metering schemes and individual equipment.
- All switches, meters, relays, and other devices shall be tested and calibrated in accordance with relevant IEC/IS standards.

- Type test certificate on any equipment, if so desired by the Purchaser, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

5.13.7.2.5 DRAWINGS, DATA & MANUALS

- **To be submitted with the bid**
- General arrangement drawings of all control boards.
- Bill of material.
- Technical leaflets and catalogues on

  a) Control board

  b) Switches , lamps and indications

  c) Meters and relays

  d) Annunciator system

  e) Auxiliary devices.

  System single line diagram and metering & protection three line diagrams.

To be submitted after award of contract

- Dimensional general arrangement drawings of all Control Boards showing equipment disposition and identification.
- Foundation plan and loading diagram, clearly showing panel fixing arrangement, floor opening for cable entry, etc.
- Schedule of material and label inscriptions.
- Detail control schematics incorporating all interlocks from and to external equipment and clearly showing terminal numbering.
- Panel wiring diagrams
- System single line diagrams and metering & protection three line diagrams.
- Back of board wiring diagram showing all equipment and devices in their relative physical positions and all wiring upto the terminal blocks.

- Equipment/Device and terminals shall be identified with designations/numbers as per approved schematic and connection diagrams.
- Data Sheets and Instruction Manual for each piece of equipment.
- Relay setting calculation and recommended settings. Relay catalogues for setting calculations.
- Tenderers may note that the drawings, data and manuals listed are minimum requirements only. They shall ensure that all other necessary write-ups, curves, and information required to fully describe the equipment offered are submitted with their bids.

ANNEXURE-A

A.C./D.C. POWER SUPPLY

1.0 **System Voltages**

All systems shall be designed for satisfactory operation on the following power supply :

A.C. Supply	:	415/240V, 3/1 Phase, 50 Hz, 4/2 Wire, effectively grounded system. Fault level 50 KA rms symmetrical.
D.C. Supply	:	220V, 2 Wire, ungrounded. Fault level 25 KA. Indicative only; actual value will be decided by the Bidder and to be substantiated by calculation.

2.0 **Permissible Variation**

Equipment and accessories shall be suitable for operation over the entire range of voltage/frequency variation as listed below :-

A.C. Supply	:	Voltage 230 ± 10%
	:	Frequency 50 ± 5%
	:	Combined Volt + Freq. 10% (absolute sum)
D.C. Supply	:	Voltage 240 ± 10%

ANNEXURE-B

ANNUNCIATOR

TYPE

The annunciation system shall be manually reset type with ring back facility, suitable for operation on 220V DC ungrounded supply.

FUNCTION

The sequence of operation shall be similar to ISA-2A with fast/slow blinking as detailed below:

Field Condition	**Visual Ringback Display**	**Audible Alarm**	**Alarm**
Normal	Off	Silent	Silent
Abnormal	Fast blinking	On	Silent
Acknowledge	Steady On	Silent	Silent
Return to normal	Slow blinking	Silent	On
Reset	Off	Silent	Silent
Normal Before Acknowledge	Slow Blinking	On	On
Acknowledge	Steady On	Silent	On
Reset	Off	Silent	Silent
Test	Fast Blinking	On	On

ANNEXURE-C

LIST OF PROTECTIONS (EXISTING PROTECTION PANELS FOR TRANSFORMER ONLY WILL BE USED UNDER SAS PERVIEW)

The following are the minimum specified protection functions as required for Transformer (132/33KV), 33KV feeders. The protections shall be furnished with accessories like master trip relays, timers, auxiliary relays, interposing CTs & VTs, tripping relays etc. as required to fulfill the functional requirement of control, indication, interlock & protection.

i. INTEGRATED TRANSFORMER PROTECTION (Two sets (2 x 100%) of numerical protection)

1.	Transformer Differential protection	:	87AT-1 & 87AT-2
2.	Transformer IDMT Over current protection with high set instantaneous unit	:	50/51AT-1 & 50/51AT-2
3.	Transformer 132KV side Restricted Earth Fault protection	:	64HVREF-1 & 64HVREF-2
4.	Transformer 132KV side Impedance protection	:	21PHV-21PHV-2
5.	Transformer 132 KV side Directional over current protection	:	67PHV-1 & 67PHV-2
6.	Transformer 132KV side Directional Earth fault protection	:	67NHV-1 & 67NHV-2
7.	Transformer Neutral Over current protection	:	51GAT-1 & 51GAT-2

8.	Transformer 33KV side Grounding Transformer Restricted Earth Fault protection	:	64LVREFG-1 & 64LVREFG-2
9.	Transformer 33KV side over voltage protection	:	59NLV-1 & 59NLV-2
10.	Transformer 33KV side over current protection	:	51LV-1 & 51LV-2
11.	Transformer 33KV side Directional over current protection	:	67PLV-1 & 67PLV-2
12.	Transformer 33KV side definite time earth fault protection		50N/2LV-1 & 50N/2LV-2
13.	Transformer over flux protection	:	24AT-24AT-2

Note: The Bidder shall check the existing 132 KV busbar. Any modification is required is in the scope of bidder. The bidder shall connect the new 132 KV CT core for busbar protection to the existing 132 KV busbar protection relays. All transformer mechanical protection devices (like WTI, OTI, PRV, Bucholtz, SPR,etc.) shall be suitably interface to the numerical protection relays to make a comprehensive protection of the new transformer.

ii. PROTECTION OF 33 KV SWITCHYARD

- Bidder shall envisage the space at the existing BCU room adjacent to the 132/33 kV Transformer Yard for the installation all the required panels and other accessories. If the space is not sufficient considering the layout requirement as per NIT, Bidder has to install new Concrete room for installation of the new CR panel. This New 33KV switchyard control room for CR Panel and other required panels are under bidder scope. The new CR Panel shall be utilized to perform control, indication, metering and annunciation of all the 33KV switchyard equipment.

- A. **Line Feeder**

1. Over-current protection(IDMT + Highset with directional feature): 50/51
2. Earth fault protection : 50N/2

(Will depend on the Vector Group Selection of the Transformer.)

ALL RELAYS ARE TO BE PROVIDED WITH IEC61850 COMMUNICATION PROTOCOL.

Note: Bidder shall design the system in such a way that flow of power can be done both the way.

ANNEXURE-D

INDICATIVE LIST OF ANNUNCIATIONS TO BE INCLUDED IN SAS (EXISTING PANEL) FOR NEW 132/33 kV TRANSFORMER

I. LIST OF ANNUNCIATIONS

Transformer lockout relay (86) - Operated

Transformer lockout relay (86) - Circuit Unhealthy

Transformer H.V Back-up E/F - Operated

Transformer H.V Back-up Over current - Operated

Transformer H.V Restricted E/F - Operated

Transformer Overfluxing (trip unit) - Operated

Transformer Overfluxing (alarm unit) - Operated

Transformer Buccholz relay - Alarm

Transformer Winding Temperature - High

Transformer Oil Temperature - High

Transformer Oil level - Low

Transformer Cooler bank 1/2 oil flow - Low

Transformer Cooler bank 1/2 fan - Fail

Transformer Cooler power/control supply - Fail

Transformer trouble - Trip

Group alarm for Buccholz trip/Winding Temperature trip/Oil temperature trip/Pressure Relief Device - Trip

Transformer EHV circuit breaker - Trip

EHV Bus Tie circuit breaker - Trip

Transformer EHV circuit breaker pole-discrepancy - Operated

EHV Bus Tie circuit breaker as 12.5 MVA Transformer circuit breaker pole - discrepancy -Operated

Transformer EHV circuit breaker bus differential- Operated

EHV Bus Tie circuit breaker as Transformer circuit breaker bus differential- Operated

Transformer EHV circuit breaker LBB lockout relay - Operated

EHV Bus Tie circuit breaker as Transformer circuit breaker - LBB lockout - Operated

Transformer EHV circuit breaker SF6 gas pressure - Low

EHV Bus Tie circuit breaker as Transformer circuit breaker air pressure - Low

Transformer EHV circuit breaker air pressure - Very Low

EHV Bus Tie circuit breaker as Transformer circuit breaker air pressure - Very Low

Transformer EHV circuit breaker trip circuit - Unhealthy

EHV Bus Tie circuit breaker as Transformer circuit breaker trip circuit - Unhealthy

Transformer yard fire protection relay - Operated

ANNEXURE-E

INDICATIVE LIST OF CONTROL EQUIPMENT, LAMP INDICATION, INDICATING INSTRUMENT/METERS TO BE MOUNTED IN TRANSFORMER NEW COOLER & OLTC BACKUP CONTROL PANEL

A. **CONTROL EQUIPMENT**

1. Auto/Off/Manual Selector Switches for –
   - Transformer Cooler Fan control
   - Transformer Cooler Pump control
2. Push button for DC Supply
3. Lower/Normal/Raiser selector switch

B. **LAMP INDICATIONS**

1. Main Incoming DC Supply – 1 FAIL

2. Main Incoming DC Supply – 2 FAIL
3. Transformer Cooler Bank 1 – Scheduled fans ON
4. Transformer Cooler Bank 1 – Standby fan ON
5. Transformer Cooler Bank 2 – Scheduled fans ON
6. Transformer Cooler Bank 2 – Standby fan ON
7. Transformer OLTC supply HEALTHY
8. Transformer TAP CHANGE IN PROGRESS
9. OLTC Control Supply ON indicating lamp

C. **INDICATING INSTRUMENT/METERS**

1. Winding Temperature Indicator for Transformers
2. Ammeters for –
   - HV side of Transformer
3. Voltmeters for –
   - HV side of Transformers
4. Tap position Indicator for Transformers

5.13.7.3 TECHNICAL SPECIFICATION FOR 132 KV AND 33 KV SWITCHYARD EQUIPMENT & ACCESSORIES

5.13.7.3.1 INTENT OF SPECIFICATION

- This specification is intended to cover complete design, engineering, manufacture, assembly, testing at manufacturer's works, supply and delivery, properly packed for transportation F.O.R. site of all equipment and accessories, Steel Structures including Civil, Structural work, complete and efficient erection, testing, commissioning & putting into successful commercial operation of Extension and retrofitting, replacement, renovation etc. of 132 kV and 33 kV STPS Switchyard at Santaldih Thermal Power Station.
- The bid for all items of equipment and system covered under this specification shall be complete in all respects and any item of equipment or accessory not specifically mentioned in this specification document but considered essential for efficient and satisfactory operation of individual equipment and system as a whole shall be included in the offer.

5.13.7.3.2 SCOPE OF WORK

The scope of work under this Specification shall essentially comprise of but not limited to the following:

Sl No	Type and description of major equipment	Quantity
1	12.5 MVA, 132/ 36 kV Oil filled Transformer complete with all accessories	1 no.
2	132 kV LA	1 Set
3	Control and relay panel for 33 kV Line bay for evacuation of Solar Power from FSP	1 no.
4	33 kV 3 Ph VCB Outdoor	1 no.
5	1250 A, 33 kV Double Break Isolator	4 sets
6	33 kV LA	3 sets
7	33 kV PT	1 Set
8	Grounding transformer	1 no.
1 set consists of 3 nos.		
These are minimum requirement, however quantity may increase subject to successful completion of the project		

New 12.5 MVA, 132/33 kV transformer shall be installed at the foundation area of existing 7.5 MVA 132/33 kV transformer at Bhojudih Transformer yard inside STPS.

Bidder shall take necessary modification, strengthening of this foundation and other structure, gantry etc. based on their design before installation subject to approval of WBPDCL.

Existing 7.5 MVA, 132/33 kV transformer shall properly be dismantled and shifted to the scrap yard about 250 mtrs distance from the location of its foundation along with all scrap material.

5.13.7.3.2.1 Switchyard

A. 132 kV switchyard

a) 132 kV switchyard structures and bus work for connecting one (1) transformers and necessary 132 kV equipment such as current transformers, Gantry, Transformer foundation, Tower, Oil pit, and their support structures.

b) Existing 132 kV Bus combination of Main Bus 1, Main Bus 2 and Transfer Bus present at 132/33 kV Transformer. The present 132 kV switchyard have bus configuration with two (2) main bus and one (1) transfer bus.

c) The scope covers following major equipment. However the bidder shall consider all equipment, materials required to make the switchyard complete in all respects.

i) 132 kV Current Transformers (CTs) (if applicable).

ii) 198 kV Lightning Arresters (LAs)

iii) Bus bars, ACSR Moose conductors, insulators, clamps and Connectors, BPI

iv) Cable laying, cable race way, termination, testing and commissioning of existing Relay Panels and Bay Controllers (SAS) with all new equipment and existing upto successful handed over of the system.

v) Interfacing with existing PH-I & PH-II SCADA & SAS with new 12.5 MVA Transformer Bay.

vi) Connection of all existing Main Bus 2 and Transfer Bus with the new equipment. Bidder shall intimate prior 20 days for each Bus shut down for connectivity.

B. 33 kV switchyard

a) 33 kV switchyard cable trench, structures and bus work for connecting transformers, line feeders and provision of necessary 33 kV equipment such as circuit breakers, disconnecting switches, current transformers, potential transformers, lightning arresters etc., and their support structures.

The 33 kV switchyard shall have following bays (Refer SLD):

i) Line bays : two (01) :

- One number new Bay with all equipment: for evacuation of Power from 5 MW Floating Solar Plant.

- 01 No. new Spare Bay: equivalent open space for Bay to be kept. Bidder shall extend the existing 33 kV switchyard fencing considering this future provisions.

ii) Transformer bay : One (01)
One incoming from 132/33 kV Transformer to 33 kV Bus with new cabling.

iii) Shifting of and retrofitting of two existing 33kV feeder bays (Bhojudih-1 & Bhojudih-2) subject to availability of shut down.

b) The scope covers following major equipment. However the bidder shall consider all equipment, materials required to make the switchyard complete in all respects.

i) 33 kV VCB Circuit Breakers
ii) 33 kV Disconnecting switch with and without Earth switches
iii) 33 kV Current Transformers (CTs)
iv) 30 kV Lightning Arresters (LAs)
v) Bus bars, ACSR conductors, 36 kV grade cables, insulators, clamps and Connectors.
vi) 36 KV power cables.
vii) Earthing transformers (if applicable).

C: The hardware, materials & miscellaneous items related to 132 kV and 33KV switchyard erection shall include but not limited to the following :

i) Al. Pipe bus, ACSR Conductors (Moose) & shilding wires.

ii) Grounding rods, flats, wires.

iii) Tension Insulator String Assembly Sets.

iv) Suspension Insulator String Assembly Sets.

v) Conductor Spacers, Clamps & connectors, sag compensators.

vi) Post and Disc insulators.

vii) Lightning protection materials.

viii) Bay marshalling boxes.

ix) Junction box for CT and PT.

x) Other item if any.

Any material or accessory, which may not have been specifically mentioned but which is usual and/or necessary, shall be supplied free of cost to the Employer.

D: Miscellaneous common items related to 132 kV and 33KV switchyard shall include but not limited to the following :

a) Earth mat below ground level and earthing of equipment and transformers.

b) Illumination System like Flood Light towers/lighting masts for transformer bays, 33KV switchyard. Complete illumination of control rooms and electrical room.

c) HVAC system, for 33KV switchyard control room and Electrical Room.

d) Fencing, drains, cable trenches with covers.

e) 415 small ACDB, DCDB, MLDB with lighting transformer to cater LTAC power requirement of new switchyard area including the new 33KV switchyard control room and electrical room.

f) Gravels (150 mm thick), in which 100 mm gravel of 40 dia. and 50 mm gravel of 20 dia. shall be laid in 132 & 33 KV Switchyard respectively as required over lean concrete.

g) Fire detection and annunciation system.

h) Fire Hydrant & Fire fighting system.

Nitrogen injection fire protection system shall be considered for transformer.

Water hydrant system shall be provided for -

a) Auxiliary power supply system area

b) Extended control room building

c) Portable extinguishers shall be provided under a shade in the new switchyard area.

i) Power and control cables.

i). Furniture for Control room & Office.

k) Any material or accessory, which may not have been specifically mentioned but which is usual and/or necessary, shall be supplied free of cost to the Employer.

E. **Complete Switchyard Gantry structures**, support, platform and miscellaneous structures, switchyard fencing, trenches and complete civil works required for extension considering the following:

i) Galvanized steel structures for CB, Disconnecting switch, CT, CVT/EMVT, LA under bidder scope.

ii) Intermediate Galvanized steel gantry structures in between 132 KV Switchyard for new Transformer bays. Galvanized steel gantry structures for 33KV switchyard, incoming Gantry for 33KV lines etc.

iii) 33KV switchyard control room building.

iv) Cable trench for Power and control cables

v) Transformer foundation, Transformer Oil pits, fire wall.

vi) Bidder shall shift 33 kV Outgoing Bhojudih feeder as per SLD.

vii) Space to be kept at 33 kV extension switchyard for another two separate 33 KV bays for future use. Bidder shall submit the 33 kV Switchyard Layout showing this future space provision for approval during detail engineering. Chain link fencing, clear space, trench layout, equipment foundation earthing and lightning layout, shield wire protection etc. shall be done considering these future provisions.

Any material or accessory, which may not have been specifically mentioned but which is usual and/or necessary, shall be supplied free of cost to the Owner.

F. All relevant drawings, data and instruction manuals.

G. Mandatory Spare parts.

H. Engineering activities to be performed by contractor shall include but not limited to the following :

i) Sizing of various electrical equipment and confirmation of the rating of the various equipment specified in the project specification.

ii) Switchyard layout drawings including plan, section, direct stork

lightning protection drawing, grounding layout, control trench layout, illumination layout, etc. in interconnection with existing switchyard.

iii) Complete civil, structure and electrics for the switchyard

iv) Design calculations for switchyard foundations/structures

v) Walk way layout for operation and maintenance of switchyard equipment

vi) Shop inspection and testing procedure along with Q.A. schedule

vii) Field testing and commissioning procedure

viii) Preparation of as built drawings

5.13.7.3.3 CODES AND STANDARDS

The entire scope of work shall be carried out in accordance with stablished engineering practice and in conformity to this specification and with the relevant specifications and codes of practice of the Indian standards.

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification. In addition, work shall also conform to the requirements of the following :

IS 10118 – 1982 : Code of practice for selection installation and maintenance of switchgear and control gear – part-3 (Installation)

Central Board Irrigation & Power (CBIP – New Delhi – India) Technical Manual on layout of substation report No.3

Indian Electricity Act and rules framed there under

Gazette notification No. 502/70/CEA/DP&D, dated 17.03.2006 on the Central Electric Authority (Installation & operation of Meters) Fire insurance regulations

Any other regulations laid down by central / state / local authorities during the execution of this contract.

Major standards, which shall be followed for manufacture and testing of different equipment, are listed below. Other applicable Indian Standards for any component part, even if not covered in the listed standards shall be followed :

i) AC Circuit Breaker

a) IEC-62271-100
b) IEC-376
c) IEC-427
d) IS-2516
e) IS-4279
f) IS-7311
g) IS-335
h) IS-2099

and Indian Boiler Regulation for SF6 gas cylinders.

ii) Disconnecting switches

a) IEC-129
b) IS-1818
c) IS-2544

iii) Instrument transformers

a) IEC-185
b) IEC-189
c) IEC-186-A
d) IS-2705
e) IS-3156
f) IS-3347
g) IS-3202

iv) Lightning Arrestor

a) IEC-99 Part I and Part IA
b) IEC-30-2
c) IEC-71-2
d) IEC-7C-37-WG-4 Documents
e) IS-4004
f) IS-3070
g) IS-8263

v) Grounding Transformer

a) IEC-289
b) IS-3151
c) IS-335

vi) Insulator

a) IEC-168
b) IEC-273
c) IEC-274
d) IEC-383
e) IEC-437

vii) Disc insulator string

a) IS-3188

viii) Post insulator stack

a) IS-2544

ix) Aluminium conductor steel reinforced (A.C.S.R)

a) IS-398

x) Tension/Suspension clamp assembly

a) IS-2486

xi) Clamps and connectors

a) IS-5561

5.13.7.3.4 DESIGN CRITERIA

- The basic system connection is shown in drawing no ST-FSP-DWG-E-001: Key Single Line Diagram.
- All the equipment, material etc. to be supplied shall be new and of the best quality and shall conform to the specification given here under. All similar materials and removable parts shall be uniform and interchangeable with one another.
- Lightning arresters for Auto transformer shall be mounted on a structure placed near the respective transformer.
- System Parameters

			132KV	33KV
i)	Voltage ..... Nom./Max. ..KV	:	132/145	33/36
ii)	Frequency ... Hz ±%	:	..... 50 ± 5%	
iii)	Fault Level .... KA rms	:	31.5	25
iv)	System earthing	:	Effectively earthed.	Earthed through Grounding TR
v)	Short-time current rating (for all Current carrying parts)	:	31.5KA for 1 sec	25KA for 1 sec
vi)	Insulation Level			
	a) Basic insulation level KVP	:	1050	170
	b) Switching impulse KVP			
	Ph-E	:	1050	
	Ph-Ph	:	1575	

vii)	Power frequency withstand voltage KV rms Dry/Wet	:	460	80
viii)	Maximum radio interference voltage level at 1 MHz & 266 KV rms phase to ground voltage for HV winding (Micro volt)	:	1000	1000 --
ix)	Minimum clearances			
	a) Phase to Phase, mm	:	1550	320
	b) Phase to Earth, mm	:	1300	320
x)	Safety Clearances			
	a) Safety working clearances, mm	:	4000	3000
	b) Ground Clearance, mm:		4500	
xi)	Creepage distance mm	:	.....25 MM/KV.....	
xii)	Bay width (minimum) m	:	as per existing	6
xiii)	Phase to phase spacing mm:		4000	3000

xiv) Auxiliary Power Supply

a) A.C. System : 415 V ± 10%, 3 Ph, 4W, 50Hz, ± 5%, 50KA, effectively earthed, combined voltage & frequency variation 10%

b) D.C. System : 132V ±10% DC, 2W, 25 KA, unearthed (for control & protection)

- Bus Configuration

132KV	:	Two Main bus and Transfer bus arrangement
33KV	:	One Main bus with bus section.

- Conductor

  i) Bus Conductor-

  132KV : Twin ACSR moose conductor for overhead bay and drop connection.

  33KV : Aluminium Tubular Bus-bar.

  ii) Shield Wire : 7/9 SWG G.I.

- The type and rating of different equipment shall be as follows :

  a) The 33 kV circuit breakers shall be outdoor, VCB, electrically controlled spring / hydraulic operated, remote controlled, trip free design, complete with local control kiosk, operating mechanism with all associated auxiliaries. The circuit breaker and its accessories viz. marshalling box / junction box shall be with IP 55 degree of protection.

  The circuit breaker shall have specified current ratings and shall be capable of making and breaking the specified fault current. All current carrying parts of the circuit breaker shall be of adequately size. Arc control devices shall be capable of rapidly and effectively extinguishing the arc with negligible stresses on the enclosure. The circuit breaker shall satisfactorily interrupt transformer magnetising current, line charging current and short-line faults.

  b) All 33KV Disconnecting switches shall be horizontal break. Disconnecting switch shall be provided with A.C. electric motor operated mechanism and manually operated earth switch for earthing one set of switch terminals, where necessary. Earth switches shall be of vertical break type and shall be gang operated.

  c) The 132KV and 33KV current transformer shall be suitable for the fault MVA & BIL as mentioned earlier. These shall be hermetically sealed, oil immersed type meant for separate mounting.

  d) Gapless type of Lightning Arrestors (ZnO) shall be used for 132KV and 33KV system. The lightning arrestors shall be heavy-duty station class, gapless type.

  e) The buses shall be adequately sized for fault and continuous current requirement coordinating with existing system and fault level. The busbar fittings, connectors, etc. will be of suitable aluminium alloy having desired mechanical strength and electrical properties.

f) Extension switchyard structures shall be latticed mild steel structures, hot dip galvanized. Equipment structures shall also be of similar construction. Switchyard structures will be sized to support dead load, short circuit loadings transmitted from high voltage buses, wind load and seismic force, which may be encountered.

- Grounding

  A grounding mat has to be provided at a depth of 1000 mm (minimum) within the switchyard to provide low impedance discharge path to earth for lightning surge and fault energy of the system. To ensure safety to personnel, this has to be designed for permissible touch and step potential. All equipment, structures etc. are to be connected to this mat to ensure safety, as per the provisions of I.E. Rules. New Bay ground mat has to be laid and provision for connecting with the future mat shall be kept as per IEEE, IE Rule. This ground mat shall be interconnected to existing switchyard ground mat and power house ground mat separately in mess.

  - Mild steel rods will be used as main ground conductor and driven electrodes at intervals. This size has been fixed based on the system ground fault current carrying capability for 1 second and considering loss of size due to corrosion for a period of 30 years. Rate of corrosion at 0.3 mm per year is to be considered in design.
  - The minimum ground conductor sizes shall be as follows :

Main ground conductor for underground grounding mat	:	40 mm dia M.S. rod.
Ground Electrode	:	40 mm dia M.S. rod x 3m length.
Risers for equipment connection	:	40 mm dia M.S. rod.
Over-ground grounding grid and	:	a. 75 x 10 mm/50 x 6 mm GI flat. equipment connection b. 8 SWG GI wire

- Testing arrangements shall be provided at suitable locations.
- Shielding

  In addition to providing lightning arrestors, switchyard shall be adequately shielded using shield conductors (Spikes) fixed on different tall switchyard structures and lightning masts meant for the purpose. Where strung shield

wires cannot be avoided, such as connection to Auto transformer etc. 7/9 galvanised steel wire (11 Kg/Sq.mm quality) will be strung between Gantry supports , over the phase conductors. The complete shielding net-work will be connected to the main ground mat of the switchyard.

- The angle of protection shall be 45 deg.
- The down conductors shall be 75 x 10 mm G.I. flat minimum.
- Electrodes shall be provided at each connection point of down conductor and underground ground mat.
- Switchyard hardware
- All the ACSR conductors post and string insulators, clamps & connectors, hardwares etc. will be used in switchyard having characteristics as listed in the Annexure-A.
- All equipment, conductors, hardwares, insulators & clamps etc. will be installed outdoor in a hot, humid & tropical atmosphere.
- The maximum temperature in any part of the clamps, connectors, conductors etc. at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.
- All equipment, conductors, clamps, connectors, insulators etc. shall be capable of withstanding the dynamic & thermal stresses of maximum short circuit current without any damage or deterioration.
- In order to avoid concentration of stresses, all sharp edges of clamps, connectors etc. shall be rounded off.
- Bi-metallic connectors shall be used for any connection between dissimilar materials.
- Expansion joints shall be provided in the Aluminium tube bus system, whenever necessary, to eliminate undue stresses on the equipment terminals and post insulator stacks.
- In order to maintain the specified inter-group spacing between the sub conductors of bundle under all normal working condition, spacers shall be fitted in the bundle.

5.13.7.3.5 SPECIFIC REQUIREMENTS OF 132 KV AND 33 KV SWITCHYARD EQUIPMENT AND ACCESSORIES

A. 33KV Circuit breaker-

The circuit breakers of 36 KV Class shall be outdoor type vacuum circuit breaker.

The equipment covered by this specification shall be complete in all respects. Any material or accessory which may not have been specifically mentioned but which is usual or necessary for satisfactory and trouble-free operation shall be within the scope of supply without any extra charge to the WBPDCL.

Two nos. trip coils shall be provided for circuit breaker for 36 KV (each pole operated individually). The support structure of Circuit Breaker as well as control cabinet shall be hot dip galvanized. All other parts shall be painted as per Specification.

The quantity of each type circuit breaker to supplied and installed are as follows:-

i) One (01) set of 1250A, 33KV VCB Circuit Breakers for incoming feeders at 33KV switchyard from Solar Plants.

- The equipment will be used in 33KV system of the substation having characteristics as listed in the Annexure-A.
- The equipment will be installed outdoor in a hot, humid and tropical atmosphere.
- All equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.
- The maximum temperature in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.
- There shall be no radio interference when the equipment is operated at maximum service voltage.
- The safety clearances of all live parts of the equipment shall be as per relevant standards.
- Corona shall be reduced to the minimum as per relevant standard by using suitable devices.
- **Type and Duty**

a) The circuit breaker shall be three-pole, VCB, outdoor type, having internal isolation without any sequential interlock.

b) The circuit breaker shall be restrike free as per IEC under all duty conditions and shall be capable of performing their duties without opening resistors.

c) The duty of the circuit breaker shall involve satisfactory interruption of short circuit currents as listed in the annexure.

d) The breaker shall be suitable for operation even under condition of "phase opposition" arising out of faulty synchronization.

e) The breaker shall be capable of clearing the "Kilometric" fault of same magnitude as rated short-circuit current.

f) The breaker shall be capable of interruption of low reactive currents (lagging/leading) without undue over voltage as per IEC.

g) Breakers with multi-break interruptions shall be so designed that the voltage developed across a pole is uniformly distributed over the power breaks.

h) The circuit breaker shall be capable of :

   i) Interrupting line/cable charging current as per IEC without any restrike and without use of opening resistors.

   ii) Clearing short line fault (kilometer faults) with source impedance behind the bus equivalent to symmetrical fault current specified.

   iii) Breaking 25% of the rated fault current at twice rated voltage under phase opposition condition.

i) The breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energization of lines with trapped charges. The breaker shall withstand successfully all transient and sustained voltages under various operating condition.

This specification covers design, manufacture, assembly, testing at manufacturer's works of Vacuum Circuit Breaker of 36 KV class (Outdoor) as detailed in the enclosed Schedule, complete with accessories required for efficient and trouble free operations.

The circuit breakers offered shall be as per specific technical parameters and suitable for outdoor installation.

The circuit breakers are required complete with structures, operating mechanism, all associated accessories and auxiliaries.

- **STANDARDS**

The equipment to be furnished under this specification, shall unless and otherwise stated, be designed constructed and tested in accordance with the latest revisions of Indian Standards as follows :

IS-13118 - General requirements for circuit breakers for voltages above 1000 V

IS-9135 - Guide for testing of Circuit Breaker

IS-2099 - Bushings

IEC - 62271-100

IEC - 60694

IEC - 56

- **GENERAL INFORMATION**

The circuit breakers of 36 KV Class shall be outdoor type vacuum circuit breaker

The equipment covered by this specification shall be complete in all respects. Any material or accessory which may not have been specifically mentioned but which is usual or necessary for satisfactory and trouble-free operation shall be within the scope of supply without any extra charge to the WBPDCL.

Two nos. trip coils shall be provided for circuit breaker for 36 KV (each pole operated individually). The support structure of Circuit Breaker as well as control cabinet shall be hot dip galvanized. All other parts shall be painted as per Specification.

- **DESIGN CRITERIA**

a) The Circuit Breakers shall be used in neutral solidly ground system with symmetrical fault level of 25 KA for 3 sec at system voltage of 33KV. Earthing of 33KV system for 220/33KV transformer is under bidder scope of design as per system requirement.

b) All controls shall be suitable for 85% to 110% for closing and 70% to 110% for tripping of 220 Volts (±10%) D.C supply voltage for 33 KV &

above. The A.C. supply shall be available at 400 V (±10%), 50 c/s, 3 phase 4 wire system or 230 V (±10%), 50 c/s, 1-ph 2-wire system.

c) Radio interference voltage shall not exceed 1000 micro volt when the equipment will be operated at maximum service voltage for circuit breakers rated 132KV and above.

d) The maximum temperature attained by any part of the equipment at specified rating should not exceed the permissible limits as stipulated in relevant standards. Equipment shall be designed taking 50ºC as maximum ambient temperature.

e) The minimum safe clearance of all live parts of the equipment shall be as per relevant standards and electricity rules. Clearance of Phase to Phase low level pipe bus are as follows :

f) 33 KV : Phase to Phase (mm) 1500

g) In case of gang operated breaker of 36 KV class, the minimum clearance between poles shall not be less than 430 mm respectively and shall withstand the impulse/power frequency level as specified in our technical parameters.

h) Provision of electrical interlocks for safe and satisfactory operation of the Breaker shall be furnished. The interlocking device shall be of proven quality.

i) The breaker shall be able to function even under conditions of phase opposition that may arise due to faulty synchronisation or otherwise as per relevant IS standard or IEC Standard.

j) Breaker shall be capable of interrupting line/cable charging current as per IEC without any restriking and without use of opening resistors.

k) The breaker shall be capable of interrupting rated breaking current with recovery voltage equal to maximum line service voltage and at all indicative power factor of the circuit equal to or exceeding 0.15.

l) Breaker shall be capable of clearing short line fault without excessive rise of restriking voltage.

m) The breaker shall be suitable for interrupting low inductive currents (0.5A to 10A) as well as capacitance, without undue over voltage.

n) The Bidder may indicate in his offer the methods adopted for limiting over voltages.

o) The circuit breaker of 36KV rating shall be capable to withstand power frequency over voltage as per value specified in IEC 62271-100 or relevant IS.

p) Operating duty of all circuit breakers from voltage range 36 KV shall be as follows :

O-0.3 sec-CO-3.0 min-CO

q) The Circuit Breaker shall be re-strike free as per IEC under all duty conditions and shall be capable of performing their duties without opening resistors.

r) The Circuit Breaker shall meet the duty requirement of any type of fault or fault location also for switching when used on 33KV ungrounded system as well as non-effectively grounded but with NGR (if applicable) for 220/33KV substation and perform make and break operation as per duty cycles specified in above clause.

s) The breaker shall be capable of interrupting steady state and transient magnetizing current corresponding of power transformers.

t) If specifically mentioned in BOQ, Circuit breaker shall be provided with Control Switching device as per relevant standard.

- **CONSTRUCTIONS**

Each 36KV VCB shall comprise of three identical poles linked together electro-mechanically for simultaneous operation of pole units.

Operation counter should be provided to monitor the no. of operations.

MAIN CONTACTS AND ARC QUENCHING CHAMBER:

The tips of the main contacts shall be of suitable design and adequately silver plated to withstand arcing.

- **OPERATING MECHANISM:**

i. The operating mechanism shall be electrically controlled spring / spring operated for 36 KV class breakers. The mechanism shall have anti-pumping and trip free circuitry. The anti-pumping arrangement shall be initiated through Normally open (NO) type auxiliary contact of circuit breaker and shall be of 'self-hold' type. Type of such mechanism shall be mentioned. Local arrangement for operating the breakers both electrically and mechanically shall be provided in addition to remote electrical operation.

ii. There shall be mechanical ON/OFF indicator and number of operation counter for each pole of breaker in case of single pole operation and one mechanical ON/OFF indicator and provision for operation counter for 3 pole gang operated breaker.

iii. All three poles of circuit breaker shall operate simultaneously. Pole discrepancy feature shall be provided to trip the breaker if all the poles do not close/open simultaneously in case of single pole operation. For mechanically gang operated breaker pole discrepancy feature need not be provided.

iv. The operating mechanism box shall be fixed at a suitable man working height from ground level. View glass shall be provided on hinged door at the front. Hinged door shall be properly earthed with main body through copper flexible braided conductor. In case operating mechanism box shall not be placed at a suitable man working height, platform is to be arranged /supplied for each such breaker by the contractor. Suitable arrangement at site has to be made near each breaker to climb on the platform and work comfortably.

v. Suitable arrangement shall have to be made for easy accessibility to the operating mechanism box. All necessary arrangements are within the scope of bidder.

vi. Indication for spring charged condition shall be provided for breaker with spring charging mechanism. The spring charging mechanism shall be motor operated. After failure of power supply to the motor, one CO operation shall be possible with the energy stored in the operating mechanism.

- **SPRING OPERATED MECHANISM:**

i. Spring operating mechanism shall be complete with motor. Opening spring and closing springs with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also to be provided.

ii. As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty.

iii. Breaker operation shall be independent of the motor, which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided.

iv. Closing action of circuit breaker shall compress the opening spring ready for tripping.

v. When closing springs are discharged after closing a breaker, closing spring, shall be automatically charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.

vi. Provisions shall be kept to prevent a closing operation of the breaker when spring is in partially charged condition. Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is already in closed position.

vii. The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case of tripping energy is derived from the operating mechanism.

- **COMMON CONTROL CUBICLE / MARSHALLING BOX**:

o A free standing outdoor type weather proof common marshalling box/cubicle shall be provided to house different accessories except those which must be located in the pole unit operating box. Rubberized gaskets of durable quality shall be provided to make it water proof, dust and vermin proof. Degree of protection shall be IP-55 as per IS:13947

o This outdoor cubicle shall be of 3.00 mm thick steel sheet and shall have hinged doors at front and rear for access to the mechanism. Doors should be of proper design & adequate MS sheet thickness and providing adequate stiffener, for smooth opening and closing. There shall be arrangement for padlocking, individual door panel should be connected with the main panel body by flexible braided copper conductor for earthing purpose at two points.

o A removable gland-plate, 3.00 mm thick shall be provided at the bottom of the cubicle for cable entry. Gland sizes shall be suitable for entry of adequate number of multicore cables separately for AC & DC as per approved scheme.

- Terminal blocks for AC & DC shall be kept isolated. Terminals shall be suitable for at least three nos. 2.5 mm sq. copper leads. All control wiring shall be of 1100 Volt grade 2.5 mm sq. copper PVC insulated cables.
- Thermostat controlled heaters shall be provided to prevent condensation within the cubicle /switchgear. Cubicle illumination lamps with switch shall be provided.
- A 230 Volt combined 5A/15A three pin socket with neutral earthing and a control switch shall be provided inside the box.
- Suitable arrangement i.e. platform shall be provided with support structure for easy access to the operating mechanism box for personnel of average height. View glass shall be provided on hinged door for reading pressure gauge, ON-OFF indication mounted inside the cubicle.
- Spring charged mechanism shall be placed within the operating mechanism box / marshalling box and contacts shall be provided for spring charged indication.
- All controls, alarms, indications and interlocking devices furnished with breaker shall be wired up to the terminal block in common operating box / marshalling box. Not more than two wires shall be connected to one terminal. All spare contacts available in the pressure switches etc shall be wired upto terminal block.
- All wires shall be identified at both ends with ferrule marking in accordance with approved wiring diagram.

The terminal blocks shall be of 1100 V grade and have continuous rating to carry the maximum expected currents on the terminals. Insulating barriers shall be provided between the terminals. The terminal block shall have locking arrangement to prevent its escape from the rails. The terminal blocks to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring. At least 20% spare terminals shall be provided.

- **INSULATORS:**

- The porcelain to be used in bushing shall be homogeneous, free from laminations, cavities and other flaws which may impair its mechanical and/or dielectric strength and shall be glossy, tough and impervious to moisture.

- The bushings shall have adequate mechanical strength and rigidity for conditions under which they will be used.
- Bushing insulation shall be coordinated with that of Circuit Breaker. The puncture strength of the bushings shall be greater than the dry flashover value.
- When operating at rated voltage and under operation in heavily polluted area, there shall not be any electrical discharge between bushing terminal and earth. No radio disturbance shall be caused by the bushings when operating up to the maximum system voltage. It shall also be free from corona.
- All iron parts shall be hot dip galvanised.
- All bushings of identical rating shall be interchangeable. Each bushing shall be provided with :
- Terminal connector suitable for connection to either 'ACSR' Conductor / Aluminium pipe shall be provided as per requirement. Particulars of 'ACSR' Conductor / Aluminium pipe to be connected with terminal of different voltage classes are specified under Specific Technical Parameters.
- All terminal connectors required for circuit breaker shall be guided by technical specification for Clamps and Connectors. Relevant drawings are to be submitted for approval before supply.

- **AUXILIARY CONTACTS**:

- The breaker shall be provided with 6 NO + 6 NC for 36KV CBs as spare auxiliary / multiplied contacts in addition to the auxiliary contacts required for breaker's own operational requirements.
- The auxiliary / multiplied contacts shall have continuous current rating of at least 10 A. The breaking capacity shall be adequate for the circuits controlled, and at least 2 A at 220 V DC for inductive circuit with time constant of minimum 20 ms.
- All auxiliary / multiplied contacts shall be wired up to terminal block in the control cubicle.
- Auxiliary/multiplied contacts shall be suitably protected against arcing. Insulating materials of the base of the contacts shall be moulded plastic or other non-breaking, non-inflammable insulating material.

- **GROUNDING**

Circuit Breaker shall be provided with two grounding terminals suitable for connecting G.S. Flat of 50×10mm (min) for all voltage classes per pole each with tapped holes. Necessary stainless steel bolts and washers, spring washers are to be supplied for connection to grounding strip, size of which shall be as per requirement.

- **PAINTING**

All steel surfaces shall be cleaned by sand blasting or chemical process as required to produce a smooth surface, free of scale, grease and rust. Steel surface in contact with insulating oil shall be painted with heat resistant oil insoluble insulating varnish. External surfaces shall be given a coat of high quality red or yellow chromate primer and finished with gray colour (IS:631) with two coats of synthetic enamel paints. Paints shall be carefully selected to withstand tropical heat, rain etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. Sufficient quantity of touch up paint shall be furnished by application at site.

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- **EQUIPMENT FOUNDATION AND SUPPORT STRUCTURE**

  The equipment shall be supplied with all support structures, which are integral part of the breaker. All support structure shall be hot dip galvanised after full chemical treatment as per IS: 4759 or equivalent.

- **36 KV VACUUM CIRCUIT BREAKER:**

  Each vacuum Circuit breaker shall comprise of three identical poles linked together electrically and mechanically for synchronous operation.

- **VACUUM INTERRUPTER AND CONSTRUCTIONAL FEATURE**

  - The vacuum interrupter, consisting of fixed contact and moving contact, shall be interchangeable among the same type interrupter. Short circuit capacity of vacuum bottle should be 25 KA and design life should be 100 nos. operation at rated short circuit level.
  - Constructional features of the vacuum chamber along with its functional arrangements are to be shown in a drawing submitted along with tender documents.
  - The gap between contacts of the Circuit Breaker inside interrupter should be capable of withstanding 1.5 time voltage to neutral at one atmospheric pressure at normal ambient condition within Breaker in the event of vacuum pressure drop due to leakage.

- The circuit breakers and their components shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current of the system without any damage or deterioration of material.
- The circuit breakers shall have motor wound spring charged trip free mechanism with anti-pumping feature, and shunt trip. In addition, facility for manual charging of spring, shall be provided.
- Each breaker shall be provided with manual close & open facility, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator.
- For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor. A visual mechanical indicating device will also be provided to show the position of the spring.
- 36KV VCB, with duty cycle O- .3sec CO-3min CO, Class- C2-M2 as per relevant IEC, 1250A, 25KA for 3 sec, 70kvrms/170kvp, 3-Phase, Outdoor VCB with 2TC & 1CC, 220V DC.
- The offered VCB shall be well proven in NTPC/WBSEDCL/WBSETCL. Offered bottle shall be identical with Type tested one. Brochures/leaflet on technical data sheet for vacuum bottle shall also to be submitted.
- The VCB shall be complete with structure, operating mechanism in a common Control cubicle with degree of protection IPW-55, situated at accessible man height, along with all associated accessories and auxiliaries and terminal connector as per specification and approved drawing during detailed engineering. The supply shall include 2 Set of complete bottle. (1 set comprises of one complete VCB i.e. inclusive of 3 poles).
- The bidder shall submit detailed as well as complete Type test reports as stipulated in relevant IS and IEC with complete identification, date and serial no. of circuit breakers of identical design with identical bottle from CPRI, NABL accredited/a Government recognized test house or laboratory during detailed engineering.
- Make & Type of VCB & Vacuum Interrupter with detailed literature shall be furnished along with bid.

- **TEST**

A. Routine Test

During manufacture and on completion, all equipment, clamps, connectors and accessories shall be subjected to the Routine Tests as laid down in latest revision of IEC/IS.

In addition to above tests specified by IEC/IS, the following tests also have to be carried out for specific equipment :

The speed curves for 220 KV circuit breaker shall with the help of a suitable operation analyser to determine the breaker contact movement during opening, closing, auto-reclosing and trip-free operation under normal as well as limiting operating conditions (Control Voltage etc.)

B. Type Test

Type tests on circuit breaker, disconnecting switch, CT & LA shall carried out as stipulated in relevant IEC/Indian Standards.
Following additional type tests are to be conducted for 220 KV circuit breaker:

i) Out of phase closing test as per IEC-267 & IEC-62271-100.

ii) Line charging breaking current test. The breaker shall be able to interrupt the line charging current with a test voltage of 1.4p.u. instead of 1.2 p.u. as per IEC-62271-10.

- **AVAILABILITY OF SPARE**

  The successful bidder shall submit manufacturer's undertaking during submission of drawings of Circuit Breaker that the spares for the supplied breaker (for all voltage classes and all makers) shall be available for at least ten years from the date of placement of LOA. All the participating bidders shall have to confirm in writing submission that the above mentioned undertaking from the manufacturer shall be submitted in case they receive order.

- **FURNISHING DETAIL GTP FOR 36 KV VACUUM CIRCUIT BREAKERS) during approval**

Sl. No.	Description	Particulars
1.	Conforming Standard	:
2.	Service (Outdoor/Indoor)	:

Sl. No.	Description	Particulars
3.	Frequency	:
4.	Rated operating duty	:
5.	Rated (TRV) for terminal fault	:
6.	Short time Fault breaking capacity MVA	:
7.	Line charging current breaking capacity	:
	a) line charging current AMP	:
	b) Corresponding Over voltage (KV)	:
	c) Whether Switching Resistor is provided	:
	i) Value of Resistor	:
	ii) Time of insertion	:
	iii) Thermal Rating of Resistor	:
8.	Maximum shunt capacitor bank switching/breaking capacity in MVA and the over voltage factor.	:
9.	Maximum over voltage in Kilovolts on switching OFF Transformer on low load.	:
10.	i) Breaks per pole (No)	:
	ii) Length of each break per pole (mm)	
	iii) Length of moving contact travel mm	
	iv) Rate of contact travel (m/sec)	
11.	Make time (ms)	:
12.	Minimum reclosing time at rated interrupting Capacity from the instant of the trip coil energisation (ms)	:
13.	Minimum dead time for 1 phase & 3 phase reclosing With corresponding limits of adjustment of dead time, If any.	:
14.	Maximum radio interference voltage between 0.5 MHz to 2 MHz with Voltage of 110% of rated rms voltage between phase & ground (Micro-Volt)	:
15.	Details of manually/motor operated spring charging mechanism.	:
16.	i)Voltage and Power requirement for a) closing coil	:

Sl. No.	Description	Particulars
	b) Tripping coil ii) No of Tripping Coil	
17	Vacuum Bottle	
17 a)	Make, Country, Type & Designation of Vacuum Bottle used in VCB.	:
17 b)	Number of operation at full short ckt level,	:
17 c)	no. of operation at rated current and other details	:
17 d)	Whether Literature & Catalogue of offered Vacuum Bottle containing the specific particulars enclosed?	:
18.	Weight of Vacuum Circuit Breaker	:
19.	No. of auxiliary contacts (Spring Charging LS) number of NO and NC shall be mentioned. No. of auxiliary spare contacts	:
20.	Power frequency withstand capability of breaker in open condition at :	:
	i) Atmospheric Pressure of Air/Zero Vacuum Pressure	:
21.	Actual opening time (from Trip Coil energisation to contact separation) (ms)	:
22.	Allowable time limit between breaker per pole (for multibreak type) and between poles (ms)	:
23.	Actual closing time (from Closing Coil energisation to contact touching (ms)	:
24.	Whether type tests report submitted in line with specification for similar breaker with offered vacuum Interrupter?	:
25.	Whether a) Dimensional GA Drawing Cross Sectional b)Drawing of interrupting Chamber and c)scheme diagram are furnished.	: a) b) c)
26.	Whether brochure/ leaflet on Technical data for Vacuum bottle enclosed?	

B. 33KV Disconnecting switch

Type, rating, connections etc. Of the equipment shall be as detailed in the annexures. The equipment shall be offered in strict compliance with the same. The quantity of each type of Disconnecting switch are as follows:-

i) Two (04) sets of 1250A, 33KV Horizontal double break type Disconnecting switch at switchyard.

Each disconnecting switch shall be furnished with fittings and accessories as listed in the Annexure-B.

Disconnecting switches shall be suitable for connection to Al.-tube bus of required no. & size.

The equipment will be used in 33KV system of switchyard, having characteristics as listed in the Annexure-A.

The equipment will be installed outdoor in a hot, humid and tropical atmosphere.

All equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.

- The maximum temperature in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.

- The equipment shall be capable of withstanding the dynamic and thermal stresses of listed short circuit current without any damage or deterioration.

- There shall be no radio interference when the equipment is operated at maximum service voltage.
- The safety clearances of all live parts of the equipment shall be as per relevant standards.
- Corona/grading ring as required shall be provided.

- **Constructional Features**

a) The 33 KV disconnecting switches shall be triple pole mechanically ganged horizontal double break type (contact blades moving through horizontal plane) with earth switches(wherever required).

b) The 3-pole disconnect switch shall be gang operated type unless specifically called for individual pole operated disconnect switch. The construction shall be such that all the poles make and break simultaneously.

c) The disconnect switch and its earthing switches including operating mechanism shall be so constructed that they can not come out of their open or closed position by gravity, wind pressure,

vibration, shocks or accidental touching of connecting rods of the operating mechanism.

d) The mechanical linkages shall be such that then deflection is negligible. Facility of adjustment of the interpole operating rods and locking arrangement shall be provided.

e) The disconnect switch shall be designed for upright disposition unless specifically stated. The steel base frame shall be suitable for mounting on steel structure/concrete column as per the requirement of the switchyard layout.

f) The disconnect switch shall have padlocking arrangement in both `Open' and 'Closed' positions.

g) All current carrying parts shall be of non-ferrous metal or alloy. All live parts shall be designed to avoid sharp points and edges.

h) All metals parts shall be of such material and treated in such a way as to avoid rust, corrosion and deterioration due to atmospheric condition. Ferrous parts shall be hot-dip galvanised.

i) Bolts, nuts, pins, etc. shall be provided with appropriate locking arrangement such as locknuts, spring washers, key etc.

j) Bearing housing shall be weatherproof with provision for lubrication. The design, however, shall be such as not to require frequent lubrication. The requirement of lubrication shall be after 1000 operations or after 5 years whichever is earlier.

k) All bearings in the current path shall be shorted by flexible copper conductor of adequate size.

l) All isolator/earth switches shall be provided with manual operating handles enabling one man to operate the switch with ease in one single movement. The operating handle shall be provided with padlocking facility and located at around one (1) meter above the ground level.

- **Main Contacts**

i) The main contacts shall be of silver-plated copper alloy and controlled by powerful springs designed for floating and pressure point contact. The thickness of the silver plate shall not be more than 25 micron.

ii) The contacts shall have sufficient area and pressure to prevent excessive heating liable to bring about pitting or welding.

iii) Contacts shall be adjustable to allow for wear, shall be easily replaceable and shall have minimum movable parts and adjustments.

iv) The blade shall be made of electrolytic copper tube of liberal section. Rotating feature of the blade at the end of travel for contact wiping shall be provided. The high-pressure type contacts of horizontal break isolators shall wipe the contact surfaces while opening and closing. The contacts shall be so designed that wiping action shall not cause scouring or abrasion on the contact surfaces.

v) Arcing horns shall be provided to divert the arc from main contacts to the separating horns after the main contacts have opened. Arcing horns shall be renewable type.

vi) Arcing contacts shall close first and open last so that no damage due to arcing whatsoever shall be caused to the main contacts.

- **Auxiliary Contacts**

i) Each disconnecting switch shall be provided with minimum ten (10) normally closed and ten (10) normally open electrically separated spare contacts, in addition to the auxiliary contacts required for its operation and indication.

ii) The contacts shall be convertible type so that normally open contact may be converted to normally closed contact and vice-versa at site.

iii) The auxiliary contacts shall be rated 10A at 230V A.C. and 2A at 132V D.C.

iv) The auxiliary contacts shall be adjustable type to suit the following requirement:

a) Signalling of 'Closed Position' shall not take place unless the main power contacts have reached a position so that rated normal and short time current can be carried safely.

b) Signalling of 'Open Position' shall not take place unless the main power contacts are at a safe isolating distance.

- **Interlocks**

i) All disconnecting switch and earth switches shall be suitable for electrical interlocks. In addition to the provision of electrical interlocks, earthing switches shall be mechanically interlocked with main isolator.

ii) The disconnecting switch shall be suitable for sequential interlocking with associated equipment, for closing and opening.

iii) Interlocks are required to be provided :

a) To prevent isolators open on load.

b) To prevent closing of earthing switch when isolator is closed.

c) To prevent closing of the line isolator when earthing switch is closed.

iv) Operating of earth blade shall not take place when corresponding main isolator is in operation stroke and vice-versa.

- **Insulators**

i) Insulators shall be solid core porcelain type and composed of stacked units including for operating rods. Insulators of identical rating shall be interchangeable.

ii) Insulator shall be of wet-process porcelain, brown glazed and free from all blemishes. Metal parts and hardwares shall be hot-dip galvanised.

iii) When operated at maximum system voltage there shall be no electrical discharge. Shielding rings, if necessary, shall be provided.

iv) Insulation shall be co-ordinated with basic impulse level of the system.

v) The insulators shall have the minimum cantilever strength of 6000 KNm.

vi) The insulators shall be so arranged that leakage current will pass to earth and not between terminals of the same pole or between phases.

vii) Each rotating insulator shall be supported on double-roller or ball bearings.

- **Blades**

i) All metal parts shall be of non-rusting and non-corroding metal. All castings except current carrying parts shall be made of malleable cast iron or cast steel.

ii) The live parts shall be designed to eliminate sharp joints. The isolators shall be so designed that the switchblade will not move to closed position if the operating shaft gets disconnected.

- **Operating Mechanism**

i) The mechanism shall be motor type with electrical control from remote as well as local position.

ii) The mechanism shall also have provision for manual operation with detachable handle. The arrangement shall be such that the operator may be able to operate without undue effort.

iii) Interlock shall be provided such that electrical power to the motor is cut off on insertion of normal operating handle.

iv) The mechanism of 3 pole disconnecting switch shall be so designed that all three blades are in positive continuous control throughout the cycle of operation.

v) Visible indication of switch position and means to prevent false indication if the mechanism fails to complete the operation shall be provided.

vi) Starters, relays, limit switches shall be provided as required for operation, indication and interlocks. Adjustable mechanical stop and/or electromagnetic brakes shall be provided to limit over travel.

vii) The motor operated mechanism shall be suitable for operation from 415 V, 3 phase, 50 Hz supply. The drive mechanism shall be such that during manual operation the motor drive shall be automatically de-coupled. Suitable reduction gearing shall be provided between the motor and the drive shaft of the disconnecting switch. A quick electro-mechanical break shall be fitted on the higher speed shaft.

viii) Hydraulically operated mechanism shall be complete with operating unit with power cylinder, control valves, motor etc. The oil pressure controlling the oil pump and pressure in the reservoir shall be continuously monitored.

- **Mechanism Box**

i) The mechanism box shall house the operating mechanism, electrical, controls, monitoring devices and all other accessories.

ii) The box shall be IP-55W, of gasketted weatherproof construction, fabricated from sheet steel minimum 2 mm thick. They shall be dust, water and vermin proof.

iii) The box shall have front access door with lock and key, and removable gland plate at bottom for cable entry.

iv) The box shall be suitable for mounting on disconnecting switch support structure. The mounting height shall be such as to permit easy manual/electrical operation standing at grade level.

v) Thermostat controlled space heater, internal illumination lamp and 3 pin 5A socket with individual ON/OFF switches shall be provided in the box.

vi) For local operation following shall be provided :

a) Local-remote selector switch.

b) Open/Close/Stop Push Button.

vii) Cable entries shall be from the bottom, suitable removable cable gland plate shall be provided on the cabinet for the purpose.

- **Wiring**

i) Wiring shall be complete in all respects to ensure proper functioning of the control, protection, monitoring and interlocking schemes.

ii) Wiring shall be done with flexible 1100V grade, PVC insulated switchboard wires with stranded copper conductor of 2.5 mm^2 for voltage circuit & 2.5 mm2 for current circuit. The operating coils and small wirings shall be tested as assembled for a power frequency voltage of 2 KV for one minute.

iii) Each wire shall be identified at both ends with permanent markers bearing wire numbers as per contractor's wiring diagram.

iv) Wire terminations shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

v) All spare contacts of push buttons, auxiliary switches etc. shall be wired up to the terminal blocks in the mechanism box.

- **Terminal Blocks**

i) Terminal blocks shall be 1100 V grade, box-clamp type, minimum 10 mm^2 or approved equal.

ii) Not more than two wires shall be connected to any terminal. Spare terminals equal in number of 20% active terminals shall be furnished.

iii) Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

- **Earthing Switch**

i) Earthing switch shall be triple-pole, gang operated type, with provision for padlocking in both open and close positions.

ii) The manual operating mechanism shall be such that it can be easily operated from standing height at grade level. The earthing mechanism shall only be locally operated.

iii) The earth switches shall be power operated but shall be constructional interlocked. Mechanical and electrical safety interlocks shall be provided to prevent closing of earthing switch when the main disconnecting switch is closed and vice-versa.

iv) Earthing switch shall be provided with minimum 4 NO + 4 NC contacts for indication and interlocking. All auxiliary switches &