BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TYPE OF DOC.	**TECHNICAL SPECIFICATION**		**NAME**	**NK**	**SK/ DKM**	**RS**
AUXILIARY TRANSFORMER			**SIGN**			
			DATE	22.06.13	22.06.13	22.06.13
			GROUP	TBEM	**W.O. No**	**89004**

CUSTOMER	**NHPC LIMITED, FARIDABAD**
PROJECT	**220/33KV SWITCHYARD FOR KISHANGANGA (3X110MW) HEP**
KISHANGANGA CONSORTIUM:	**HINDUSTAN CONSTRUCTION COMPANY (HCC) LTD. HALCROW SUBCONTRACTOR: BHARAT HEAVY ELECTRICALS LTD.**
CONSULTANT	**HALCROW NOIDA**

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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch, performance testing, acceptance testing, guarantee for two years from commissioning as per the specification hereunder, complete with all accessories and all auxiliaries, spare parts as listed in clause 1.2 & 1.3 below and warranting a trouble free safe operation of the installation of Auxiliary Transformer required for Aux. supplies to various equipment at Kishanganga Switchyard Area.

The equipment being supplied shall be suitable for increased external insulation levels with suitable altitude correction factor for an altitude of 1795m from MSL (min. 1.1times the normal values).

This section covers the specific technical requirements of Auxiliary Transformer. In case of any discrepancies between the requirements mentioned in this section and those specified in the following sections of this specification, the specifications given herein shall prevail and shall be treated as binding requirements.

In case of variance in the requirements specified under Section-1 and other Sections of this specification, requirements of Section-1 shall prevail.

No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer as per attached Annexure-1.

1.1 The equipment is required for the following project.
Name of Customer : NHPC Ltd.
KISHANGANGA CONSORTIUM:
Hindustan Construction Company (HCC) Ltd. / HALCROW
Subcontractor: Bharat Heavy Electricals Ltd.
Name of Consultant : HALCROW Noida
Name of the project : 220/33kV Switchyard for Kishanganga (3x110MW) HEP
Refer Section - 3 for Project Details and General Specifications.

1.2 TECHNICAL REQUIREMENTS

1.2.1 GENERAL TECHNICAL REQUIREMENTS

Altitude : Since this switchyard is situated at an altitude of 1795M above MSL, the equipment shall be suitable for increased insulation level with an altitude correction factor of 1.1 times the normal values and shall be suitable for operation under prescribed conditions. *Bidder to inform what steps have been taken to ensure the same at bid stage.*

Sub-zero temperature: Further the equipment being supplied shall be suitable for operation under sub zero temp, with ice/snow considerations. The equipment shall be suitable for temperature variation between (-) 12 degree C to (+) 38degree C. *Bidder to inform what steps have been taken to ensure the same at bid stage.*

1.2.2 SPECIFIC TECHNICAL REQUIREMENTS

Sl. No.	Description	Parameters	
1.	Type	Two winding	
2.	Service	Outdoor	
3.	Number of phases	Three	
4.	Frequency	50 Hz	
5.	Type of Cooling	ONAN	
6.	Rating and Ratio	312kVA and 11/0.415 kV	
7.	Impedance at 75^0C with tolerance	0.05 ± 10%	
8.	Duty	Continuous	
9.	Overload	As per IS:6600	
10.	**Maximum Temp. rise over 40^0C ambient Temp. (Considering high altitude correction factor)**		
i)	Oil (Temp. rise measurement by thermometer)	50^0C	
ii)	Winding (Temp. rise measurement by resistance method)	55^0C	
11.	**Windings**	**11kV**	**0.415kV**
i)	System apparent short circuit level (kA)	As per IS 2026: Part-1	
ii)	Winding Connection	Delta	Star
iii)	Vector Group	Dyn 1	
iv)	Insulation*	Uniform	
v)	Insulation level (kV)*	**11**	**0.415**
a)	Power frequency test level (kVrms)*	28	2
b)	Basic Impulse level (kVpeak)*	75	---
vi)	Highest voltage (kV) for each winding *	24	---
vii)	Method of earthing	Solidly earthed	
12.	**Tap Changer**		
i)	Tap range	+5% /-10% in steps of 2.5% on HV side	
ii)	Tap control	Off-circuit tap change switch	
13.	**HV Bushings**		
i)	Rated Voltage, kV	12	
ii)	Rated Current, A	100	
iii)	Basic Impulse level, kVp*	75	
iv)	Wet and dry power frequency withstand voltage (kVrms)*	28	
v)	Minimum total Creepage distance (mm)	300	
vi)	Mounting	Tank / Transformer body	
14.	**LV and Neutral Bushing**		
i)	Rated Voltage (Volts)	1100	
ii)	Rated Current, A	1000	
15.	**Terminal details**		
i)	High Voltage	Suitable for 1CX70 sq.mm 11kV cable	
ii)	Low Voltage phase and Neutral	Cable Box suitable for 1-3.5CX300 sq.mm	
16.	**Minimum Clearance in Air**	**11 kV**	**0.415 kV**
i)	Phase to Phase	280 mm	25 mm
ii)	Phase to Earth	140 mm	25 mm
17.	Bushing CT details		
	L.V.		
	L.V. Neutral		

* See Clause 1.0 highlighted portion for rating factor due to high altitude.

1.2.3 GUARANTEED LOSSES: The maximum losses with IS 2026 tolerance for each L.T. Transformer shall be guaranteed by you in your offer.

Sl. No.	Description	Guaranteed loss (kW)
312 KVA, 11/0.415kV, L.T. Transformer		
1.	Copper Loss (at 75 deg C at rated current)	3.5
2.	Iron Loss (at rated voltage and frequency)	0.65

If the above guarantees are not established at factory tests, then the Owner at his discretion may reject or accept the equipment. However, the equipment under no circumstances shall be accepted if the measured component losses are more than +15 percent of the guaranteed losses, indicated above.

Rest as per NHPC Technical Specifications enclosed as below:

PTS: Chapter 19: AUXILIARY TRANSFORMER, Page 362 to 375(11 sheets).

1.3 BILL OF QUANTITY

1.3.1 Main Equipment

Sl. No.	Description	Quantity
1.	312 kVA, 11/0.433 kV, ONAN, Dyn1, 3-phase Transformer complete with and including off-load tap-changer, cable glands lugs, anchor bolts, etc.	1 No.

1.3.2 Mandatory Spares

Sl. No.	Description	Quantity
1.	Winding temperature protection equipment(DTT) for the auxiliary transformer(if applicable)	10 no. of each used type
2.	11kV, terminal bushing	3 nos.
3.	415V, terminal bushing	4 nos.

1.4 TYPE TESTS

The Auxiliary Transformer should have been type tested as per relevant IEC/IS.
The Type Tests on Auxiliary Transformer shall meet the requirements as per cl. 2.11.2.2 of Section -2 and Quality Assurance Plan (Model) for 11/415,3-Ph Oil Filled Transformer.

1.5 At contract stage, the reports for all type tests as per technical specification shall be submitted for BHEL/NHPC approval. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited base on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by the representatives(s) of NHPC or Utility. The test reports submitted shall be of the tests conducted within last 5 (five) years prior to the date of bid opening. In case In case the test reports are of the test conducted earlier than 5 (five) years prior to the date of bid

In the event of any discrepancy in the test reports i.e. any test report not acceptable to NHPC due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification on any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

1.6 SHOP TEST

The Shop Tests on Auxiliary Transformer shall meet the requirements as per page of Annexure-1A, clause 19.2 of Section-1.

1.7 MINIMUM TECHNICAL QUALIFYING REQUIREMENT

The bidder should have manufactured, type tested and supplied similar equipment earlier during the last ten(10) years. The equipment so manufactured should have been successfully commissioned at least at three power stations/sub stations.

1.8 MANUFACTURING QUALITY PLAN

Quality Assurance Plan (Model) for 11/415,3-Ph Oil Filled Transformer(Enclosed in Section-5) shall be followed.

The contractor shall carry out the works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval.

1.9 CHECK LIST

Duly filled and signed checklist shall be submitted along with the offer, in the absence of which, offer may not be considered for evaluation.

1.10 FIELD TESTS

All field tests including tests during installation, pre-commissioning, commissioning and field acceptance tests shall be conducted by the Contractor, in presence of representative of the Employer as per Annexure-1A, clause 19.3 of Section-1.

Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance test shall be submitted well in advance, at least six months before start of relevant testing, for approval by the employer.

1.11 INSPECTION & TESTING

Prior to dispatch, the Routine tests shall be carried out on Auxiliary Transformer in accordance with the applicable IEC /IS and the material shall be offered for final inspection by BHEL and NHPC/HCC in accordance with quality assurance plan.

Inspection and Testing shall be as per Annexure-1A, of Section-1 and Quality Assurance Plan of NHPC in Section-5.

19. ~~415 V SWITCHGEAR AND~~ AUXILIARY TRANSFORMERS

19.1. Scope of Work

Scope of work under this section covers the provision of labour, tools, plants, materials and performance of work necessary for the design, manufacture, quality assurance, quality control, shop assembly, shop testing, delivery at site, site storage and preservation, installation, commissioning, performance testing, acceptance testing, training of Owner's personnel, handing over to Owner and guarantee for two years of ~~415V switchgear and~~ auxiliary transformers as per the specifications hereunder, each complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation.

The scope of work shall be a comprehensive functional system covering all supply and services including but not be limited to following:

19.1.1. Auxiliary Transformers

i) Three (3), 13.8/0.415kV, 1000 KVA, three phase, Dry type, Unit auxiliary transformers complete with cubicles and all necessary accessories such as bushings, off-circuit tap changer, CTs, instrumentation, fittings etc.

ii) Two (2), 11/0.415kV, 1500 KVA, three phase, Dry type, station service transformers complete with cubicles and all necessary accessories such as bushings, off-circuit tap changer, CTs, instrumentation, fittings etc.

iii) Following 11/0.415 KV, three phase, Oil filled transformers complete with cubicle and all necessary accessories:

- One (1) 312 KVA Switchyard Transformer.
- ~~One (1) 250 KVA Transformer for Valve House.~~

19.1.2. 415 V switchgear

3-phase, 50 HZ, 415 V switchgear systems consisting of following major items:

i) Three (3) sets of unit auxiliary boards (UABs),

ii) Two (2) sets of station service boards (SSBs),

iii) One (1) set of Switchyard auxilliary Board (SAB),

iv) One (1) set of Valve House Board (VHB),

v) One (1) set of Main Access Tunnel (MAT) Board,

vi) One (1) ser of TRT Service Board,

vii) One (1) lot of distribution board as per requirement complete with cubicles, bus bar system, circuit breakers, instruments transformers, instruments, relays, cabling and wiring and other accessories.

All the above boards shall be of indoor metal enclosed 415 V switchgear type, complete with cubicles, protection, metering, bus-bar system, cabling, wiring and other accessories, each comprising of

- Draw out type incoming air circuit breaker,
- Required no. of draw out type MCCBs,
- Current transformers for protection and all outgoing feeder of motor loads and load more than 25 amp,
- Required no. of Potential transformers,
- Required no. of Ampere meters with selector switch,
- Required no. of Voltmeters with selector switch,
- Required no. of Energy meters,
- All necessary AC bus bars (including N-Bus bar),
- Local control switches,
- Indicators as specified,
- All necessary auxiliaries for control and supervisory circuits, and other relays as required,
- Other additional feeder units necessary to fulfil the requirements of the specification and sockets etc.,
- All secondary wiring, terminal blocks, labelling and nameplates, sockets etc.,
- Cubicle lighting including lighting fixtures and power and communication sockets,
- Cubicles heating including heating elements.

viii) All protection relays and systems for transformer and switchgear as elaborated in "Section - 15 Protection System",

ix) Coordination and provision of necessary contacts and/or ports for integration with plant SCADA system.

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.

19.2. Specific Parameters and Layout Conditions

19.2.1. Layout and General Arrangement

The switchgear system is solidly grounded, 3 phases+TNS, according to IEC Publication 60364-3.

Each UAB shall normally be supplied by one dedicated UAT. Each SSB shall be supplied by one dedicated SST. SAB, VHB and MAT Board shall be supplied by Switchyard transformer and Valve House transformer

UABs and SSBs shall be interconnected as per arrangement shown in drawings NH/DEM/KSG/SLD/01, NH/DEM/KSG/CP/01 & NH/DEM/KSG/LT/01 for redundancy and reliability of power supply to various connected auxiliary and station loads.

It shall be the responsibility of the Contractor to complete the work in all respect and to make the scheme functional as per above drawings.

The 13.8 kV sides of UATs shall be connected through tap off Bus duct tapped from main generator Bus Duct. The 11 kV sides of SSTs shall be connected to 11 kV switchgear through XLPE cable. The 415 V side of UATs and SSTs shall be connected to respective UABs and SSBs respectively through cables. The SAT, VHT and MAT transformer shall also be fed from 11KV Switchgear through XLPE cables.

19.3. Rating and Functional Characteristics

19.3.1. Rating

19.3.1.1. Dry Type Transformer

Description	UAT	SST
Type of Transformer	Dry Type	Dry Type
No. of phase	3	3
Installation	Indoor	Indoor
Total No. of Transformers	3	2
Rated KVA	1000	1500
Minimum % Impedance at Principal Tap, rated MVA and rated frequency	5%	6.25%
Minimum efficiency of Transformer	98%	98%
Type of cooling	AN	AN
Winding material	Copper	Copper
Connection of Transformer		
HV Winding	Delta	Delta
LV Winding	Star with neutral directly earthed	Star with neutral directly earthed
Vector Group	Dyn11	Dyn11
Rated frequency	50 Hz	50 Hz

Description	UAT	SST
Rated Voltage		
HV Winding , kV	13.8	11
LV Winding , V	415	415
Tap Changer		
Type	Off circuit	Off circuit
Range	From -5% to +5%	From -5% to +5%
Steps	5, at 2.5% each	5, at 2.5% each
Location	HV side	HV side
Power frequency withstand voltage		
H.V winding	38 kV	28 kV
L.V. winding	3 kV	3 kV
Rated lightening impulse withstand voltage of HV winding (peak)	95 kV	75 kV
Class of insulation	H	H
No. of CTs for each transformer	1	1
Accuracy	PS	PS

19.3.1.2. Oil Filled Transformer

	Switchyard	Valve House
Type of Transformer	Oil filled	Oil filled
Rated capacity KVA	312	250
Minimum efficiency of Transformer	97.8%	97.8%
No. of phases	3	3
HV Winding voltage, KV	11	11
LV Winding , V	415	415
Tap Changer		
Type	Off circuit	Off circuit
Range	From -5% to +5%	From -5% to +5%
Steps	5, at 2.5% each	5, at 2.5% each

Location	HV side	HV side
Power frequency withstand voltage		
H.V winding	28 kV	28 kV
L.V. winding	3 kV	3 kV
Rated lightening impulse withstand voltage of HV winding (peak)	75 kV	75 kV
Class of insulation	H	H
Type of Cooling	ONAN	ONAN

19.3.1.3. 415 V switchgear

Location	Indoor
No. of bus bars, 3-phase	1
Rated voltage , V	415
Rated frequency, Hz	50± 5%
Rated short time withstand current for bus bars and boards for 1 sec	50 KA
Rated circuit breaker short circuit breaking capacity (UAB and SSB)	50 KA
Protection class	IP42
Rated power frequency withstand voltage 60s for main circuits	2500 V
Rated power frequency withstand voltage 60s for control circuits	2000 V
Control voltage, DC	220 +10 % / -20%V
Auxiliary AC supply, 3 phase	415 ± 10 %
UAB	
Rated current of Bus bar, A	2000
Material of Bus bar	Copper
Current ratio of CTs	2000/5
Accuracy of CT	
For O/C and E/F	5P20
For REF	PS

For metering	0.5
SSB	
Rated current of Bus bar, A	2500
Material of Bus bar	Copper
Current ratio of CTs	2500/5A
Accuracy of CT	
For O/C and E/F	5P20
For REF	PS
For metering	0.5
VHB	
Rated current of Bus bar, A	400
Material of Bus bar	Copper
Current ratio of CTs	400/5A
Accuracy of CT	
For O/C and E/F	5P20
For REF	PS
For metering	0.5
SAB/MAT/TRT Service Board	
Rated current of Bus bar, A	400
Material of Bus bar	Copper
Current ratio of CTs	400/5A
Accuracy of CT	
For O/C and E/F	5P20
For REF	PS
For metering	0.5

The rated capacity of the transformers is the minimum proposed and the capacity as per requirement shall be supplied.

19.4. Performance Guarantee

The ~~415 V switchgear and~~ auxiliary transformers along with all auxiliaries and accessories shall be capable of performing intended duties under specified conditions. The Contractor shall guarantee the reliability and performance of the individual equipment as well as of the complete system.

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NHPC

19.5. Design and Construction

19.5.1. Standards

The system and equipment shall be designed, built, tested and installed to the latest revisions of the following applicable standards. In the event of other standards being applicable they will be compared for specific requirement and specifically approved during detailed engineering for the purpose:

Standards	Description
IEC 60726	Dry-type power transformers
IEC 60076	Power transformers
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60439	Low-voltage switchgear and controlgear assemblies
IEC 60364	Electrical installations of buildings
IEC 60947	Low-voltage switchgear and controlgear
IEC 60044-1	Instrument transformers - Part 1 : Current transformers
IEC 60044-2	Instrument transformers - Part 2 : Inductive voltage transformers
IEC 60044-6	Instrument transformers - Part 6 : Requirements for protective current transformers for transient performance

19.5.2. Auxiliary Transformers

19.5.2.1. Dry Type Transformer

UAT and SST shall be of the indoor dry type, vacuum impregnated resin insulated, naturally cooled. Ratings, characteristics, etc. shall comply with the requirements of the IEC 60726. The cubicles housing of the transformers shall be ventilated by natural air.

The transformer shall be equipped with necessary accessories such as temperature sensors of PTC-thermistor type including a solid-state switching device with relay output (one each for alarm and tripping) for the maximum hot-spot winding temperature installed on each leg of the LV-

The enclosure shall be of at least IP 31 with enclosure thickness of at least 12 gauge. The transformer base shall be of rigid steel welded construction and shall include provisions for lifting, jacking and skidding or

rolling in both directions with two tapped holes for attaching ground leads one in each diagonally opposite corner of the base.

19.5.2.2. Oil Filled Transformer

Switchyard and Valve House transformers shall be of the outdoor oil type, ONAN cooled. Ratings, characteristics, etc. shall comply with the requirements of the IEC Publication 60076.

The transformer shall be equipped with necessary accessories such as temperature sensors for oil &winding temperature relay output (one each for alarm and tripping). Buchholtz Alarm & trip relay shall also be provided.The transformer shall be fitted with lifting lugs or holes and provisions for jacking and rolling.

19.5.3. 415 V switchgear (UABs, SSBs and Other Service Boards)

19.5.3.1. General

The 415 V switchgear shall be metal enclosed indoor cubicles free floor standing type.

The cubicle assemblies shall be designed in accordance with the recommendations of IEC Publication 60439-1 with protection class IP 42 according to IEC Publication 60529.

19.5.3.2. Compartments

Each cubicle shall be divided into sections, or compartments, housing the incoming, interconnecting or out going feeder air circuit breaker units and moulded case circuit breaker units respectively.

Each ACB and MCCB unit shall be mounted on a carriage assembly, constructed so that the unit can be removed and replaced while the buses are energized. The carriage shall have self-engaging definite position stops for disconnected, test and connected positions. All necessary means shall be provided for easy removal and handling of the unit.

19.5.3.3. Cable compartments

All feeders to and from the cubicle assemblies will be cables. The assemblies shall be accessible for the cables from bottom to each feeder circuit breaker via separate cable compartment. Solder less connectors shall be furnished for each power conductor entering the equipment. Provisions shall be made to clamp and fasten cables in the cable compartment. Terminals for cable connection will be suitable for Aluminium cables.

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of sustained voltage drop at the UABs, an automatic changeover to the other station service boards shall be provided

19.6. Drawings, Documents and Design Calculations

19.6.1. Design memorandum

The Contractor shall submit to Owner a design memorandum prepared in accordance to clause 1.6 "Record and Documentation" of "Section 1- General Technical Requirements."

19.6.2. Drawings and documents

The Contractor shall submit all the drawings and documents in accordance with requirements stipulated in "Section 2 - Technical Documents" of "General Technical Specification (GTS)".

19.6.3. Design calculation

The Contractor shall submit the design calculation in accordance to Clause 2.6 of "General Technical Specification (GTS)" covering at least the following, for review / acceptance.

- Fault level at each board taken in consideration for their design,
- Load calculation of transformers,
- Burden on CTs,
- Temperature rise calculation of transformers,
- Thermal ability to withstand short circuit.

19.7. Delivery, Installation and Commissioning

The Contractor shall follow the requirements of Delivery, Installation and commissioning elaborated in clause 1.7 "Delivery, Installation and commissioning" of "Section 1 - General Technical Requirements."

19.8. Spare Parts

Recommended spare parts shall be supplied in accordance to clause 1.8 "Spare Parts" of "Section 1 - General Technical Requirements". Specified spare parts to be supplied under this section are as follows:

S. No.	Description	Quantity
1	Air circuit breakers of type used	6 nos. of each used type
2	MCCB of type used	8 nos. of each used type
3	Current transformer of type used	4 nos. of each used type

4	Supporting insulator of type used	6 nos. of each used type.
5	Bushing of type used	1 no. of each used type
6	Arcing chamber assemblies for circuit breaker	2 sets of each used type
7	Main contacts for three poles, with spring, bolts, nuts etc. for circuit breaker	12 sets of each used type
8	Primary isolating contacts used	12 sets of each used type
9	Coils for tripping and closing of type used	12 nos. of each used type
10	Complete motor drives of type used	4 nos. of each used type
11	Complete spring closing mechanism for the breakers (If applicable)	12 nos. of each used type
12	Winding temperature protection equipment (DTT) for the auxiliary transformers (if applicable)	10 nos. of each used type
13	Overload and instantaneous trip mechanism for circuit breakers	10 nos. of each used type
14	Indication lamps used including assemblies	10 nos. of each used type
15	Fuses	10 nos. of each used type
16	Control and instrumentation switches	3 nos. of each used type
17	Contactors	2 nos. of each used type
18	Indicating instruments	2 nos. of each used type
19	11 kV, terminal bushing	3 nos.
20	415 V, terminal bushing	4 nos.
21	Under voltage relays	2 nos. of each type used
22	Over current and E/F relays	2 nos. of each type used

19.9. Tools and Instruments

The Contractor shall supply all necessary tools and instruments etc. for installation, repair and maintenance in accordance to clause 1.9 "Tools and Instruments" of "Section 1 - General Technical Requirements".

19.9.1. Special tools

The Contractor shall propose the list of special tools including their make and detailed specification as recommended by manufacturer(s), to be accepted by the Owner.

The proposed list of special tools must include the following in addition to tools recommended by manufacturer(s)

- One (1) hand lever or crank for manual closing of the electrically operated breakers or other means as applicable.

19.10. Quality Assurance and Testing

The Contractor shall follow the quality assurance and testing requirements specified separately in "Quality assurance and Testing Specifications (QTS)".

Annexure-1A

19. ~~415 V SWITCHGEAR AND~~ AUXILIARY TRANSFORMERS

19.1. Type Tests

The contractor is required to carry out all type tests as per relevant IEC / International Standards on one apparatus of each type of similar rating and shall submit the reports to the NHPC. The type test may not be mandatory if similar equipment has been type tested and test certificates for relevant tests are accepted by the Employer.

19.2. Shop Tests

The UAT, SST and 415 V Switchgear shall be routine tested as per relevant IEC with latest amendments. Following shop tests shall be carried out at the manufacturer works:-

Test on ~~Power Transformer,~~ Oil Filled Transformer, ~~Dry Type Transformer~~ as per IEC: 60726 and IEC 60076 are as follows:-

- Measurement of Winding Resistance,
- Measurement of Voltage Ratio/ Check of Polarity/Vector Relationship,
- Measurement of No Load Losses,
- Measurement of Magetizing Current (before and after Dielectric Test),
- Measurement of Insulation Resistance and Polarization Index,
- Separate Source Voltage Withstand Test,
- Induced Over Voltage Withstand Test,
- Partial Discharge Test,
- Determination of sound level,
- Determination of transient voltage transfer characteristics. (Not applicable for Cast resin Dry Type Transformer)

The Partial Discharge test and determination of sound level are special tests as per IS. The same shall be conducted on one transformer as type test. The price of such special tests shall be reimbursed to contractor by NHPC.

Following Tests on 415 V Cubicle assembly as per relevant IEC:

- Visual and BOM Check,
- Scheme Checking,
- Insulation Resistance Test
- High Voltage Test.

The details of tests are given in Model Quality Assurance Plan of 415 V Switchgear, Auxiliary and Station Service Transformer.

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Annexure-1A

19.3. Field Tests

All field tests including tests during installation, pre-commissioning, commissioning and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer.

Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance tests shall be submitted well in advance, at least six (6) months before start of relevant testing, for approval of the Employer.

19.3.1. Tests during installation and pre commissioning

At least following inspections/ tests shall be performed:-

19.3.1.1. Transformers

- Correct functioning of the various protection systems.
- Inspection of the insulation to earth of the various parts of the transformers.

- Phase order checking.
- Measurement of the winding resistance.
- Ratio test.
- Measurement of the no load current at 415 V.
- Calibration and setting of WTI.
- Final IR values between windings and winding and earth.

19.3.1.2. 415 V switchgear

- Functional and operational tests.
- Measurement of the insulating resistance of the different power and control circuits, including cables, instruments and apparatus, against earth.
- Adjustment of the protection equipment.
- Calibration of releases.
- Verification of component temperatures.
- Verification of interlocks: ensure that interlocks are correctly installed and that access is prevented to live portions of the system when interlocks are in place and that access is permitted when interlocks are removed.

- Other test as suggested by the Contractor and/or the Employer at site.

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ANNEXURE-1

It is confirmed that there are no deviations and the offer is in full compliance with the specification. It is also confirmed that there are no deviations in any other form such as comments, variations and/ or exceptions. Further it is confirmed that at all drawings / data sheets/QP/ type tests reports shall be submitted to BHEL for organising approval of ultimate customer. Also, furnishing of all relevant information / repetition of type tests (if required for meeting the specification requirement) shall be carried out by us at no extra cost to BHEL & without affecting delivery requirements.

Signature of the authorized representative of Bidder

Name _____

Designation _____

Place _____

Date _____

Company seal

Section-2

TECHNICAL SPECIFICATION

FOR

OIL FILLED SERVICE TRANSFORMERS

SPECIFICATION NO.: PE - RC - 999 - 302 - E001

REV. NO. 00

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA

CONTENTS

SECTION 'A'

SCOPE OF ENQUIRY

SCOPE OF ENQUIRY

1.0 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of **OIL FILLED SERVICE TRANSFORMERS.**

2.0 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respect to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation.

3.0 The general terms and conditions, instructions to bidders and other attachment referred to elsewhere are hereby made part of the tender specification.

4.0 The bidders shall be responsible for and governed by all requirements stipulated hereinafter.

5.0 Bidders shall confirm total compliance to the specification without any deviation from the technical/ quality assurance requirements stipulated

SECTION 'D'
GENERAL TECHNICAL REQUIREMENTS

1.00 INTENT OF SPECIFICATION

1.01 This specification covers the design, manufacture, inspection & testing, packing at manufacturer's works and delivery to site of mineral oil filled service Transformers complete with all fittings & accessories for satisfactory operation at site.

1.02 The intent of specification is not to specify all details of design & construction of equipment. The equipment shall, however, conform in all aspects to high standard of design, engineering and workmanship and be capable of performing in continuous operation upto & after bidder's guarantee period in manner acceptable to purchaser who will interpret the drawings & specification and shall have power to reject any work or material which in his judgement is not in full accordance with this specification.

2.00 CODES AND STANDARDS

2.01 The equipment shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the equipment is to be installed including Indian Electricity Act, Indian Electricity Rules and Bureau of Indian Standards.

2.02 The design, material, construction, manufacture, inspection, testing and performance of LT Service Transformers shall conform to the currently applicable standards and codes of practices as per Annexure-VIII. General design, electrical & constructional features and various fittings & accessories shall be as per CBIP manual on Transformers Publication No. 275 (latest edition).

2.03 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

3.00 SCOPE OF ENQUIRY

3.01 Bidder shall quote for mineral oil filled LT Service Transformers including 10% spare oil in accordance with various sections of this specification. The transformer shall be provided with all fittings & accessories (including foundation hardware) & shall be complete in all aspects, for satisfactory operation, in accordance with this specification & technical particulars. Design ambient temperature shall be 50 deg. C. Project information shall be given separately for the specific project.

3.02. Bidder shall quote for following equipment & services:

1. Transformers (Rating & quantity of transformers shall be as per specific project requirement).

2.	Special Tools & Tackles required for erection, commissioning and proper maintenance of equipment.	One Lot (Bidder to furnish list along with offer)
3.	Commissioning spares for each transformer.	One Lot (Bidder to furnish list along with offer)
4.	O & M spares	As specified in Annexure-I
5.	Type Tests	As specified in Annexure-II

Note:
Extra 10% of total oil quantity shall be supplied along with the first lot of transformers in sealed non returnable drums.

4.00 SERVICES & EQUIPMENT TO BE EXCLUDED

4.01 Civil work such as transformer foundation, cable trenches etc.
4.02 Erection, testing, commissioning of transformer at site.
4.03 External power connection for HV & LV side of transformer by means of busduct/ cables, as applicable.
4.04 HV termination kits.
4.05 Connection to Station Earth.

5.00 TERMINAL POINTS

I. HV bushings with terminal connector for bus duct/ cable glands & lugs in case of cable connection.
II. LV bushings with terminal connector (3 Phase + 1 Neutral) for bus duct/ cable glands & lugs in case of cable connection.
III. LV neutral earth busbar brought near the base of transformer for bus duct/ cable glands & lugs in case of cable connection.
IV. Transformer earthing pads.
V. Terminals of marshalling box for external connection to equipment supplied by the purchaser.

6.00 TECHNICAL REQUIREMENTS

6.01 Technical particulars of transformers are specified in Data Sheet –A

6.02 Equipment shall give continuous service under specified site conditions.

6.03 All windings shall be fully insulated. Material of the windings shall be electrolytic grade copper, free from scales and burrs. Winding shall be uniformly insulated.

6.04 The core shall be constructed from high grade, non-ageing, cold rolled, grain oriented silicon steel laminations.

6.05 Internal design of transformer shall ensure that air is not trapped in any location.

6.06 Underbase of tank shall be fixed type.

6.07 Nuts, bolts and pins used inside the transformer shall be provided with lock washers & locknuts

6.08 Specific technical requirements are as follows:

6.08.01 **Tank** — Fabricated from tested quality steel and designed to withstand continuous internal pressure of 35 kN per sq. m. over normal pressure as well as short circuit forces. The main tank body including tap-changer compartment, radiators and coolers shall be capable of withstanding full vacuum. All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant oil in soluble insulating varnish. Tank shields, if provided, shall not resonate at natural frequency of equipment.

6.08.02 **Tank mounting** — Transformer tank shall be mounted on bi-directional rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer. Tank shall also be provided with lifting lugs and minimum four jacking pads. Rollers shall be provided with holding clamp plates (04 nos), required hardware and foundation bolts etc. for each transformer.

6.08.03 **Tank openings** — At least two adequately sized inspection openings, one at each end of the tank for easy access to bushings and earth connections.

6.08.04 **Oil preservation** — Conservator tank of adequate capacity for expansion of oil from minimum ambient to 100 deg. C shall be provided. The transformers rated 6.3MVA and above shall be provided with air bag breathing through silica gel breather. For lower rating transformers with conventional conservator with dry air filling of the space above oil and connected to silica gel breather shall be provided.

6.08.05 **Radiators** Tank mounted with shut off valves.

6.08.06 **Insulating Oil** As per IS: 335. No external inhibitors are permitted.

6.08.07 All transformers shall be suitable for cable/ busduct termination as indicated in data sheet-A.

6.08.09 **Bushings/ Insulators**

a) The bushings shall conform to the requirements of IS: 2099 and IS: 3347 and shall be of porcelain and above 3150A for the LV bushing Epoxy bushing can be acceptable .

b) For 3.3kV, 6.6kV and 11 kV windings, 17.5kV bushing shall be provided. For 415V windings, 1.1kV bushings shall be provided.

c) The porcelain shall not engage directly with hard metal and, wherever necessary, gaskets shall be interposed between the porcelain and the fitting.

d) Clamps and fittings of steel or malleable cast iron shall be galvanised.

e) Where bushing current transformer is provided, the bushing shall be mounted so
that it can be removed and replaced without disturbing the current transformers. CTs shall be cast resin type & suitable for operation at ambient temperature existing at its location on the transformer.

f) Creepage distance shall be minimum 25mm/ kV per unit of system phase to phase voltage.

g) Minimum rated current for bushings shall be as under:

1) H V Bushing for 11kV ~~& 6.6kV~~
   10.0MVA= 1000A
   8.0MVA = 1000A
   6.3MVA = 800A
   5.0MVA = 630A
   3.5MVA = 250A
   2.5 MVA = 250A
   2.0 MVA = 250A
   1.6 MVA = 250A
   1.0 MVA = 100A
   630 kVA = 100A
   312KVA = 100A
2) H V Bushing for 3.3kV
   2.5 MVA = 630A

2.0 MVA = 500A
1.6 MVA = 400A
1.0 MVA = 250A
630 kVA = 250A

3) L V Bushing for 11kV, 6.6kV & 3.3kV
10.0MVA= 2500A
8.0MVA = 2000A
6.3MVA = 1600A
5.0MVA = 1250A
3.5MVA = 1250A

4) L V Bushing for 433V/420V/415V
2.5 MVA = 4000A
2.0 MVA = **4000**A
1.6 MVA = 3150A
1.0 MVA = 2000A
630 kVA = 1000A
312 KVA = 1000A

6.08.10 **Cable Box**

a) A dust tight air insulated type cable box with D.O.P. of IP: 55 shall be provided for terminating the cables directly of size and type specified in Data sheet-A. Suitable cable glands (double compression type) and lugs shall be provided for cable termination.

b) Dimensions of cable box shall be subject to purchaser's approval.

c) Inspection cover for fixed portion of cable box shall be provided. Handles for lifting cable box shall be provided.

d) Creepage distance and clearances in air shall be as per CBIP manual.

e) Provision shall be made for earthing the body of each cable box. Separate earthing pads shall be provided for this purpose, suitable for bolted connection to galvanised mild steel flat of size to be specified during contract engineering stage.

f) Gland plate for single core cable termination shall be of Aluminium.

g) Cable box(es) shall be provided with suitable air-insulated disconnecting chamber so that if required, transformer can be removed from its position without disconnecting the cables in the cable box(es). Independent supporting arrangement shall be provided for cable box(es) for this purpose. Supporting arrangement shall be supplied along with required hardware & foundation bolts etc.

6.08.11 **Busduct Termination**

If LV terminals are specified to be connected by means of a busduct, a flanged throat or equivalent connection shall be provided to suit purchaser's busducts. The winding termination shall be on outdoor type of bushing. Necessary flexibles shall be provided by purchaser to connect the bushing terminals to the busbars of the busduct. Details of busduct shall be furnished during detail engineering stage.

6.08.12 **Neutral Terminals**

Two (2) nos. neutral terminals shall be provided on LV side. One neutral terminal shall be part of phase connection arrangement busduct throat/ LV cable-box (as applicable). Other neutral terminal shall be in a separate box and brought to tank bottom by means of earthing bar of 50x6 mm of copper, supported on porcelain insulators mounted on transformer tank. The neutral earthing bar brought to the tank bottom for connection to station earth shall be provided with holes and suitable connecting hardware. This earthing bar shall have fork type arrangement at the end.

6.09 **Neutral CT**

Bidder to provide neutral bushing CT as per details given in data sheet - A for restricted earth fault protection or standby earth fault protection. In case neutral CT is tank mounted, CT box shall be weather proof having D.O.P. IP: 55. CTs shall be cast resin type. CT mounted inside the tank shall not be acceptable.

6.10 Voltage control (off circuit type)

a) Off circuit tap-changing switch shall be three phase, hand operated, for simultaneous switching of similar taps on all the three phases by operating an external handle/ hand wheel.

b) Operating mechanism of tap changer shall be suitably labelled to show the direction of operation for raising secondary voltage & vice versa. Position markings shall be provided.

c) Arrangement shall be made for securing and padlocking the tap-changing switch at any working position. It shall not be possible to set and padlock in any intermediate position.

d) The position of off-circuit tap switch handle/hand wheel provided outside the transformer tank should be such as to enable an operator standing on ground to operate the same with ease. A caution plate indicating that switch shall be operated only when the transformer is de-energised shall be fitted near tap switch.

e) Tap position indicator and mechanical stops to prevent over-cranking of the mechanism shall be provided.

6.11 Marshalling box

a) Tank mounted vermin and dust proof marshalling box shall be provided.

b) The marshalling box shall be fabricated using sheet steel of at least 2.5mm thickness. The marshalling box shall have domed or sloping roof.

c) Marshalling box shall be complete with all internal wiring and identification ferrules, cables, conduits required for wiring between marshalling box and instruments on transformer. Wiring shall be by 1100 V grade, copper cable of size 2.5mm^2.

d) The terminal blocks shall be complete with insulating barriers and clip-on type terminals suitable for 2.5mm^2 stranded copper wire. At least 20% spare terminals shall be provided.

e) The marshalling box shall be provided with thermostatically controlled space heaters and shall have IP:55 degree of protection.

f) CT terminals shall be with shorting and disconnecting facility.

6.12 Flux density

Flux density in any part of the core & yoke on any tap position with ±10% voltage variation from voltage corresponding to the tap shall not exceed 1.9 Wb/m^2. Transformer shall also withstand following conditions due to combined voltage and frequency variations:

Continuous operation for 110% flux density
At least 1 minute operation for 125% flux density
At least 5 sec. operation for 140% flux density

6.13 Winding

For 11KV & 3.5KVwinding, type of winding shall be continuous disc & for 433 winding, type of winding shall be spiral type.

6.14 Noise & Vibration

The design and manufacture of transformer, fittings and accessories shall be such as to reduce noise & vibration. Noise level shall not be more than as specified in NEMA Standard Publication TR-1, when measured with transformer energised at normal voltage and frequency.

6.14 All transformers and their accessories shall be capable of withstanding without damage any external short circuit at the terminals for duration of two seconds.

Calculation shall be furnished by the bidder during contract engineering stage to substantiate the adequacy of support system to withstand short circuit forces.

6.15 ~~Maximum Transformer losses including tolerances shall be as per annexure – III.~~

6.16 LOADING CAPABILITY

Transformer shall be suitable for continuous operation at rated kVA on any tap with voltage variation of ± 10 % corresponding to voltage of the tap. Short duration overloading shall be in accordance with IEC 354/IS: 6600.

7.0 Fittings & accessories

7.01 Transformer shall be provided with, but not restricted to following minimum fittings and accessories for satisfactory operation:

a) Conventional type conservator with drain plug and oil filling hole.
b) Magnetic oil level gauge with low-level alarm contact.
c) Prismatic & toughened glass oil level gauge.
d) Silica gel breather with oil seal.
e) Double float type Buchholz relay with alarm and trip contacts with suitable gas collecting device with two shut-off valve on both side.
f) Diaphragm type explosion vent for transformers of rating less than 2MVA
g) Pocket on tank cover for thermometer.
h) Protected type mercury in glass thermometer.
i) Dial type (150 mm) Oil temperature indicator (OTI) with two sets of electrical potential- free contact rated for 2A, 220V DC, for alarm and trip purpose. The OTI shall be provided with anti-vibration mounting. OTI shall have maximum reading pointer along with resetting device. For remote oil temperature metering, an independent 4-20 mA should be made available.
j) Dial type (150 mm) Winding temperature indicator (WTI) with two sets of electrical potential- free contact rated for 2A, 220V DC, for alarm and trip purpose. The WTI shall be provided with anti-vibration mounting. WTI shall have maximum reading position along with resetting devices. For remote winding temperature metering, an independent 4-20 mA should be made available.
k) Drain Valves.
l) Sampling devices.
m) Filter valves.
n) Earthing terminals – 2 Nos.
o) Rating & Diagram plates.
p) Valve schedule plate.
q) Two sets of lifting lugs (one for transformer with oil and other for tank cover).
r) Jacking pads.
s) Skids and pulling eyes on both sides.
t) Air release devices.

u) Inspection cover.
v) Oil filling hole and cap.
w) Tank mounted marshalling box.
x) Detachable, flat, bidirectional rollers with 90 deg. swivel mechanism.
y) Clamping arrangement for rollers.
z) Ground support for cable box.
aa) Neutral CT secondary box.
bb) Haulage facilities.
cc) Two nos. spring operated pressure relief devices with extension pipe to bring oil to plinth level along with electrically insulated contact for alarm and tripping for transformer rating 2 MVA and above.
dd) Gas collection device along with all accessories.

7.02 Breather shall be fitted at a height not exceeding 1.5 M.

7.03 Rating and diagram plate shall be fitted at a height of about 1.75 M above the ground level.

7.04 The WTI and OTI shall have accuracy class of $\pm$ 2 deg. C or better.

7.05 Rating/ Name/ Valve schedule plates shall be of white non-hygroscopic material with engraved black lettering. Such plates shall be bi- lingual with Hindi inscription first, followed by English. Alternatively, two separate plates with Hindi & English inscription shall be provided.

8.00 PAINTING

Paint shade shall be informed to successful bidder during detail engineering as applicable for specific project.
Successful bidder shall furnish painting specification/ procedure to be used for BHEL/ CUSTOMER approval during detailed engineering. Adequate quantity of touch up paint shall also be supplied. There shall be no commercial or delivery implication to BHEL on account of paint shade, paint specification/ procedure.

9.00 COMMISSIONING, O & M SPARES AND SPECIAL TOOLS & TACKLES

9.01 Commissioning spares are those, which may be required during commissioning of the equipment. Bidder to furnish list of commissioning spares along with technical offer

9.02 O & M spares are those which are required for satisfactory & trouble free operation of equipment. List of O & M spares is enclosed as per Annexure-I.

9.03 The bidder shall supply with the equipment, one unused complete set of all special tools & tackles required for the erection, assembly, disassembly and proper maintenance of the equipment. A list of such tools & tackles (price deemed to be included in the total bid price) shall be submitted by the bidder along with the offer.

10.00 QUALITY ASSURANCE, TESTING & INSPECTION

10.01 BHEL's Standard QP (QP NO. PED-302-00-Q-001/01) is enclosed as per Annexure-V for reference. However, at contract stage, the successful bidder shall submit the QP for BHEL/ ultimate customer's approval. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ ultimate customer's approval. There shall be no commercial implication to BHEL on account of QP approval.

10.02 All materials, components and accessories of the transformers shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan.

10.03 Tests shall be performed in presence of Purchaser's representative. The bidder shall give at least fifteen (15) days advance notice of date when the tests are to be carried out.

10.04 All routine and acceptance tests as per relevant standards and specification shall be carried out by the vendor/ sub-vendor on all transformers. Charges for all these routine and acceptance tests for all the equipments & components shall be deemed to be included in the bid price.

10.05 Additionally, the bidder shall include in his equipment price the cost of carrying out the following special tests as routine tests on all the transformers:

1) Oil Leakage test for 24 hours
2) Jacking test on transformer's load bearing members.
3) Repeat no load loss tests after electrical tests.
4) Measurement of capacitance & tan delta to determine capacitance between winding & earth.

10.06 Type tests & special tests shall be conducted on one transformer of each rating and type as per Annexure-II. The charges for each of the type test & special test shall be quoted in "Schedule of Prices –Type/special Tests on Transformers". These charges shall also be applicable in case of waival of any type test/special test by the purchaser at a later date.

10.07 Successful bidder shall furnish List of sub-vendors/ makes of items for BHEL/ Customer approval at contract stage. This shall not have any commercial implication to BHEL.

10.08 All type tests except Short circuit test shall be considered for price comparisons purpose.

10.09 Charges for carrying out Short circuit test shall be payable based on actual invoice from the designated laboratories (CPRI, Bhopal / CPRI, Bangalore / ERDA, Vadodara) with an additional lump sum amount of 5% of ex-works price of transformer being tested to cover handling costs (transportation, insurance etc.).

10.10 The criteria for establishing similarity of transformer for acceptance of Short circuit test report is as follows :

Criteria for establishing similarity of transformer for acceptance of Short circuit test report

Transformers similar to a reference transformer can be identified by comparison using the following list of critical features :

1. Same kVA rating as the reference unit.
2. Same voltage ratio as the reference unit.
3. Same % impedance as the reference unit.
4. The tested No load loss and load loss of the reference unit shall be in the range of 100% to 90% of the max. No load loss and load loss respectively being guaranteed for the unit proposed to be supplied.
5. Same type of operation i.e. aux. Service distribution as the reference unit.
6. Same conceptual design i.e oil-immersed type, core type with concentric windings, sandwich type, shell type, circular coils, non- circular coils as the reference unit.
7. Same arrangement of main windings and geometrical sequence as the reference unit.
8. Same type of winding conductors i.e annealed or hardened copper, continuously transposed conductors and epoxy bonding, if used, as the reference unit.
9. Same type of main windings e.g. helical, disc, layer, pancake, as the reference unit.
10. Same relative winding stresses (ratio of actual to critical stress) at short circuit not exceeding 110% of those as the reference unit.
11. Same manufacturing process as the reference unit.
12. Same clamping and supporting arrangement as the reference unit.

11.00 DRAWINGS, DATA & DOCUMENTS TO BE SUBMITTED

11.01 Following shall be submitted along with the offer:

a) The enclosed Data Sheet-B filled up completely for each rating/ type of transformers.
b) Clause – wise deviation, if any.
c) Out line General Arrangement Drawings for each rating & type of transformer.
d) Foundation plan drawing for each rating & type of transformer.

11.02 Following documents shall be submitted after placement of order for BHEL & customer's approval:

a) The enclosed Data Sheet – C duly filled up.
b) Vendor Drawing submission schedule.
c) Design calculation for short circuit withstands capability (refer cl. 6.14).
d) Overall General Arrangement Drawing clearly showing all fittings, accessories, termination details, foundation details with roller locking arrangement.
e) General Arrangement of Marshalling Box.
f) Rating & Diagram Plate Drawing.
g) Valve Schedule Plate Drawing.
h) Cable Box Arrangement Drawing.
i) Bushing/ Insulator Drawings.
j) Busduct Trunking Drawings.
k) Quality Plan.
l) Type test procedure
m) Wiring Diagrams.
n) Type/ Special Test certificates for tests already carried out on similar transformers.
n) Painting procedure of vendor for approval of customer.
o) Recommended Field Quality Plan
q) Routine test reports
r) O & M Manuals

The documents listed at sl. no. a),b) & c) shall be submitted by successful bidder within 2 weeks from L.O.I while documents sl. no. d) through o) shall be submitted by successful bidder within 4 weeks from L.O.I.

No. of documents/ drawings required shall be as per "Documents/ Drawings Distribution Schedule" enclosed as per Annexure-IV.

12.00 O & M MANUALS

12.01 O & M manuals for the installation, operation and maintenance of transformers shall be furnished at least three months before despatch of equipment.

12.02 Draft manual should first be submitted for purchaser's approval. The manual should contain minimum following details:

a) General description of equipment.
b) Approved Technical Data Sheet
c) Salient constructional features.
d) Technical leaflets of fittings/ important parts.
e) All drawings.
f) Type and routine test certificates.
g) Instructions to be followed on receipt of equipment at site & for storage.
h) Instructions for foundation arrangement.
i) Erection procedures and checks.
j) Pre-commissioning checks.
k) Commissioning procedures.
l) Withdrawal arrangement/ material handling instructions.
m) Operation instructions.
n) Maintenance instructions.
o) Trouble-shooting.
p) Safety instructions.

13.00 All drawings/ documents indicated at clause no. 11 & 12 above shall be computer generated. Drgs. / documents shall be required in soft form (PDF format) also. All drawings shall be prepared in AUTOCAD latest version. Drawings & documents shall be submitted in CD also. The number of copies of various drawings/ documents shall be as per Annexure -IV.

ANNEXURE-II

TYPE/SPECIAL TESTS FOR OIL FILLED SERVICE TRANSFORMERS

a) Tank Pressure test
b) Tank Vacuum test
c) Capacitance & tan delta of windings
d) Noise level
e) Measurement of harmonic current in no load current
f) PRD operation test (applicable for 2000kVA & 2500kVA transformer)
g) Short circuit test
h) Degree of protection (IP55) test on marshalling box.
i) Degree of protection (IP55) test on cable box.
j) Zero sequence impedance.
k) Temp rise test.
l) Dielectric type test (including chopped wave impulse test)
m) DGA test on oil before and after temperature test.

ANNEXURE - VIII

APPLICABLE STANDARDS & CODES FOR TRANSFORMERS

Specification for power transformers	IS: 2026 [ ] IS: 11171 [ ] IS:6600 [ ]	IEC: 76 [ ] IEC:354 [ ]	BS: 171 [ ]
Fittings & accessories for power transformer	IS: 3639 [ ]	IEC: [ ]	BS: [ ]
Specification for new insulation oil	IS: 335 [ ]	IEC: 296 [ ]	BS: 148 [ ]
Bushing for alternative voltage above 1000 volts	IS: 2099 [ ]	IEC: 137 [ ]	BS: 223 [ ]
Dimension for porcelain transformer bushings	IS: 3347 [ ]		
Current transformers	IS: 2705 [ ]	IEC: 185 [ ]	BS: 3938 [ ]
Gas operated relays	IS: 3637 [ ]		
Classification of insulating material for electrical machinery & apparatus in relation to their thermal stability in service	IS:1271 [ ]	IEC: 216 [ ]	
Classification of degrees of protection provided by enclosures of electrical equipment	IS: 12063 [ ]	IEC: 529 [ ]	IS: 13947 [ ]
Method of high voltage testing	IS: 2071 [ ]	IEC: 60 [ ]	
Colours for ready mixed paints & enamels	IS: 5 [ ]		
Specifications for power & distribution transformers	CBIP Publication No275(1999 edition [ ]		
Guide for loading of oil immersed transformers	IS: 6600 [ ]	IEC: 354 [ ]	BS: [ ]
Noise level	NEMA, STANDARD-TR1		

बीएचईएल	TITLE : **TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS** DATA SHEET-A	SPECIFICATION NO. **PE-RC-999-302-E001**
		VOLUME NO. : **III**
		SECTION : **D**
		REV NO. : 00 DATE : 28/05/10
		SHEET : 1 OF 3

11/0.433 kV or 0.420, ~~6.6/0.433kV or 0.420, 3.3/0.433kV or 0.420~~ 0.415V

S. No.	Description	Unit	Particulars
1.0	Quantity	As per Requirement	312 KVA 630 kVA 1000 kVA 1600 kVA 2000 kVA 2500 kVA
2.0	Service (Unit/Station)		Unit/Station
3.0	Installation		Out Door
4.0	Type of insulating oil		Mineral
5.0	No. of phase	No(s)	03
6.0	Frequency	Hz	50
7.0	Type of cooling		ONAN
8.0	Rated output under site conditions	kVA	As indicated
9.0	Rated Voltage a) HV Winding b) LV Winding	 kV kV	 11.0, 6.6, 3.3 ~~0.433~~ 0.415
11.0	No Load transformation ratio		11/0.433 or ~~420~~ 415 6.6/0.433 or 420 3.3/0.433 or 420
11.0	Vector group		Dyn1/ ~~Dyn11/ Dyn5~~
12.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	312 KVA S/. 630 kVA : 6% or 5 % 1000 kVA : 6% or 5%. 1600 kVA : 8% or 7% 2000 kVA : 10% or 8% 2500 kVA : 10% or 9% (Actual impedance shall be indicated for specific project along with LOI/ PO)
13.0	Total range of tappings and tapping steps		± 5% in steps of 2.5%
14.0	Type of tap changing equipment		Off-Circuit

15.0	Temperature rise		
	a) Top oil by thermometer	deg. C	50 deg. C above ambient of 50 deg.C
	b) Winding by resistance	deg. C	55 deg. C above ambient of 50 deg.C
16.0	System Highest Voltage		
	a) HV Winding	kV	12.0, 7.2 , 3.6 kV
	b) LV Winding	V	415V + 10%
18.0	Phase Connection		
	a) HV Winding		Delta
	b) LV Winding		Star
18.0	Insulation Levels		
18.1	One minute power frequency withstand voltage		
	a) HV Winding	kV	28 (11kV), 20 (6.6kV) 10 (3.3 kV)
	b) LV Winding	kV	3
18.2	Impulse withstand voltage		
	a) HV Winding	kVp	75 (11kV), 60 (6.6kV) 40 (3.3 kV)
	b) LV Winding	kVp	-
19.0	Terminal details		
	a) HV Line		Cable box (XLPE cables)
	b) HV Neutral		N.A.
	c) LV Line		Flange throat for TPN non-segregated Al Busduct
	d) LV Neutral		One neutral as part of LV busduct throat and second neutral with copper earthing bar for system earthing brought near the base of the transformer.
20.0	System Fault Level		
	a) HV Winding	kA	25~~40~~ kA RMS
	b) LV Winding	kA	50 kA RMS
21.0	Method of System Earthing		
	d) HV System		low resistance earthed to limit earth fault current to 300A-1000A
	e) LV System		Solidly grounded
	f) Through fault withstand time		2 Sec.

22.0	Details of Cooling Equipment		Detachable tank mounted radiators
23.0	Provision/ accommodation of CTs LV Neutral		**2** Core PS CLASS or 5P20. CT particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.
24.0	Colour Shade : a) Interior (For M. Box) b) Exterior		 As required As required
25.0	Space/ Layout Limitation if Any		
26.0	Cable details c) HV side		
	i) Type		XLPE
	ii) Voltage Grade	12kV	Unearthed
	iii) Conductor material & size		Stranded Aluminium, after award of contract
	iv) No. of cores & runs		Three core, one run
	d) LV side		
	i) Type		N.A
	ii) Voltage Grade	kV	N.A
	iii) Conductor material & size		N.A
	iv) No. of cores & runs		N.A
27.0	Penalty for Losses		
	d) Rates for bid evalution		N.A.
	e) 'A' (for no load loss)		Losses not to exceed max. losses as per annex-III to sec-C of the specification
	ii) 'B' (for load losses)		- Do-
	f) Rates for penalty		
	i) 'A' (for no load loss)		Rs. 1.95 lacs per kW
	ii) 'B' (for load loss)		Rs. 1.95 Lacs per kW

DATA SHEET-B

(TO BE SUBMITTED ALONG WITH OFFER FOR EACH RATING)

बीएचईएल	TITLE : **TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS** DATA SHEET-B	SPECIFICATION NO. **PE-RC-999-302-E001**
		VOLUME NO. : **III**
		SECTION : **D**
		REV NO. : 00 DATE : 28/05/10
		SHEET : 1 OF 1

FOR 11kV/~~0.433V~~ 0.415V 3.12V

S. No	Description	2.5MVA	2.0MVA	1.6MVA	1.0MVA	kVA
1.	Rating					
2.	No Load transformation ratio					
3.	Maximum No- load losses at rated frequency and 100% rated voltage					
4.	Maximum load losses at normal ratio, rated current and 75 deg. C					
5.	Overall Dimensions					
6.	Total weight					
7.	Total oil Quantity					

FOR 6.6kV/0.433V

S. No	Description	2.5MVA	2.0MVA	1.6MVA	1.0MVA	630kVA
1.	Rating					
2.	No Load transformation ratio					
3.	Maximum No- load losses at rated frequency and 100% rated voltage					
4.	Maximum load losses at normal ratio, rated current and 75 deg. C					
5.	Overall Dimensions					
6.	Total weight					
7.	Total oil Quantity					

FOR 3.3kV/0.433V

S. No	Description	2.5MVA	2.0MVA	1.6MVA	1.0MVA	630kVA
1.	Rating					
2.	No Load transformation ratio					
3.	Maximum No- load losses at rated frequency and 100% rated voltage					
4.	Maximum load losses at normal ratio, rated current and 75 deg. C					
5.	Overall Dimensions					
6.	Total weight					
7.	Total oil Quantity					

GUARANTEED TECHNICAL PARTICULARS
(DATA SHEET-C)

बीएचईएल BHEL	TITLE : **TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS** DATA SHEET-C	SPECIFICATION NO. **PE-RC-999-302-E001**
		VOLUME NO. : **III**
		SECTION : **D**
		REV NO. : 00 DATE : 28/05/10
		SHEET : 1 OF 5

Instructions to vendor : This data sheet shall be submitted by successful bidder after award of contract

S. No.	Description	Unit	Particulars
1.0	Name of Manufacturer		
2.0	Reference Standards		
3.0	Installation		
4.0	Rated no load Voltage		
	a) HV Winding	kV	
	b) LV Winding	kV	
5.0	Type of cooling		
6.0	Rated kVA		
7.0	No. of phase	No(s)	
8.0	Rated Frequency	Hz	
9.0	Winding connections		
	a) HV Winding		
	b) LV Winding		
10.0	Vector group		
11.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	
12.0	Off-Circuit tap changer		
	a) Total range of tappings (+/-)	%	
	b) Size of tapping step	%	
	c) For HV/LV variation		
13.0	Impulse voltage withstand level		
	a) HV Winding	kVp	
	b) LV Winding	kVp	

Name of Vendor			Project		
Revision number	0	1	2	3	VANDOR'S SEAL
Vendor's Signature					
Date					

Instructions to vendor : This data sheet shall be submitted by successful bidder after award of contract

14.0	Power frequency withstand voltage for one minute	
	a) HV Winding	kV
	b) LV Winding	kV
15.0	Maximum No load losses at rated frequency and	
	a) 100% rated voltage	kW
	b) 110% rated voltage	kW
16.0	Maximum Load losses at normal ratio, rated current and 75 deg. C	
17.0	Tolerance on losses (+/-)	
18.0	Guaranteed maximum Temperature rise of	
	a) Top oil by thermometer above ambient of 50 deg. C	deg. C
	b) Winding by resistance above ambient of 50 deg. C	deg. C
19.0	Efficiency at 75 deg. C and unity power factor for	
	a) 100% full load	%
	b) 75% full load %	
	c) 50% full load	%
20.0	Voltage regulation at full load at 75 deg. C	
	a) Unity power factor	%
	b) 0.8 Power factor (Lagging)	%
21.0	External short circuit withstand capacity	MVA
22.0	Max. short time (30 sec.) rating of transformer	KVA
23.0	Type of magnetic circuit	Core/ Shell
24.0	Type of core joints	

Name of Vendor			Project		
Revision number	0	1	2	3	VANDOR'S SEAL
Vendor's Signature					
Date					

25.0 Type of winding
- a) HV Winding
- b) LV Winding

26.0 Type of insulation
- a) HV winding
- b) LV winding
- c) Between core & adjacent winding
- d) Between windings

27.0 HV terminal arrangement
- a) Bushing with or without CTs
- b) CT details (Ratio, ACC. Class, VA, Type)
- c) Clearance between phases in air mm
- d) Clearances to earth in air mm

28.0 LV terminal arrangement
- a) Bushing with or without CTs
- b) CT details (Ratio, ACC. Class, VA, Type)
- c) Clearance between phases in air mm
- d) Clearances to earth in air mm

29.0 Neutral terminal arrangement
- a) No. of neutral terminals
- b) Neutral CT provided or not
- c) NCT details (Ratio, ACC. Class, VA, Type)

30.0 HV Bushing
- a) Rated voltage class kV
- b) Rated current A

31.0 LV Bushing
- a) Rated voltage class kV
- b) Rated current A

32.0 LV Neutral Bushing
- a) Rated voltage class kV
- b) Rated current A

Name of Vendor			Project		
Revision number	0	1	2	3	VANDOR'S SEAL
Vendor's Signature					
Date					

Instructions to vendor : This data sheet shall be submitted by successful bidder after award of contract

33.0	Maximum flux density	
	a) At rated voltage	Wb/M2
	b) At 110% rated voltage	Wb/M2
34.0	Maximum current density for	
	a) HV Winding	Amp/mm2
	b) LV Winding	Amp/mm2
35.0	Magnetising current at rated voltage and frequency (% of full load current)	
36.0	Rollers	
	a) Type	
	b) Unidirectional/ Bidirectional	
	c) Quantity	
	d) Gauges	
	i) Longitudinal	mm
	ii) Transverse	mm
37.0	Pressure test withstand	
	a) Tank	Kg/M2
	b) Radiator and other fittings	Kg/M2
38.0	Vacuum withstand	
	a) Tank	mm of Hg
	b) Radiator and other fittings	mm of Hg
39.0	Approximate weight of	
	a) Core	Kg
	b) Windings	Kg
	c) Tank, Fittings & Coolers etc.	Kg
	d) Oil	Kg
	e) Total weight with oil	Kg
	f) Untanking weight (core & winding)	Kg
	g) Shipping weight of the heaviest package	Kg
40.0	Quantity of Insulating Oil	
	a) Oil in tank	Ltrs.
	b) Oil in cooling equipment	Ltrs.
	c) Total oil Quantity	Ltrs.

Name of Vendor			Project		
Revision number	0	1	2	3	VANDOR'S SEAL
Vendor's Signature					
Date					

41.0	Dimensions	
42.1	Tank dimensions	
	a) Length	mm
	b) Breath	mm
	c) Height	mm
42.2	Shipping dimensions of the largest package	
	a) Length	mm
	b) Breath	mm
	c) Height	mm
42.3	Overall Dimensions (LxBxH)	(mmXmmXmm)
43.0	Details of tank and other material	
	a) Thickness of tank side plate	mm
	b) Thickness of tank bottom plate	mm
	c) Thickness of tank cover plate	mm
	d) Thickness of radiator sheets	mm
	e) Minimum clearance height for lifting core and winding from tank	mm
44.0	Positive sequence impedance at	
	a) Maximum voltage tap	%
	b) Minimum voltage tap	%
45.0	Zero-sequence impedance at principal tap	%

Name of Vendor			Project		
Revision number	0	1	2	3	VANDOR'S SEAL
Vendor's Signature					
Date					

UNIT PRICE SCHEDULE - O & M SPARES

S. NO.	DESCRIPTION	QTY.	UNIT PRICE Rs.	REMARKS
1	HV bushing with metal parts & gaskets	1 nos. each rating		
2	LV bushing with metal parts & gaskets	1 nos. each rating		
3	WTI with alarm & trip contacts	1 no.		
4	OTI with alarm & trip contacts	1 no.		
5	Magnetic oil level gauge (MOG)	1 no.		
6	Pressure relief device	1 no.		Applicable for 2000kVA & above Transformers
7	Diaphragm of explosion vent	1 no.		
8	Buchholz relay	1 no.		
9.	Silica gel charge	3 charge		
10	Floats with contacts for Buchholz relay	1 set		
11	Set of gaskets	2 sets		
12	Contacts for tap changer	1 set		
13	Set of valves (1 no. of each size & type)	1 set		
14	Set of windings for one limb in a suitable oil container	1 no. each rating and type of transformer		The container shall be completely filled with transformer oil.
15	Hydraulic/Screw Jack	4 no.		
16	Any other item considered essential by the bidder			

NOTES

1) Wherever 'set' is indicated above, it means the total parts / accessories required to replace the particular item for a given equipment.
2) O & M spares shall be supplied along with transformers and packed separately with proper inscription on the boxes.
3) Prices to be given separately for each rating & type of transformer.

SECTION - 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 INTRODUCTION

Kishanganga Hydroelectric project (3x110=330MW) is located in Baramulla district of Jammu and Kashmir state of India. As a part of the project, 220/33 kV Switchyard is being carried out.

3.1 PROJECT INFORMATION

SL. NO	DESCRIPTION	
a)	Customer	NATIONAL HYDRO ELECTRIC POWER CORPORATION LIMITED (NHPC) **KISHANGANGA CONSORTIUM:** **Hindustan Construction Company (HCC) Ltd.** **HALCROW** **Subcontractor: Bharat Heavy Electricals Ltd. (BHEL)**
b)	Project	220/33kV Switchyard for Kishanganga (3x110MW) HEP
c)	Project locations	Kishanganga Hydroelectric project(3x110=330MW) is located in Baramulla district of Jammu and Kashmir state of India. Refer Project Details from Contract Specification attached herewith.
d)	Nearest Airport	Srinagar is the nearest city, well connected by Air.
e)	Nearest Railway station /Gauge Distance from Railway Station	Jammu is the nearest broad guage railway head
f)	Road Approach	Refer Project Details from Contract Specification attached herewith.
	Transport Limit	Refer Project Details from Contract Specification attached herewith.

3.2 SITE CONDITIONS

SL. NO	DESCRIPTION	
i.	Altitude	About 1795 m above mean sea level.
ii.	Rainfall (Average annual rainfall)	Refer Project Details from Contract Specification attached herewith.
iii.	AMBIENT AIR TEMPERATURE (a) Max. temp (b) Min. temp	 38 deg C -12 deg C
iv.	RELATIVE HUMIDITY (a) Maximum (b) Minimum	 94% 62%

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the above tropical conditions.

Seismic Design

The project is situated in a hilly seismic area and falls within Zone V of the seismic zoning Map of India. Value of horizontal component of peak ground acceleration for Maximum Credible Earthquake (MCE) and for Design basis Earthquake (DBE) shall be 0.36g and 0.18g respectively. The forces being caused by earthquake including hydraulic loads, which may occur additionally, shall be taken into account for the computations. Stresses resulting after including these loads shall not exceed permissible stresses.

The Contractor shall design all equipment supplied under this contract to satisfy the seismic criteria. The Contractor shall submit the method of calculation and relevant codes he intends to use for this purpose.

In addition to above, the IS 1893 shall be adopted for seismic design. Hydrodynamic forces due to seismic conditions shall be considered on HM or EM equipment in addition to hydro static loads.

3.2.1 Auxiliary Supply

Auxiliary electrical equipment pertaining to this project shall be suitable for operation at the following supply system.

Normal Voltage	Variation in Voltage	Frequency (Hz)	Phase/Wire	Neutral Connection
415 Volts	± 10%	50 ± 5%	3/4 wire	Grounded neutral
240 Volts	± 10%	50 ± 5%	½	effectively earthed
220 Volts	± 10%	DC	2 wire	Ungrounded, with earth fault detection
48 Volts	± 10%	DC	2 wire	Ungrounded, with earth fault detection

Combined variation of voltage and frequency shall be limited to ± 10%.

3.3 INSPECTION, TESTING AND INSPECTION CERTIFICATE

All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with relevant standards.

All tests and inspection of the equipment specified shall be performed to the extent and in the manner as stipulated in the relevant standards and in this specification. All type test/routine tests/acceptance tests as specified shall be conducted in the presence of BHEL/NHPC. Wherever equipment similar to the one being offered has already been type tested in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, Type test reports of the same shall be submitted for approval of BHEL /NHPC.

If these are not found technically acceptable, contractor will have to carry out the type test without any extra cost and/ or delivery implications in presence of BHEL/NHPC.

Where specified by the purchaser, type tests will have to be conducted by the sub-contractor

on the equipment in the scope of supply. Such test shall be witnessed by the customer and BHEL, for which the test charges and delivery implications if any shall be indicated separately by the sub-contractor.

The contractor shall give the Owner/Inspector 3 week's written notice of any material being ready for inspection/testing. Such tests shall be to the Contractor's account except for the expenses' of the Inspector.

The purchaser NHPC/BHEL or their authorized representative shall have at all reasonable times free access to the contractor's works and shall have the power at all reasonable times to inspect the material and workmanship of the works during manufacturing or erection if part of the works is being manufactured or assembled at other premises. Inspection may be made at any stage of manufacture, dispatch or at site at the option of NHPC/BHEL and the equipment if found unsatisfactory due to bad workmanship or quality is liable to be rejected.

When the factory tests have been completed at the subcontractor's works the Owner/Inspector shall issue a certificate to this effect after completion of tests. But if the tests are not witnessed by the Owner/Inspector, the waival shall be issued by the Owner/Inspector within fifteen (15) days of the receipt of the Contractor's test certificate. Failure of the Owner/Inspector to issue such a waival shall not prevent the contractor from proceeding with the works. The completion of these tests or the issue of the waival shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the Contract. However, in case of waivals, the contractor shall ensure to carry out the testing as per approved quality plans and specification requirements and send two copies of all the test results to the Owner for his review and approval.

In all cases where the Contract provides for tests at the premises or works of the contractor, the contractor, except were otherwise specified shall provide free of charge such items as labor materials, electricity, fuel; water, stores, apparatus and instruments as may be reasonably demanded by Owner/Inspector or his authorized representatives to carry out such tests.

The Inspection by Employer and issue of inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the contract.

The owner will have the right of having at his own expenses any other test(s) of reasonable nature carried out at contractor premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

The Employer reserves the right for getting any field tests conducted on the completely assembled equipment at site.

3.4 QUALITY ASSURANCE PROGRAMME

The supplier should adopt suitable quality assurance programme to control all necessary activities to ensure that the equipment and / or services under the scope are in accordance with this specification. A quality plan detailing out the specific quality measure and procedures adopted for controlling the quality characteristics to be submitted for BHEL and NHPC approval.

The quality programme is defined by ISO 9001, 1994 Quality systems - Model for quality assurance in design, development, production, installation and servicing.

on reproducible tracing film on which the VENDOR/Contractor shall make in a neat and accurate manner, a complete record of all changes and revisions to, the original design, as installed in the completed work. These drawings shall be submitted to the Owner/Engineer.

AS BUILT DRAWINGS

The Contractor shall prepare and submit to the Owner/Engineer "As- Built drawings" of the Works, showing all Works as executed. The drawings shall be prepared as the Works proceed, and shall be submitted to owner/Engineer for his inspection. The Contractor shall obtain the consent of the Owner as to the drawing size, the referencing system and other pertinent details.
The drawings/documents distribution schedule shall be as indicated below.
The title block of drawings shall contain the following information incorporated in all contract drawings

CUSTOMER	National Hydroelectric Power Corporation Limited (NHPC)				
PROJECT	220/33kV Switchyard for Kishanganga (3x110MW) HEP KISHANGANGA CONSORTIUM: Hindustan Construction Company (HCC) Ltd. HALCROW Subcontractor: Bharat Heavy Electricals Ltd. (BHEL)				
BHEL P.O. No.		**PROJ. DOC. No.**		**REV. No.**	
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED				
VENDOR'S STANDARD TITLE BLOCK					

DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

1) **Drawings**
2) **Guaranteed Technical Particulars**
3) **Type Test Reports**
4) **Manufacturing Quality Plan**

DOCUMENTATION SCHEDULE AT CONTRACT STAGE

A	**For Approval**
7 (6+1)	Copies of GA drawings with projects details, dimension, equipment weight, fixing details, tolerances and terminal details etc.
7 (6+1)	Copies of type test reports
7 (6+1)	Copies of shipping list detailing the description & quantities of all items being dispatched separately, with shipping weights, number of cases and dimensions.
7 (6+1)	Copies of manufacturing and field quality plan.
B	**After Approval and For Information/Distribution.**
11 (10+1)	Copies of All drawings plus 2 Set Reproducibles.
11 (10+1)	Bound sets containing all 'as built' drawings/manuals, type and routine test reports etc. along with sub-vendor's test reports for all bought out assemblies/components/parts including Internal wiring diagrams and exploded diagrams of assemblies/ parts, shall be furnished plus 2 Set IR
11(10+1)	Copies of Installation, Operation & Maintenance manual.
11(10+1)	Sets of Spare parts catalogue.
5	Set of Computer CD-ROMs containing all 'as-built' drawings/documents.

All the technical documents and drawings required to be furnished under this contract as per specification shall be prepared in internationally accepted software of latest version used for preparation of documents and drawings.

All the drawings and documents shall be submitted in presentable folders properly bound and catalogued for easy retrieval / reference. Drawings shall be submitted in A0 / A2 /A3 and all documentation in A4 size. All drawings shall be digitally printed/ plotted. Ammonia print/ blue print shall not be accepted.

Time schedule of drawings/documents required at contract stage shall be furnished by the supplier.

Material shall not be dispatched without the approval of test certificates by purchasers.

3.6 MATERIALS AND WORKMANSHIP

3.6.1. GENERAL REQUIREMENTS

Where the specification does not contain characteristics with reference to workmanship, equipment materials and component of the covered Equipment, it is understood that the same must be new, of highest .grade of the best quality of their kind, conforming to the best engineering practice and suitable for the purpose for which they are intended.

The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice, latest state of ardent and in accordance with purpose for which they are intended and to ensure satisfactory performance throughout the service life.

Incase where the equipment material or components are indicated in the specification as "similar" to any special standard, the employer shall decide upon the question of similarity. When required by the specification or required by the employer the supplier shall submit, for approval, all the information concerning the material or components supplied, installed or used. Without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Supplier.

The design of the work shall be such that Installation, future expansions, replacement and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All Joints and fastenings shall be devised, constructed and documented so that the component part shall be accurately positioned and retained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Employer.

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same material and workmanship as the corresponding parts of the equipment supplied under specification. Where feasible, common component units shall be employed in different pieces of the equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All material and equipment shall be installed in strict accordance with the manufacturer's

recommendation(s). Only first-class work in accordance with the best modern practice will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall Include unpacking, cleaning and lifting into position, grouping, leveling, aligning, coupling of or bolting down to previously installed equipment bases/ foundation, performing the alignment check and final adjusting prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instruction and the specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and/or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated location and tested for healthiness.

The Supplier shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment Lubricants used for installation purpose shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Supplier shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/Equipment shall be purchased in India unless the Supplier has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Employer in establishing equivalent India make and Indian supplier. The same shall be applicable to other consumables too.

A cast iron or welded steel base plate shall be provided for all rotating equipments which are to be installed on a concrete base unless otherwise agreed to by the Employer. Each base plate shall support the units and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, If so required.

All components exposed to rain shall be designed with sloped upper surface to avoid water pools.

3.7 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

All power clamps and connectors shall confirm to IS:5561 & NEMA CCI and shall be made of materials listed below:

a	For connecting ACSR	Aluminium alloy casting conforming to designation A6 of IS:617 and shall be tested for all test as per IS:617
b	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from Aluminium alloy casting conforming to designation A6 of IS:617 with 2mm thick liner and shall be tested as per IS:617
c	For connecting GI shield wire	Galvanised mild steel
d	I) Bolts, nuts & plain washer galvanised II) Spring washers for items 'a' to 'c'	i) Electro galvanisation for sizes below Ml2, for others hot dip Galvanised ii) Electro Galvanised mild steel suitable for at least service condition-3 as per IS: 1573

Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor termination of equipment shall be suitable for Twin/ single Zebra/ Moose ACSR Conductor with 250 mm Sub-Conductor spacing. The requirement regarding external RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position

Where copper to aluminium connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the employer by the supplier.

Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of work.

No current carrying part of any clamp shall be less than 12 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminium body for Bi-metallic clamps.

Lateral load deflection test shall be carried out as an acceptance test. The test procedure and accepted norms shall be mutually discussed and agreed to.

All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified with respect to the specified reference ambient temperature shall also be indelibly marked on each component of the clamp/connector, except on the hardware.

All current carrying parts shall be designed and manufactured to have minimum contact resistance.

Clamps and connectors shall be designed to be corona controlled. RIV level for 220 kV/ 132 kV system shall not be more then 1000 micro volts respectively at the specified test voltage as per IS/NEMA

3.7.1. TESTS

Clamps and connectors shall confirm to type tests and shall be subjected to routine tests as per IS:5561

3.7.2. HIGH VOLTAGE TERMINAL

The high voltage terminals shall be preferably made of aluminium or aluminium alloy. If copper terminals are used, they shall be tin-plated. The conductor termination of equipment shall be either expansion, sliding or rigid type suitable for ACSR Conductor./Aluminium tube.

3.7.3. GROUND TERMINAL EARTHING

Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of star of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

3.8 NAME PLATES, RATING PLATES AND LABELS

a) Each main and auxiliary item of equipment is to have permanently attached to it in a

conspicuous position a rating plate of non-corrosive material upon which is to be engraved the following:

i) Manufacturer's name
ii) Type number
iii) Serial number
iv) Rated voltage
v) Rated impulse withstand voltage
vi) Rated power frequency withstand voltage
vii) Rated frequency
viii) Rated current
ix) Rated short circuit breaking current
x) Rated short time current (rms) & duration.

together with details of the loading conditions under which the item of substation in question has been designed to operate and such diagram plates as may be required by the Employer. The rating plate shall confirm to IEC requirement.

b) All such name plates, instruction plates, rating plates etc. shall be in bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi & the other with English inscription may be provided.

3.9 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

Outdoor and indoor equipment supplied shall be suitable for service and storage under tropical conditions of high & low temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mild dew.

3.9.1. SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heater shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heater to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centred in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material to prevent any contact between the wires. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built in to an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value, which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

3.9.2. FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied to parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shaft be protected against the application of the varnish.

3.9.3. VENTILATION OPENING

In order to ensure adequate ventilation, components shall have ventilation openings provided with fine wire mesh of brass or galvanized steel to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

3.9.4. DEGREE OF PROTECTION

The enclosures of the control cabinets, junction boxes and marshalling boxes to be installed shall provide degree of protection as detailed here under:

a) Installed outdoor: IP-65
b) Installed Indoor in air conditioned area: IP-40 or higher
c) Installed in covered area:IP-52
d) Installed indoor in non-air conditioned area where possibility of entry of water is limited: IP-41
e) For LT Switchgear (AC & DC Distribution Boards): IP-52

The degree of protection shall be in accordance with IS: 13947(Part-I) or IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

3.9.5. TROPICALISATION

All equipment shall be suitable for installation in a tropical monsoon area having hot, humid climate and dry and dusty seasons with ambient conditions as specified. All control wiring, equipment and accessories shall be protected against fungus growth, condensation, vermin and other harmful effects due to a tropical environment.

3.10 SURFACE TREATMENT, PAINTING AND FINISHING OF METAL SURFACES

3.10.1. GENERAL

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro-galvanized to service condition. All steel conductors Including those used for earthing/grounding (above ground level shall also be galvanized according to IS:2629.

3.10.2. HOT DIP GALVANIZING

The minimum weight of the zinc coating shall be 610g/sq.m and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For Items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM.

The galvanized surfaces shall consist of a continuous and uniform thick coaling of zinc, firmly adhering to the surface of steel. The finished surfaces shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, plate which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the standard preece test. All other coating shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating
- Uniformity of zinc
- Adhesion test
- Mass of zinc

Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit Application of zinc rich paint at site shall not be allowed.

3.10.3. PAINTING

All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 'code of practice for phosphating Iron and sheet'. All surfaces which will not be easily accessible after shop assembly, shall before hand to be treated and protected for the life of the equipment The surface which are to be finish painted after installation, shall be shop painted with atleast two coats of primer. Oil, grease, dirt and swart shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats or ready mixed, stoving type zinc chromate primer, the first coat may be flash dried, while the second coat shall be stoved.

After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

The exterior colour of the paint shall be as per shade No.:631 of IS-5 and inside shall be glossy white. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

In case the bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc. the procedure shall be submitted along with the bids for employer's review & approval.

3.11 CASTING

All castings shall be true to pattern, free from defects and of uniform quality and condition. The surface of castings, which do not undergo machining, shall be free from foundry irregularities. The casting shall be tested for NDT, chemical, mechanical and metallographical tests. This shall be specified in quality plan for the specific equipment. Iron casting material shall be in accordance with ASTM A 126 class B. Steel casting shall be manufactured in accordance with ASTM A 27 and shall be subject to appropriate tests and inspection.

3.12 FORGINGS

If requested by purchaser, forging shall be tested by magnetic particle, dye penetration, radiographic, ultrasonic or any combination of methods, which may suit material type and forging design. The testing is to be carried out according to appropriate ASTM standards. The forging shall be tested for mechanical and metallographical tests as per ASTM.

3.13 FABRICATED COMPONENTS

All components machined or fabricated from plate, sheet or bar stock shall meet the material requirements of ASTM. Structural steel, rolled shapes, bars etc. shall comply with the latest ASTM for A36.

All or a representative number of such components shall be subjected to one or more of the tests: visual, dye penetration, magnetic particle (transverse and longitudinal), ultrasonic or radiograph. These tests shall be in accordance with the ASTM. The acceptance shall be as per ASTM Specifications.

3.14 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

Unless otherwise specifically called for or described in these Contract documents all electrical appliances shall conform to the applicable IEC Publications.

The cubicles and enclosures shall be of protection class IP 40 or higher according to their location. For outside installation and area which are humid, corrosive, and prone to dripping and/ or spray of water, the protection class of cubicles shall be IP 65. Cubicles housing electronic cards/modules such as of unit control boards/local control boards, digital governors, static excitation equipment shall be of protection class of IP 5X.

Cables shall have at least 1000 V PVC insulation except for 220V DC and tele-metering or communication system equipment for which 650V and 300 V ratings respectively are acceptable.

For current and potential transformer secondary circuits the minimum cross section of the conductors shall not be less than 4.0 mm2.

Wiring shall terminate at terminal blocks at one side only. Where tap connections are required, they shall be made on terminal blocks. Wiring shall be neatly arranged and laid in wire ways accessible from the front door. The wire ways shall not be filled more than 70 %.

Each cubical shall be provided with an earthing bar (PE) of sufficient cross section carrying any possible fault current without undue heating. All metallic parts of the cubicle not forming part of the live circuits, all instrument transformer terminals to be earthed and other earthing terminals as well as all cable screens and PE-wires shall be connected to the earthing bar.

All internal equipment and wiring shall be neatly and clearly marked as indicated on the schematic and wiring diagrams. Internal wiring and cables shall be marked with sleeve type engraved marking. Marking system and marking material shall be subject to approval by Employer. Identification of the respective conductors shall be in accordance with the requirements of IEC publication 60204. In cable, having five conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than five conductors colour coding in accordance with IEC Recommendations 60204 shall be used.

Cubicles and control panel enclosures shall be of cold rolled sheet steel with minimum thickness for load bearing members as 2.5mm and non load bearing as 2 mm, of rigid, self-supporting construction and supplied with channel bases made to ensure no bulging takes place.

Cubicles shall be fitted with close fitting, gasketted, hinged, lift-off doors capable of being

opened through 180 deg. The doors shall be provided with integral lock and master key.

Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. Under no circumstances shall the floor/roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.

The cubicles and panels shall be adequately ventilated, if required, by vents or louvers, and shall be so placed as not to detract from the appearance. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

Unless stated otherwise, all cubicles and panels shall be provided with a ground bus with 40mm copper bar extending through out the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm2.

The standard phase arrangement when facing the front of the motor control centres and switchboard shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipments involving 3 phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards and shall not require cutting away of adjacent framework.

All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.

The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.

The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Engineer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise.

Switched interior light and socket outlets shall be provided for all cubicles and control panels.

All cubicles and control panels shall be provided with lamacoid nameplates, identifying the purpose of the panel and all of its components.

Control switches, indicating lamps and instruments

Measuring converters

The converters shall be suitable for direct connection to the secondary circuits of the potential and current transformers used, or other sensors, each as they apply. The converters shall be static type, having all accessories to provide an output signal of 4-20 mA, filtered DC.

For the measuring converters the following minimum requirements shall be fulfilled:
Current transducers shall be single-phase, of accuracy class 0.5 or better.

Voltage transducers shall be single-phase of accuracy class 0.5 or better.

W and VAr transducers shall be two elements, three-phase. Accuracy class of the transducers shall be 0.5 or better.

Measuring transformers

Potential transformer secondary windings shall be rated $110/\sqrt{3}$ V

Current transformer secondary windings shall have a rated current of 1A/2.5A /5A.

3.14.1. EARTHING:

Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of star of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

3.14.2. TESTS

a) The marshalling kiosks shall be subject to routine tests as per IS:5039

b) The following routine tests shall also be conducted:

I) Check for wiring
II) Visual and dimension check

Marshalling kiosks shall be provided with danger plate and a diagram showing the numbering /connection / ferruling by pasting the same on the inside of the door.

3.15 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS:

Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5621. The support insulators shall be manufactured and tested as per IS 2544/IEC 168 and IEC 273. The insulators shall also conform to IEC 815 as applicable.

Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

Supports insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

All iron parts shall be hot dip galvanized and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

3.16 SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstand test on complete equipment shall be carried out along with the supporting structure. The Supplier shall arrange to transport the structure from the structure supplier's works/ project site or alternatively arrange the structure as per approved drawings for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pads of the equipment and any other point as agreed by BHEL / customer. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of BHEL / customer.

3.17 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering / brazing material for all copper piping of circuit breakers and essential chemicals etc which will be required to put the equipment covered under the scope of the specifications, into successful operations, shall be furnished by the contractor unless specifically excluded under the exclusions in these specifications and documents.

3.18 PACKING AND SHIPPING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken account.

The Contractor shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows:

- Consignee : to be furnished at a later date
  - Contract No. :
  - Country of Origin :
  - Port of entry :
  - Item number (if applicable) :
  - Package number, in sequence :
  - and quantity per package :
  - Description of Works :
  - Net and gross weight, volume :

The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to Improper packing. Employer takes no responsibility of the wagons.

- - x x - -

ANNEXURE-4

CHECKLIST FOR OIL FILLED TYPE AUXILIARY TRANSFORMER

RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

1.0 TECHNICAL PARAMETER

Sl. No.	Parameters	Data	Compliance	Remark
(a)	Applicable IS	IS:2026 / IEC: 60076	Yes	
(b)	Rated Voltage (i) HV Winding (kV) (ii) LV Winding (kV)	 (i) 11000 (ii) 0.433	 Yes Yes	
(c)	Service- (i) Outdoor/ Indoor	(i) Outdoor	Yes	
(d)	Percentage Impedance	5%	Yes	
(e)	Rated frequency (Hz)	50	Yes	
(f)	Number of phases	3	Yes	
(g)	Connections (i) HV Winding (ii) LV Winding	 (i) Delta (ii) Star	 Yes Yes	
(h)	Winding Connections	Dyn 11	Yes	
(i)	Type of cooling	ONAN	Yes	
(j)	Tap changing equipment (i) Type (ii) No. of steps	 Off circuit tap change switch 5 in steps of 2.5% on HV side	 Yes Yes	
(k)	Guaranteed positive sequence impedance at 75 °C with 100 % rating at (i) Principal tap- As per IS/IEC/customer specified (ii) Maximum tap- As per IS/IEC/Customer specified (iii) Minimum tap- As per IS/IEC/Customer specified	Vendor to furnish data		
(l)	Maximum Temperature rise over an ambient of 50 °C (i) Oil (if applicable °C) (ii) Windings (°C)	 (i) 50°C (ii) 55°C	 Yes Yes	

(m)	Guaranteed losses at rated voltage on principal tap and at rated frequency (i) No load loss or iron losses (KW) -As per IS/IEC /Customer specified (ii) Copper loss at full load at 75 °C (KW)- As per IS/IE/Customer specified	Vendor to furnish data		
(n)	Withstand time for three phase short circuit at terminals (second)	2 sec	Yes	
(o)	Insulation level (A) Power frequency voltage withstand (i) HV Winding (kV rms)- (ii) LV Winding (kV rms)- (B) Basic Impulse level (i) HV Winding (kVp) (ii) LV Winding (kVp) (C) Highest voltage (i) HV Winding (kV) (ii) LV Winding (kV)-	 (A) (i) 28 (ii) 3 (B) (i) 75 (ii) NA (C) (i) 12 (ii) 1.1	 Yes Yes Yes Yes Yes Yes	
(p)	Terminal arrangement (i) High voltage- Suitable for Cables /Overhead conductor (ii) Low voltage- (iii) LV Neutral-	 (i) Cables (ii) Cable box (iii) Cable box	 Yes Yes Yes	
(q)	Bushing (A) High voltage (i) Rated Voltage(kV) (ii) Rated Current(A) (iii)Basic Impulse level (kV) (iv) Minimum Creepage distance (mm) (v) Wet and dry power frequency Winding Voltage (kV rms) (B) Low voltage and Neutral (i) Rated Voltage(V)- (ii) Rated Current(A)- (iii) Minimum Creepage distance	 (A) (i) 12 (ii) 250 (iii) 75 (iv) 300 (v) 28 (B) (i)1100 (ii)2000 (iii)31mm/kV	 Yes Yes Yes Yes Yes Yes Yes Yes	
(r)	Minimum clearance (mm) in air (i) Phase to Phase (HV side) (ii) Phase to Earth(HV side) (iii) Phase to Phase (LV side) (iv) Phase to Earth(LV side)	 (i) 280 (ii) 140 (iii) 25 (iv) 25	 Yes Yes Yes Yes	
(s)	Method of Earthing	Solidly earthed	Yes	

2.0 TESTS

A) ROUTINE TESTS

Whether during manufacture and on completion, all transformers are subjected to the routine tests in accordance with latest IS/IEC and its different parts.

YES

B) TYPE TESTS

Whether Type test reports of the tests conducted earlier (not more than 5 years from 22.01.09) on similar equipment submitted.

YES

If type test report submitted, indicate report number.

Sl. No.	TESTS	REPORT NO.
A	**Type tests**	
1.	Measurement of winding resistance	
2.	Measurement of voltage ratio and check of voltage vector relationship	
3.	Measurement of impedance voltage /short –circuit impedance (principal tapping) and load loss	
4.	Measurement of no-load loss and current	
5.	Measurement of insulation resistance	
6.	Dielectric test	
7.	Temperature –rise	
8.	Test on on–load tap –changers, where appropriate	
B	**Special Tests**	
1.	Short circuit tests	
2.	Measurement of zero sequence impedance of three-phase transformers	
3.	Measurement of acoustic noise level	
4.	Measurement of the harmonics of the no load current	

If the valid type test reports are not available with the bidder then the above mentioned tests shall be conducted by the bidder without any cost/ delivery implication to BHEL/ RPCL.

YES

-- xx --

The power house and switchyard would also have illumination system, grounding system, Public address system and PLCC system.

3.0 SALIENT FEATURES OF THE PROJECT

Based upon preliminary designs, the salient features of the project are as under:

Location	
State	Jammu & Kashmir
District	Baramulla
River	Kishanganga
Dam site	Gurez valley-100m u/s of Malik Kadal bridge
Latitude	34° 39' 00"
Longitude	74° 45' 08"
Powerhouse site	Near village Kralpora Tehsil Bandipura
Latitude	34o 28' 17"
Longitude	74o 38' 28"
Hydrology	
Catchment area	1815 Km^2
Maximum observed flood	740 cumec
Probable max. flood	2000 cumec
Average Annual run off	1342.5 Mcum
Annual rainfall	676 mm
Annual snowfall (in terms of water equivalent)	1206 mm
Reservoir	
Full Reservoir Level	El. 2390.00 m
Maximum Reservoir level	El 2390.00 m
Minimum Draw Down Level	El. 2384.50 m
Gross storage up to FRL	18.35 Mcum
Dead storage capacity	10.80 Mcum
Live storage capacity	7.55 Mcum
Diversion tunnel	
Number	1
Size, Shape	6.5m diameter, Horse shoe
Length	560 m
Diversion capacity	286 cumec

Dam

Type	Concrete face rock fill dam
Maximum height above Deepest river bed	37 m
Elevation of top of dam	El. 2395.00m

Spillway

Design flood	2000 cumecs
Type	Chute spillway
Crest Elevation	El 2370 m
No.& size of spillway gates	3 Nos., 7.0m (w) x 9.5m (h)
Maximum discharge over Spillway per meter width	95.23 cumec / m
Energy dissipation	Flip bucket
Crest level of spilling channel	El 2389.00 m
Width of spilling channel	12.5 m

Intake

Invert level	El 2378.80 m
No. & size of opening	2 nos. , 4.25m(w) x 2.5m (h)

Head Race Tunnel

Number	1
Size & Shape	5.4m HS (DBM) / 5.2 Circular (TBM)
Length	23.5 km .
Design discharge	58.4 cumec

Construction Adit

No. & length	Inlet Adit 200 m Adit-1 500m Surge shaft end adit 300 m

Surge shaft

Diameter	15 m
Height	112 m
Type	Restricted orifice
Maximum surge level	El. 2415.00 m
Minimum surge level	El. 2325.00 m

Pressure shaft

No. & Type	One, stepped, circular, Steel lined
Diameter	4.0m diameter, trifurcating into three 2.10 m diameter penstocks

Powerhouse complex

Type	Underground
Installed capacity	330 MW
No. of units	3
Powerhouse cavern	113 m(l) x 21.3m (w) x 46.5m (h)
Transformers hall cavern	75 m (l) x 15m (w) x 15.2m (h)
Service bay level	El 1735.80m
C/L of machines	El 1723.50m
Elevation of bottom of draft tube	El 1714.00m
Type of turbine	Pelton wheel
Design Max. gross head	665m
Rated net head	640m
Ventilation cum cable tunnel	
Size, shape	4m x 4m, D-shape
Length	580 m
Access tunnel	
Size, shape	8.0m (w) x 6.5 m (h) D-shape
Length	686m
Adit to powerhouse crown	
Size, shape	6m x 6m, D-shape
Length	184 m

Tail Race System

Tunnel	D-shape
Length	700 m (approx)
Diameter	5.0 m
Open channel portion	
Length	100 m

Switchyard

Size & location	200m x 130m near Kralpora village

Power Generation

Installed capacity	330 MW

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Peaking capacity during lean period 330 MW

Annual Design Energy generation 1350 MU

4.0 ACCESS TO AND WITH IN THE PROJECT AREA.

4.1 General

The Kishanganga Hydro electric project is located in the great Himalayan ranges close to the LOC. The dam site of the project is situated in Gurez valley and power house site is at Bandipora in Kashmir valley of J&K state. Srinagar Is the nearest city, well connected by Air. Approximate distances of Project from different important towns are as below.

	Dam site	Power House Site
From Delhi	1025 km	955 km
From Jammu	440 km	370 km
From Srinagar	140 km	70 km

4.2 Jammu – Srinagar Road

(1) The principal access road to the Site is the approximately 300 km long National highway NH-1A connecting Jammu to Srinagar. This road is under the administrative control of BRO (Border Roads Organisation) which is responsible for the maintenance of this road.

Along certain stretches of NH-1A, the slopes above the road become unstable when saturated during the monsoon time and the road gets blocked by the resulting landslides and rock falls. Such blockages will, in general, be cleared by BRO as soon as reasonably possible. .

(2) NH1A between Banihal and Quazigund passes through a road tunnel known as Jawahar Tunnel and has height and width restrictions. Cross-section of tunnel is enclosed as plate-4.1
(The Contractor has to keep in view, of above mentioned critical dimensions of Jawahar Tunnel for transportation of his Construction Equipment and Electromechanial & Hydromechanical Plant & Machinery).

4.3 Srinagar – Bandipora road

(1) First 8 km stretch of this road (Between Srinagar and Sheltang) is covered under National Highway 1 A.

(2) The next 50 Kms(i.e KM 8 to 58) between Shetang and Bandipora is also a National highway with double lane specification and plain ruling gradient. While in general the formation width of this road is between 7

to 10 m , at certain locations the formation width available is restricted to 4m only.

(3) Bridge Details

- At KM 25, Sumbal RCC bridge (168 m length) with loading capacity 70 R.
- At KM 27, Nadinara steel bridge(18.5 m length) with loading capacity 18 R. However, this nallah portion can also be crossed by diversion road through Nandinara Village. Any temporary additional measures for diversion road shall be planned and executed by the Contractor.
- At KM 41.9, Ajass RCC bridge (14 m length) with loading capacity 70 R.
- At KM 53.75, RCC bridge (10 m length) with loading capacity 70R.
- At KM 53.80, RCC bridge (5 m length) with loading capacity 70R.
- At KM 54.70, Steel Bridge on papchan nallah (A) with length 29 m and loading capacity 18 R. At KM 54.80, Steel bridge on Papchan nallah(B) with length 29 m and loading capacity 18 R. However, these nallah portions can also be crossed during the lean season through bed crossing. Any temporary additional measures for crossing of these nallahs shall be planned and executed by the Contractor.

4.4 Bandipora – Surge shaft top stretch of road

1. The total length of this reach of the road is 21 km. The road is class 9H with ruling gradient and with formation width of 5.95 m.
2. At Km .3 of this road there is a steel bridge on Madumati Nallah with length 75.73 m and loading capacity 24 R. At the same location, a RCC Bridge with length 55 m and loading capacity 70 R is under construction. *by BRO.* However, the nallah can also be crossed during the lean season through bed crossing. Any temporary additional measures for crossing of this nallah shall be planned and executed by the Contractor.

4.5 Bandipora – Dam site road

1. Bandipora- Dam site road beyond surge shaft top is 51 km (KM 21 to 72) long. Between KM 21 to 39, road is class 9 H with ruling gradient

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with formation width of 5.95 m. Between KM 39 to 60, road is class 9 (Snow bound specification) with ruling gradient with formation width 7.45 m.Between KM 60 to 72 and beyond, road is again class 9 H with ruling gradient with formation width 5.95 m.

2. This road is maintained by Border Roads Organisation (BRO). This road remains open only for approximately 5-6 months i.e May/ June to November in a year and for rest of the period of the year remains blocked due to heavy snow fall as it passes through Razdan pass at an altitude of 3600 m.

3. Bandipora - Gurez road is a strategic road. Contractor shall plan his movements in coordination with concerned authorities. Owner shall provide assistance in such co-ordination. Up-gradation and maintenance of Bandipora - gurez road if required by the Contractor for transportation of his Construction Equipment shall be done by the Contractor with specific approval from BRO. Bridge Details

   - At KM 55.0, SSRBB type bridge with length 21.34 m and loading capacity 24 R.
   - At KM 59.5, SSRBB type bridge with length 18.29 m and loading capacity 24R.
   - At KM 66.0, HAMILTON type bridge with length 18.29 m and loading capacity 18 R.

     However the above nallahs can also be crossed during the lean season through bed crossing. Any temporary-additional measures for crossing of these nallah shall be planed and executed by the Contractor.
   - At KM 66.95, TSRBB type bridge with length 44.12 m and loading capacity 18R (Kanjalwan Bridge on Kishanganga River)
   - At KM 71.80, TSRBB type bridge with length 42.87 m and loading capacity 24 R (Malik Bridge on Kishanganga River)
   - At KM 72.2, HAMILTON type bridge with length 12.19 m and loading capacity 18R on Dudkhatu nallah. However, the nallah also be crossed during the lean season through bed crossing.

     Any temporary additional measure for crossing of the nallah shall be planned and executed by the Contractor.

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4.6 Access to Gurez valley during winter:

Hellcopter access (between Bandipora-Gurez or Srinagar – Gurez) is must during winter to continue at least the underground works pertaining to HRT at inlet Adit and Adit 1 during the period November to May. The Contractor shall be required to tie up this arrangement with Indian Army / Indian Air Force authorities. Owner shall provide any assistance for coordination with concerned authorities.

4.7 Access roads to permanent works

4.7.1 Access roads with in Power house complex

Following access roads shall be required in power house complex.

Access road to main access tunnel

Access road to switch yard/ ventilation tunnel

Access road to tail race outlet

Access road to various adits of pressure shaft

Access road to Surge shaft bottom and for TBM tunneling

Access road to surge shaft top

The land for these roads shall be made available by Owner free cost. The detailed planning, engineering, construction and maintenance shall be done by the Contractor.

4.7.2 Access roads for HRT adit 1 and with in Dam complex

The HRT Adit 1 portal is situated on Bandipora – Gurez road near Kanzalwan. Various access and temporary haul roads for access to different locations in dam complex shall be planned, constructed and maintained by the Contractor.

4.7.3 Land for Permanent Works

The land for the Permanent Works shall be handed over in a phased manner as per the following schedule subject to Contractor complying with the requirement under GCC Article 46.1:

Sl. No.	Allocation of Land for	Time from the date of Order to Commence
1	Dam Area including Intake Adit and Diversion Tunnel Area.	4 Months
2	Adit-I Area	4 Months
3	Surge Shaft Area and T.B.M Adit Area	4 Months
4	Power House Area and Construction Adits to Pressure Shaft.	9 Months
5	T.R.T and Switchyard Area.	9 Months

For the purpose of land acquisition the layout of the Project structures, should normally be as per the Project Profile to the extent possible. However, in case of change in Project Layout due to unavoidable circumstances the bidder shall note that the land acquisition for any new location would take about 1 year.

5.0 Local facilities and services in the project area

5.1 Availability of land for Contractor's infrastructure for main works

The Contractor has to make his own arrangement to develop infrastructure for all their men and material required during the construction period. The necessary residential and labour camps including other facilities like water supply, sanitation etc. are to be developed by the Contractor on his own.

Private land is available for Contractor's use at Badwan, Wampore, Dawar and Kanjalwan for dam site and at Bandipore and near by villages for powerhouse site. The Contractor will be responsible for arranging land for his infrastructure and other facilities in these areas.

All the camps, facility areas, main works area etc. are required to be fenced and protected by the Contractor on his own.

5.2 Identified source of water supply for Contractor's use

The main source of water supply for construction purposes as well as domestic use is river Kishanganga and various nallas for dam site area and Madumati nallah, Bonar nallah for power site. Necessary pumping arrangements for supply of water and filtration/treatment facilities, if required, are to be made by the Contractor of his own.

5.3 Arrangement of construction power for Contractor's use for main works and their establishment

The construction power is of vital importance for construction of any project and needs to be planned properly so that uninterrupted power is available at all times. The Contractor shall have to make his own arrangement for construction power as well as power for township/auxiliary power by his own diesel generating sets to meet their full requirement. Further, the Contractor has to provide distribution facilities and necessary safety precautions on their own.

5.4 Communication facilities available

Nearest BSNL telephone exchange is at Bandipore, a satellite exchange has been established by BSNL at Dawar (Gurez).The existing telephone system is not reliable and the contractor may have to install his own communication system like V-SAT, LDST etc. on his own.

5.5 Details about local taxes including works contract taxes leviable presently in the state of J&K

The following taxes / royalty are leviable from the Contractor: -

a) Works Tax (J&K. Sales tax)

b) Royalty on boulders, aggregates, etc.

c) Sales tax on royalty.

d) Income tax on payments.

e) Excise duty as applicable.

f) Customs duty on imports

J&K entry tax on the goods shall be chargeable at Lakhanpur as per Schedule I&II of J&K entry tax on Goods Act 2000.

The above is meant for general information only and the Bidder should verify the same for rates and additional taxes/levies etc. if any, before filling his price Bid.

5.6 Inner line permit / Pass, if required for contractors and his workmen

Inner line permit/ pass is not required In the state of J&K at present. However, for foreign national, the inner line permit/pass may be required.

5.7 Availability of nearest fuel station

The Contractor has to make arrangement for his own fuel station having sufficient storage capacity for meeting his petrol and HSD requirement. The nearest fuel station is available in Sopore town only which is 30 km from Bandipore (and extension counter located at Bandipore), while Indian Oil depot is available at Srinagar.

5.8 Issue of materials to the contractor

All the construction material required for the construction of Project shall have to be arranged by the Contractor himself. In view of the availability of approach by road for only 5-6 months in a year at dam site, sufficient storage shall be required to be created by the Contractor to ensure the availability of construction material and machinery required for full year working.

5.9 Law and Order situation

The proposed Dam site, located in Gurez valley falls within the shelling range from Pakistan border. The proposed Powerhouse site is located near Bandipora town and its surrounding areas have witnessed sporadic incidents of militancy and hence vulnerable to security. Incidents of militancy in and around the Project Area are reported in national and international media from time to time. The Owner shall be providing general security for the Project through CISF/BSF. However the Contractor will be responsible for any additional security in terms of G.C.C, Article 11.2.

5.10 Other relevant information

The manpower engaged by the Contractor for the works of the project shall be mainly from local population to the extent available. However, in case of non-availability of highly skilled/semi skilled manpower among local population, the same shall be arranged from outside Gurez/Bandipora.

Reduction in efficiency of man and machinery in high altitude may be taken care of by the tenderers while quoting tender bids.

The project has only 500 Kg portable explosive license at dam site and 400 Kg portable explosive license at power house site. The Contractor shall have to arrange his own explosive magazine and the license of the capacity as per his requirement.

The location of the batching plant, crushing plant and other installations etc. shall be finalized by Contractor himself as per his convenience and as per the convenience of local people/administration.

HINDUSTAN CONSTRUCTION CO. LTD. MUMBAI

Bidder's Appreciation Of The Project

Our technical team comprising of experienced Engineers have visited the site at different times. The team made first site visit in last week of September 2006 and second site visit in last week of October 2006.

This appreciation is broadly based on our site visit and gives an account of our understanding of all principal technical and logistic problems related to transportation and installations, handling of the construction equipments, materials, and availability of land, infrastructures, local taxes and laws and construction of works.

Following is a summary of various aspects of the project, which is based on, our site visits and information collected:

- Location of the site and Access to the site from railhead, airport and highways and large cities.
- Project Roads – Permanent and temporary
- Problems related to transportation and erection of heavy construction equipments.
- Quarries and borrow areas for aggregates, sand and clay
- Source of cement, steel, explosives and other material and transport & storage.
- Rainy season, river flows and river banks
- Disposal areas
- Location/land for site installations like crushing plant, batching plant, site offices, stores, workshop and colony for officers, staff and workers etc.
- Water and Power supply
- Communication, medical banks, post office.
- Local conditions – Local taxes and laws.
- Other project specific matters.

Above aspects are explained in detail below:

1.1 Location of the site and Access to the site from railhead and highways and large cities

The Kishanganga HE project is located in the state of Jammu and Kashmir. Logistically the project has been divided in to two work centers one at powerhouse and other at Dam site (Gurez valley). Dam site, Part of HRT (inlet adit and Adit-I) of the project is located in Gurez valley and Surge shaft, pressure shaft and powerhouse are near Bandipora in Kashmir valley. Srinagar is the nearest city, well connected by Air. Following table gives the approximate distances of Project from various important cities

	Dam Site	Powerhouse site
From Delhi	1025 Km	955 Km
From Jammu	440 Km	370Km
From Srinagar	140 Km	70 Km

Structures form surge to powerhouse are located near Bandipora and can be accessed using NH-1A and 50km limb NH connecting NH-1A at Sheri to

Bandipora. On this route, there are bridges with carriage capacity varying from 70R to 18R. Wherever low capacity bridges are located we can cross the Nallah through the bed during lean season.

Dam complex (Gurez valley):
Road from powerhouse to dam site is predominantly class 9H except for about 20 km which is of class-9. On this stretch, there are bridges with carrying capacity varying from 24R to 18R. All Nallahs can be crossed through bed during lean season.

Jammu is the nearest BG railway head and Srinagar is the nearest airport. All materials and equipments will have to be transported from Jammu by utilizing NH-1A.

1.2 Project Roads – Permanent & Temporary

The present statuses of roads, which have been inspected by us during our site visit, are as under:

- The principal access road to the site is NH-1A: Slopes above the road have become unstable along certain stretches and frequent landslides during monsoon block the roads. BRO is undertaking the road clearing activity in case of blockages.
- Srinagar – Bandipora road: This road is NH-1A and 50km limb of NH connecting NH-1A at Shetang to Bandipora. Generally the road width is 7-10m but somewhere the width is restricted to 4m only. On this route, there are bridges with carriage capacity varying from 70R to 18R. Wherever low capacity bridges are located we can cross the Nallah through the bed during lean season.
- Bandipora – Surge shaft top stretch of road: Length of this road is 21 km and it is class 9H with ruling gradient and formation width of 5.95m. There is a 24 R class steel bridge across Madumati Nallah at 3 km of this road. The length of this bridge is bout 76-M. At the same location BRO is constructing a "70 R" class RCC Bridge and length is about 55m.
- Bandipora – Dam site road: Length of this road beyond surge shaft top is 51 km, having varying width from 5.95m - 7.45m. This road during winter months due to heavy snow fall remains blocked and remains open only for 5-6 months i.e. May/June to November in a year.
- Bridge details: In the following table we have given the details about the various bridges in project area

Chainage In Km	Type of Bridge	Length (m)	Loading capacity
55	SSRBB type	21.34	24R
59.5	SSRBB type	18.29	24R
66	HAMILTON type	18.29	18R
66.95	TSRBB type - Kanjalwan bridge over Kishanganga river	44.12	18R
71.80	TSRBB – Mallai Kadal bridge	42.87	24R
72.2	HAMILTON type	12.19	18R

However, where existing bridges have inadequate capacity, the Nallahas may be crossed through the bed during lean season. Some temporary measures like new access, filling & clearing later may be required at these locations.

The project foresees following permanent access roads, which are required to be constructed by the EPC contractor.

- To main access tunnel
- To switchyard / ventilation tunnel
- To tail race outlet
- To various adits of pressure shaft
- To surge shaft bottom and for TBM tunneling
- To surge shaft top

Apart from above permanent roads following temporary roads have to be constructed for construction purposes.

- Construction access on left bank and right bank
- Temporary haul roads in Dam complex
- Temporary roads in powerhouse
- Various access roads to batching plants, crushing plant, colony area etc.

Temporary access road can be designated to an average 10% gradient, taking into consideration of traffic ability of hauling equipment.
A bridge over Dudkhatu nallah near Intake adit is also required.

1.3 Problems related to Transportation and erection of heavy construction equipments:

Problems in Equipment transport

Construction equipments required are dozers, excavators, drilling jumbos, batching plant (to be brought in parts), crushing plant (in parts), concrete-placing arrangements etc. These equipments will come from all parts of the country. Tunnel Boring machine and certain E&M equipments are to be imported in parts and will come from Mumbai / Kandla port.

All of these equipments will have to be transported by road from port or from other source. These will travel first to Jammu and via NH 1A to Bandipore. While traveling through NH 1A, the equipments will have to pass through Jawahar tunnel, which has size limitation. So, we keep an options of (a) unloading these equipments, specially the parts of E&M / HM equipments which have larger sizes, to certain terrace like plots on either sides (approximately 20 km) of NH 1A and transship them on smaller vehicles or (b) Design the TBM specially cutter head and other components including EM equipments suitable to pass the tunnel and also the road conditions beyond Bandipore.

The road from Bandipore to Gurez valley has lesser width and vehicles with 7-8 tons load can access through. The road has to be strengthened at some places. During material and equipment transportation we have to avoid traffic congestion and road accidents by taking following measures:

- Load trucks / trailers only to allowable capacities keeping in view the gradient and nature of roads and also the pulling power of the vehicle.
- Heavily loaded vehicles will generally travel during nighttime when traffic will be minimum, so as to minimize traffic congestion.
- If needed, organize a dummy load to run along the route to understand the problems.
- Employ experienced agencies for transportation of equipments / materials.
- Dismantle all the heavy equipments in such a manner so that their transportation over the bridges and Jawahar tunnel is within permissible limits.

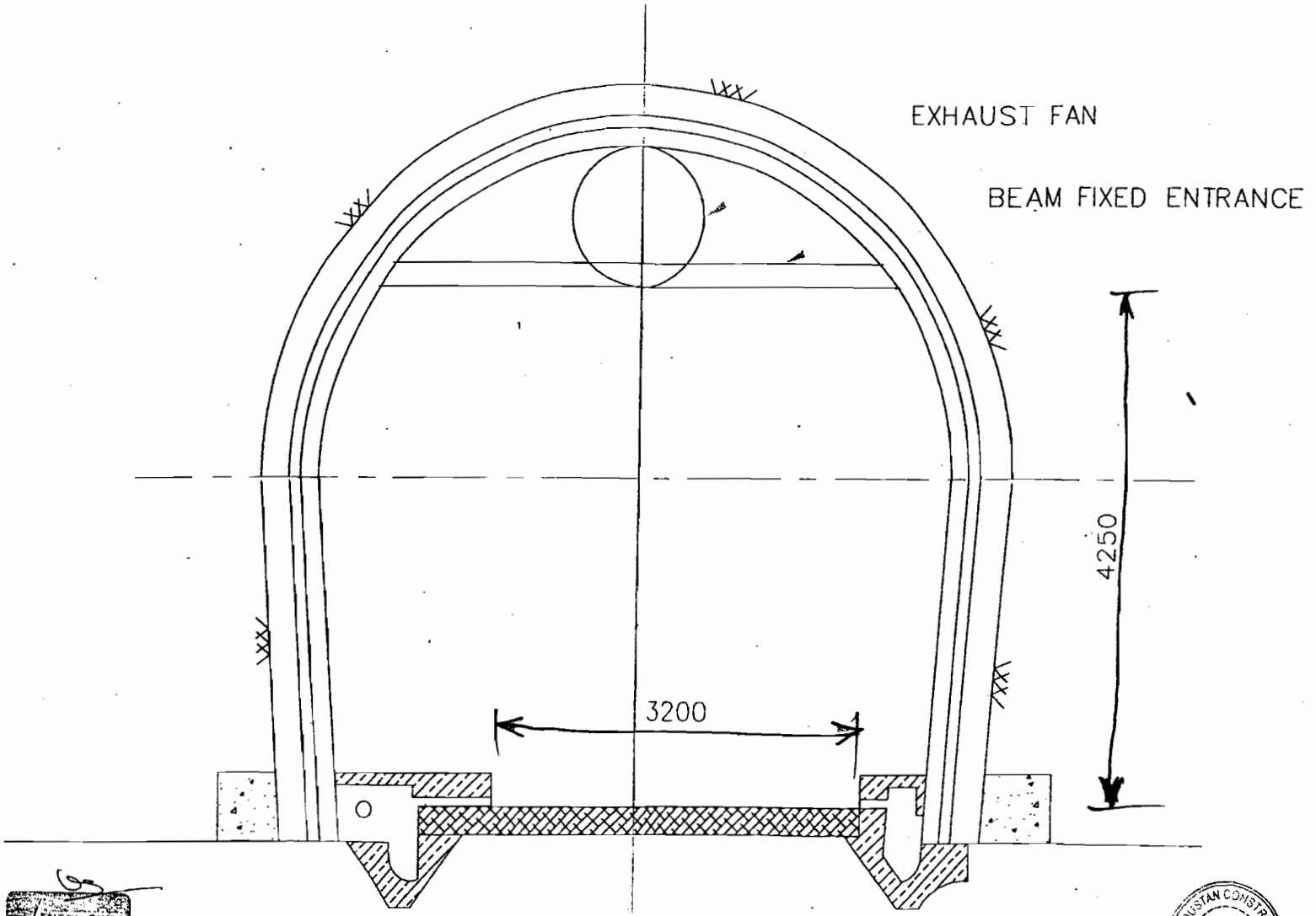
Problems in Equipment erection:

(a) Crushing plant: We do not envisage any problem in the erection of crushing plants.
(b) Batching plants, cement storage, aggregate bins: We do not envisage any problem in the erection of these equipments.
(c) Concrete placing arrangements: We do not envisage any problem in the erection of concrete placing arrangement.
(d) TBM: TBM can be erected on the flat terrace near the proposed portal of TBM adit / adit-2.

1.4 Quarries and borrow areas for aggregate, sand and clay.

NHPC have carried out detailed investigations for availability and testing of construction materials for use as concrete aggregate, rock fill material, semi-pervious material and impervious soil. In total twelve river bed deposits / shoals, three rock quarries, three deposits of semi-pervious material and three impervious soil deposits have been investigated. These have been listed in the Vol-I of Tender document.

We have visited the deposits and checked their feasibilities. In additional to the material sources as above, use of excavated material from open excavation, riverbed excavation, tunnel excavation and powerhouse excavation as concrete aggregate and rock fill materials can also be considered.



C/S OF JAWAHAR TUNNEL NH–1A

HINDUSTAN CONSTRUCTION CO. LTD. BOMBAY

SECTION 5

ENCLOSURES TO SPECIFICATIONS

ANNEXURE 1	NO DEVIATION CERTIFICATE (1sheet): Attached with Section-1
ANNEXURE 1A	AUXILIARY TRANSFORMER: TYPE TESTS, SHOP TESTS, FIELD TESTS (2sheets): Attached with Section-1
ANNEXURE 2	CHECK LIST OF INFORMATION TO BE FURNISHED WITH THE OFFER (1sheet)
ANNEXURE 3	QUALITY ASSURANCE PLAN (MODEL) FOR 11/415, 3-PH OIL FILLED TRANSFORMER (10 sheets)
ANNEXURE 4	CHECKLIST FOR OIL FILLED TYPE AUXILIARY TRANSFORMER (3 sheets)

Annexure-2

CHECK LIST FOR INFORMATION TO BE FURNISED WITH OFFER

BIDDER SHALL PUT A TICK '✓' **IF THE INFORMATION IS ENCLOSED WITH THE OFFER, PUT A CROSS 'X' IF THE INFORMATION IS NOT ENCLOSED OR WRITE 'NOT APPLICABLE' IF THE QUERY/ SCHEDULE IS NOT RELEVANT AND RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED**

The offer may not be considered if the following information and this Checklist are not enclosed with the offer.

BIDDER: OFFER REFERENCE:

1.	Technical offer with detailed schedules of equipment/ material and spares	_____
2.	Guaranteed Technical Particulars	_____
3.	List of past supplies complete with purchase Order & Project name, quantity, order reference, etc. where identical equipment have been supplied.	_____
4.	Manufacturer's quality plans for approval	_____
5.	Field Quality plan for approval	_____
6.	General Arrangement drawings with dimensions and weights and foundation/fixing details	_____
7.	Drawing/data submissions schedule	_____
8.	Type test reports. The type test reports shall be accompanied with a list listing all the relevant clauses of the applicable standard and the corresponding type test report. The manufacturer shall also furnish a certificate certifying that the test reports have been carried out on equipment identical in all respects to the one offered. In case the reports are for different equipment and the applicability of the report is permitted as per applicable standards, the justification shall be enclosed to the list of type test reports.	_____
9.	Bar Chart showing time schedule showing time required for design, manufacture, test and inspection, transport, erection, site testing and commissioning	_____
10.	Makes of all important components, like motors, operating switches, fuses, etc.	_____
11.	Provenness Data	_____
12.	Any additional information called for in any part of the technical specification.	_____

Date: **Signature of the authorized representative of Bidder**

Company Seal

19.MODEL QUALITY ASSURANCE PLAN (QAP) FOR 415 V SWITCHGEAR & AUXILIARY TRANSFORMERS

Special instructions: -

1. Contractors/Manufacturers/Sub-suppliers are advised to submit QAP for equipments/ materials after incorporating all tests for bought out items, in process inspection and final inspections as per their latest manufacturing practice and Indian/ International Standards (with latest amendments, if any).
2. Contractors/Manufacturers/Sub-suppliers are required to use properly calibrated instruments /equipments during testing/inspection, for which necessary calibration certificates are required to be provided/presented to the Inspecting Officer.
3. Contractors/Manufacturers/Sub-suppliers have to make on their own all arrangements for testing facilities at their works for testing of equipments/materials.
4. One set of complete test certificates as per the requirement of QAP be made available to the Inspecting Officer at the time of inspection/testing.
5. All the records, as per the requirement of QAP are to be made available for review by the Inspecting Officer during inspection.
6. Field tests are to be carried out as per the requirements of the contract / purchase order.

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E.PROJECT
NAME OF EQUIPMENT:11/415, 3Φ Oil Filled Transformer

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE / ACCEPTANCE DOCUMENTS NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
A	**RAW MATERIALS**								
1	**Paper Covered Copper Conductor (PICC)**								
a)	Overall dimensions	Measurement	sample/lot/	Tech. Spec./Appd.drg./ IS:7404	TC	2/3	-	1	TC
b)	Conductor dimensions	-do-	-do-	-do-	TC	2/3	-	1	TC
c)	Tensile Strength	-do-	-do-	-do-	TC	2/3	-	1	TC
d)	Resistance measurement	-do-	-do-	-do-	TC	2/3	-	1	TC
e)	Elongation	-do-	-do-	-do-	TC	2/3	-	1	TC
f)	Chemical composition	-do-	-do-	-do-	TC	2/3	-	1	TC
2	**CRGO lamination**								
a)	Core loss	-do-	Sample	Tech.Spec./Appd.drg./IS	TC	2/3	-	1	TC
b)	Thickness	-do-	-do-	-do-	TC	2/3	-	1	TC
c)	Chemical composition	-do-	-do-	-do-	TC	2/3	-	1	TC
3	**Kraft Paper for covering on** Thickness, Air resistance,	Measurement	Sampling plan	Tech.Sp./Appd.drg./IS:9335	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

F/IQA/740/01/01
Rev no.-01

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E.PROJECT
NAME OF EQUIPMENT:11/415, 3Φ Oil Filled Transformer

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE ACCEPTANCE DOCUMENTS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
4	**Press Board** Thickness, Density, Tensile strength, Compressibility, Electrical strength, Shrinkage, Oil absorption, Conductivity of aq. Extract, Ph value, Mineral ash & Moisture content	Measurement	Sampling plan	Tech.Spec./Appd.drg./IS:1576	TC	2/3	-	1	TC
5	**Transformer Oil (Naptha based)**								
a)	Appearance	Visual	-do-	Tech. Specn. & IEC 60296	TC	2/3	-	1	TC
b)	Density	Measurement	-do-	-do-	TC	2/3	-	1	TC
c)	Electrical strength (BDV)	-do-	-do-	-do-	TC	2/3	-	1	TC
d)	Tan delta	-do-	-do-	-do-	TC	2/3	-	1	TC
e)	Specific resistance	Electrical	Sampling plan	Tech. Specn./ IEC 60296	TC	2/3	-	1	TC
f)	Viscosity	-do-	-do-	-do-	TC	2/3	-	1	TC
g)	Interfacial tension	Measurement	-do-	-do-	TC	2/3	-	1	TC
h)	Flash point, Pour point	-do-	-do-	-do-	TC	2/3	-	1	TC
i)	Neutralisation value	-do-	-do-	-do-	TC	2/3	-	1	TC
j)	Corrosiveness	-do-	-do-	-do-	TC	2/3	-	1	TC
k)	Oxidation stability	-do-	-do-	-do-	TC	2/3	-	1	TC
l)	Ageing characteristics	-do-	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency' column figure 1, 2 or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E.PROJECT
NAME OF EQUIPMENT:11/415, 3Φ Oil Filled Transformer

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE ACCEPTANCE DOCUMENTS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
m)	Presence of oxidation inhibitor	Measurement	Sampling plan	Tech. Specn./ IEC 60296	TC	2/3	-	1	TC
n)	Water content, ppm	-do-	-do-	-do-	JIR	2/3	1	-	CHP
o)	S.K. Value	-do-	-do-	-do-	TC	2/3	-	1	TC
B.	**BOUGHT OUT ITEMS AND COMPONENTS**								
1	**Bushings**								
a)	Visual examination	Visual	100%	Tech.Sp./Appd.drg./IS:3347 & 5621	TC	2/3	-	1	TC
b)	Verification of dimensions	Measurement	Sampling plan	Tech.Sp./Appd.drg./IS:3347 &	TC	2/3	-	1	TC
c)	Porosity test	-do-	-do-	-do-	TC	2/3	-	1	TC
d)	One minute power frequency dry and wet withstand test	Electrical	-do-	-do-	TC	2/3	-	1	TC
e)	Electrical Routine test	-do-	-do-	-do-	TC	2/3	-	1	TC
f)	Temp. cycle test (for 12 KV bushing)	Electrical	Sampling plan	Tech.Spec./ IEC	TC	2/3	-	1	TC
2	**Buchholz relay**								
a)	HV test	-do-	100%	Tech.Spec./IS:3637	TC	2/3	-	1	TC
b)	IR test	-do-	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

HINDUSTAN CONSTRUCTION CO. LTD. * MUMBAI *

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F/QA/740/01/01
Rev no.-01

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E.PROJECT
NAME OF EQUIPMENT:11/415, 3Φ Oil Filled Transformer

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE ACCEPTANCE DOCUMENTS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
c)	Operational check	Electrical	100%	Tech.Spec./IS:3637	TC	2/3	-	1	TC
d)	Porosity test & Element test	-do-	-do-	-do-	TC	2/3	-	1	TC
e)	Gas volume test	-do-	-do-	-do-	TC	2/3	-	1	TC
g)	Continuity test for contact manually with test lock screw at 5°C	-do-	100%	-do-	TC	2/3	-	1	TC
h)	Loss of Oil & Surge test	-do-	100%	-do-	TC	2/3	-	1	TC
3	**Pressure Relief Valve**								
a)	Functional test	Pressure test	-do-	Tech.Spec./Appd.drg./ IS	TC	2/3	-	1	TC
b)	Dielectric test	Electrical	-do-	-do-	TC	2/3	-	1	TC
4	**Temp. Indicators**								
a)	Size	Measurement	100%	Tech.Spec./Appd.drg/IEC	TC	2/3	-	1	TC
b)	Accuracy	-do-	-do-	-do-	TC	2/3	-	1	TC
c)	Operation (alarm/trip) check	Testing	100%	Tech.Spec./Appd.drg/IEC	TC	2/3	-	1	TC
d)	HV Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
5	**Magnetic oil level Gauge**								
a)	Size	Measurement	-do-	Tech.Sp./Appd.drg./IS:2147	TC	2/3	-	1	TC
b)	Operation (alarm) check	Testing	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

F/IQA/740/01/01
Rev no.-01

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

HINDUSTAN CONSTRUCTION CO. LTD. * MUMBAI *

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E.PROJECT **CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.**
NAME OF EQUIPMENT: 11/415, 3Φ Oil Filled Transformer **VENDOR :** **NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE ACCEPTANCE DOCUMENTS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
c)	HV test	Electrical	100%	Tech.Sp./Appd.drg./IS:2147	TC	2/3	-	1	TC
d)	IR test	-do-	-do-	-do-	TC	2/3	-	1	TC
e)	Continuity test for low level alarm	-do-	-do-	-do-	TC	2/3	-	3	TC
f)	Porosity test	Measurement	-do-	-do-	TC	2/3	-	2	TC
g)	Rain test	-do-	Sampling plan	-do-	TC	2/3	-	3	TC
6	**Radiators /Coolers**								
a)	Physical & dimensional verification	Visual &	100%	Tech.Spec./Appd.drg/IEC	TC	2/3	-	1	TC
b)	Leakage test	Pressure test	-do-	-do-	TC	2/3	-	1	TC
7	**Rubber Gaskets**								
a)	Dimensions	Measurement	Sampling plan	Tech.Spec./Appd.drg./IS:4253	TC	2/3	-	1	TC
b)	Physical Properties	Visual	-do-	-do-	TC	2/3	-	1	TC
8	**Valves**								
a)	Size	Visual	-do-	Tech.Spec./Appd.drg/IS	TC	2/3	-	1	TC
b)	Leakage test	Testing	-do-	Tech.Spec./Appd.drg/ IS:778	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

HINDUSTAN CONSTRUCTION CO. LTD. * MUMBAI *

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F/QA/740/01/01
Rev no.-01

Signature
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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E.PROJECT
NAME OF EQUIPMENT:11/415, 3Φ Oil Filled Transformer

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE ACCEPTANCE DOCUMENTS NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
9	**Breather**								
a)	Physical verification	Visual	100%	Tech.Spec./Appd.drg/IEC	TC	2/3	-	1	TC
b)	Silicagel capacity	Measurement	-do-	-do-	TC	2/3	-	1	TC
c)	Pressure Test	Testing	-do-	-do-	TC	2/3	-	1	TC
d)	Silica gel Test	Visual	-do-	-do-	TC	2/3	-	1	TC
C.	**IN PROCESS INSPECTION**								
1	**TANK**								
a)	Size & Dimension	Measurement	100%	Tech.Spec./Appd.drg/IEC	TC	2/3	-	1	TC
b)	Pressure Test	Testing	100%	-do-	TC	2/3	-	1	TC
c)	Vacuum testing	Testing	100%	-do-	TC	2/3	-	1	TC
2	**Core assembly**								
a)	Physical verification	Visual	100%	Tech.Spec./Appd.drg/IEC	TC	2/3	-	1	TC
b)	Size & Dimension	Measurement	-do-	-do-	TC	2/3	-	1	TC
c)	Magnetising Current test	Elect.	-do-	-do-	TC	2/3	-	1	TC
d)	H.V. test on core	-do-	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E.PROJECT
NAME OF EQUIPMENT:11/415, 3Φ Oil Filled Transformer

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE ACCEPTANCE DOCUMENTS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
D.	FINAL INSPECTION ON ASSEMBELD TRANSFORMER								
1	Routine Test								
a)	Voltage ratio/polarity/ Vector group	Electrical	100%	Tech.Spec./IEC 60076 & IS:2026	JIR	2/3	1	-	CHP
b)	Measurement of Insulation Resistance and Polarization Index	-do-	-do-	-do-	JIR	2/3	1	-	CHP
c)	Winding resistance	Electrical	100%	Tech.Spec./IEC 60076 & IS:2026	JIR	2/3	1	-	CHP
d)	Measurement of No-load losses	-do-	-do-	-do-	JIR	2/3	1	-	CHP
e)	Measurement of Magnetizing current (before & after dielectric test)	-do-	-do-	-do-	JIR	2/3	1	-	CHP
f)	Dielectric tests								
i)	Separate source power freq. Withstand test	Electrical	100%	Tech.Spec./ IEC:60076 & IS:2026	JIR	2/3	1	-	CHP
ii)	Induced over voltage withstand test along with Partial dischrge measuerment (ACLD/ ACSD as applicable)	-do-	-do-	-do-	JIR	2/3	1	-	CHP

Note: a. In 'Inspection Agency'column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E.PROJECT **CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.**
NAME OF EQUIPMENT:11/415, 3Φ Oil Filled Transformer **VENDOR :** **NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE ACCEPTANCE DOCUMENTS NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
g)	Impedance voltage & Load loss	Electrical	100%	Tech.Spec./ IEC:60076 & IS:2026	JIR	2/3	1	-	CHP
h)	Oil Leakage test on transfomer	-do-	-do-	-do-	JIR	2/3	1	-	CHP
i)	Marshalling box								
i)	Wiring continuity test	Electrical	100%	Tech.Spec./ IEC:60076 &	JIR	2/3	1	-	CHP
ii)	H.V. test on wiring (2 kV for 1 min)	-do-	-do-	-do-	JIR	2/3	1	-	CHP
iii)	Functional Test	-do-	-do-	-do-	JIR	2/3	1	-	CHP
j)	Test on On load tap changer	Electrical & Mechanical	-do-	-do-	JIR	2/3	1	-	CHP
k)	Complete transformer with fittings, overall physical verification/ dimension	-do-	-do-	Tech.Spec./Approved drawings IEC:60076 & IS:2026	JIR	2/3	1	-	CHP
l)	Routine tests on W.T.I. & C.T.	Electrical	100%	Tech.Spec./Appd.drg/IS:2705	TC	2/3	-	1	TC
m)	Transformer Oil Test (before & after Dielectric test)								
i)	Electrical Strength (BDV)	-do-	-do-	Tech.Spec./Appd.drg./IS:60296	JIR	2/3	1	-	CHP
ii)	Water Content, ppm	-do-	-do-	-do-	JIR	2/3	1	-	CHP

Note: a. In 'Inspection Agency'column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

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NHPC (QA&I DEPT.)

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E.PROJECT
NAME OF EQUIPMENT:11/415, 3Φ Oil Filled Transformer

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE ACCEPTANCE DOCUMENTS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
n)	Acoustic Noise Level	Electrical	100%	Tech.Spec./ IEC:60076 & IS:2026	JIR	2/3	1	-	CHP
o)	Magnetic Balance Test	-do-	-do-	Tech.Spec./CBIP	JIR	2/3	1	-	CHP
2	Type Tests								
a)	Heat Run test	Electrical	One Unit	Tech.Spec./Appd.drg./ IEC 60076 & IS:2026	JIR	2/3	1	-	CHP
b)	Lightning Impulse on HV terminal and Lightning Impulse test on LV terminal	-do-	-do-	-do-	JIR	2/3	1	-	CHP
3	Special Tests								
a)	Capacitance and Tan Delta test	-do-	-do-	-do-	JIR	2/3	1	-	CHP
b)	Short Circuit Test	-do-	-do-	-do-	JIR	2/3	1	-	CHP
c)	Zero sequence impedance	-do-	-do-	-do-	JIR	2/3	1	-	CHP
d)	Insulation power factor test	-do-	-do-	-do-	JIR	2/3	1	-	CHP
e)	Determination of Transient volt. transfer characteristics	-do-	-do-	-do-	JIR	2/3	1	-	CHP

Note: a. In 'Inspection Agency'column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

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ANNEXURE-4

CHECKLIST FOR OIL FILLED TYPE AUXILIARY TRANSFORMER

RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

1.0 TECHNICAL PARAMETER

Sl. No.	Parameters	Data	Compliance	Remark
(a)	Applicable IS	IS:2026 / IEC: 60076	Yes	
(b)	Rated Voltage (i) HV Winding (kV) (ii) LV Winding (kV)	 (i) 11000 (ii) 0.415	 Yes Yes	
(c)	Service- (i) Outdoor/ Indoor	(i) Outdoor	Yes	
(d)	Percentage Impedance	5%	Yes	
(e)	Rated frequency (Hz)	50	Yes	
(f)	Number of phases	3	Yes	
(g)	Connections (i) HV Winding (ii) LV Winding	 (i) Delta (ii) Star	 Yes Yes	
(h)	Winding Connections	Dyn 1	Yes	
(i)	Type of cooling	ONAN	Yes	
(j)	Tap changing equipment (i) Type (ii) No. of steps	 Off circuit tap change switch 5 in steps of 2.5% on HV side	 Yes Yes	
(k)	Guaranteed positive sequence impedance at 75 °C with 100 % rating at (i) Principal tap- As per IS/IEC/customer specified (ii) Maximum tap- As per IS/IEC/Customer specified (iii) Minimum tap- As per IS/IEC/Customer specified	Vendor to furnish data		
(l)	Maximum Temperature rise over an ambient of 50 °C (i) Oil (if applicable °C) (ii) Windings (°C)	 (i) 50°C (ii) 55°C	 Yes Yes	

(m)	Guaranteed losses at rated voltage on principal tap and at rated frequency (i) No load loss or iron losses (KW) -As per IS/IEC /Customer specified (ii) Copper loss at full load at 75 °C (KW)- As per IS/IE/Customer specified	Vendor to furnish data		
(n)	Withstand time for three phase short circuit at terminals (second)	2 sec	Yes	
(o)	Insulation level (A) Power frequency voltage withstand (i) HV Winding (kV rms)- (ii) LV Winding (kV rms)- (B) Basic Impulse level (i) HV Winding (kVp) (ii) LV Winding (kVp) (C) Highest voltage (i) HV Winding (kV) (ii) LV Winding (kV)-	 (A) (i) 28 (ii) 3 (B) (i) 75 (ii) NA (C) (i) 12 (ii) 1.1	 Yes Yes Yes Yes Yes Yes	
(p)	Terminal arrangement (i) High voltage- Suitable for Cables /Overhead conductor (ii) Low voltage- (iii) LV Neutral-	 (i) Cables (ii) Cable box (iii) Cable box	 Yes Yes Yes	
(q)	Bushing (A) High voltage (i) Rated Voltage(kV) (ii) Rated Current(A) (iii)Basic Impulse level (kV) (iv) Minimum Creepage distance (mm) (v) Wet and dry power frequency Winding Voltage (kV rms) (B) Low voltage and Neutral (i) Rated Voltage(V)- (ii) Rated Current(A)- (iii) Minimum Creepage distance	 (A) (i) 12 (ii) 250 (iii) 75 (iv) 300 (v) 28 (B) (i)1100 (ii)2000 (iii)31mm/kV	 Yes Yes Yes Yes Yes Yes Yes Yes	
(r)	Minimum clearance (mm) in air (i) Phase to Phase (HV side) (ii) Phase to Earth(HV side) (iii) Phase to Phase (LV side) (iv) Phase to Earth(LV side)	 (i) 280 (ii) 140 (iii) 25 (iv) 25	 Yes Yes Yes Yes	
(s)	Method of Earthing	Solidly earthed	Yes	
(t)	Transformer Oil grade for higher altitude	Vendor to furnish data		

2.0 TESTS

A) ROUTINE TESTS

Whether during manufacture and on completion, all transformers are subjected to the routine tests in accordance with latest IS/IEC and its different parts.

YES

B) TYPE TESTS

Whether Type test reports of the tests conducted earlier (not more than 5 years from 22.01.09) on similar equipment submitted.

YES

If type test report submitted, indicate report number.

Sl. No.	TESTS	REPORT NO.
A	**Type tests**	
1.	Measurement of winding resistance	
2.	Measurement of voltage ratio and check of voltage vector relationship	
3.	Measurement of impedance voltage /short –circuit impedance (principal tapping) and load loss	
4.	Measurement of no-load loss and current	
5.	Measurement of insulation resistance	
6.	Dielectric test	
7.	Temperature –rise	
8.	Test on on–load tap –changers, where appropriate	
B	**Special Tests**	
1.	Short circuit tests	
2.	Measurement of zero sequence impedance of three-phase transformers	
3.	Measurement of acoustic noise level	
4.	Measurement of the harmonics of the no load current	

If the valid type test reports are not available with the bidder then the above mentioned tests shall be conducted by the bidder without any cost/ delivery implication to BHEL/ NHPC.

YES

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