BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NEW DELHI

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TITLE	NITROGEN INJECTION FIRE PROTECTION SYSTEM			DATE	24.07.15	24.07.15	24.07.15
				GROUP	TBEM		
				W.O. No	83012		
CUSTOMER	MADHYA PRADESH POWER TRANSMISSION LTD.						
PROJECT	Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turnkey basis (Lot no. 1) Balaghat, Badnawar, Bhopal, Chhegaon and Nagda						

List of Contents

Rev.	Date	Altered	Checked	Approved	REVISION DETAILS

Distribution	CUSTOMER	TBMM	O/C	
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SECTION - 1

SCOPE, TECHNICAL REQUIREMENTS, TECHNICAL QUALIFYING REQUIREMENT AND BILL OF MATERIAL

SECTION 1
SCOPE, TECHNICAL REQUIREMENTS, TECHNICAL QUALIFYING REQUIREMENT AND BILL OF MATERIAL

1.1 SCOPE

1.1.1 This specification covers the Design, Engineering, manufacture, inspection and testing at Contractor's and/ or his Subcontractor's works, transportation & delivery (FOR destination), handling, erection, testing & commissioning at site of **Nitrogen Injection Fire Protection System [NIFPS] for 315 MVA Transformers, 100 MVA Transformers and 125 MVAR Reactors at MPPTCL Balaghat, Badnawar, Bhopal, Chhegaon and Nagda Substation** as mentioned in different sections of this specification. (Unloading and Storage at Site is excluded from the scope of Bidder)

1.1.2 The Nitrogen Injection fire Protection System shall be designed, erected & commissioned in accordance with Standards and regulations as mentioned in SECTION 2 of this Specification pertaining to Customer Specification.

1.1.3 The requirement(s) specified under 'SECTION 2, SECTION 3, SECTION 4' and 'SECTION 5' of this specification shall be considered as part of this Specification. In case of any ambiguity / dispute between various sections, requirements of Section-2 i. e. Customer Specification shall prevail. In case of any ambiguity between various Sections, the same shall be spelt out clearly and Clause wise in the Technical Deviation Sheet.

1.1.4 It shall be the responsibility of successful bidder to obtain necessary approval(s) /clearance(s) from statutory organization(s) / authority(s) wherever applicable for the equipment / system / sub-system(s) under the scope specified herein.

1.1.5 **The Contract shall be Unit Rate based on the BOQ furnished by BHEL for the package. Addition/ deletion in quantities during contract stage shall be settled on the basis of unit rates, quoted by the bidders in their respective bids.**

1.1.6 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Purchaser/ Owner, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgment is not in full accordance herewith.

1.1.7 The bidder shall be deemed to have understood completely all the tender drawings and documents and quoted accordingly.

1.1.8 The bidder has to note carefully the parameters, estimated capacities of equipment indicated and the tender drawing in the specification are only for guidance of the bidder. The system shall be designed as per relevant standards / codes and exact capacities and quantities are to be estimated by the bidder. All such estimations and design calculations shall be submitted for Purchaser's approval.

1.1.9 The Contract shall be on unit rate basis for the quantities furnished by BHEL. During contract stage, quantities of various items of BOQ may vary to any extent and same rates will be applicable so far the resultant variation in total contract value is within ±20%. Variations beyond ±20% shall be negotiated mutually.

1.1.10 **Deviation:** Any deviation or variation from the Scope requirement and/or intent of this specification shall be clearly defined clause wise with respect to the specification under relevant **Deviation Schedule** given as Annexure-1 in Section-5 of this specification. *Deviations in any other form including clarifications / assumptions / etc will not be considered and it will be construed that the bid conforms strictly to the specification.*

1.1.11 The specification comprises of following sections :

Section-1:Scope, Technical requirements, Technical Qualifying Requirement & Bill of Material
Section - 2 : Customer Specification
Section - 3 : General Technical Requirement and Title Block
Section - 4 : Guaranteed Technical Particulars and List of Drawings
Section - 5 : Enclosures to Specification.

The equipment is required for the following projects:

Name of the Customer : Madhya Pradesh Power Transmission Company Ltd.

Name of the Project : Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turnkey basis (Lot No-1)

1.1.12 The term 'Customer' or 'Owner' appearing in this specification shall refer to **M/s. MPPTCL [M/s. Madhya Pradesh Power Transmission Company Ltd]**, the term 'Purchaser/Employer' shall refer to **BHEL** and the term 'Contractor' shall refer to the **Successful Bidder**.

1.2 TECHNICAL REQUIREMENTS

As per Customer Specification mentioned in Section-2.

1.3 LIST OF NITROGEN INJECTION FIRE PROTECTION SYSTEM REQUIREMENT AT VARIOUS LOCATIOS

Sl. No.	Description of Transformer / Reactor on which Nitrogen Injection Fire Protection System is to be fitted	Unit	Quantity					Total
			Balaghat	Badnawar	Bhopal	Chhegaon	Nagda	
1.	**315 MVA 400/220/33 kV Transformer**	Nos.	00	02	01	01	00	04
2.	**100 MVA 400/132 kV Transformer**	Nos.	02	00	00	00	00	02
3.	**125 MVAR 3 Phase 400 kV Shunt Reactor**	Nos.	00	01	00	00	01	02

1.4 TYPE OF FIRE PROTECTION REQUIRED

Nitrogen injection fire protection system for BHEL make 4 Nos. 315 MVA 400/220/33 kV Transformer, BHEL make 02 Nos. 100 MVA 400/132 kV Transformer and BHEL make 02 Nos. 125 MVAR 3 Phase 400 kV Shunt Reactor at 05 Nos. Sites of MPPTCL as detailed in Clause 3 above.

1.5 DESIGN CRITERIA

The **NITROGEN INJECTION FIRE PROTECTION SYSTEM** shall prevent tank explosion and fire during internal faults resulting in an arc where tank explosion will normally take 3-4 seconds after arc generation and also extinguishes the external oil fires on Transformer / Reactor's top cover due to Tank explosion and/or external failures like bushing fires, OLTC fires and fires from surrounding equipments.

The **NITROGEN INJECTION FIRE PROTECTION SYSTEM** shall protect the oil filled Transformer / Reactor against explosion fire that may emanate internally (during internal fault etc) and / or externally (such as failure of condenser bushing of the transformer / Reactor under subject, other source of equipment etc). It should be fully automatic and shall require minimum maintenance and practically no running cost.

All the requirements regarding supplies, provisions of control, interlocks, indications, annunciations, alarms etc, stipulated in Specification shall be satisfied by the contractor in totality.

1.6 SCOPE OF SUPPLIES & SERVICES

The requirements mentioned under this clause are ***indicative*** for the system. Any other item/ service, which is not specifically mentioned herein but required to complete the work for safe and sound operation of system shall be supplied and installed by the contractor at **NO EXTRA COST** to the purchaser. The scope of the work under the contract shall be deemed to include all such items, which although not specifically mentioned in the bid documents and/or in the bidder's proposal, but are required to make the equipment/system complete for its safe, efficient, reliable and trouble free operation, unless the same is specifically excluded from the Bidder's scope of work.

Anything major left out in the BOM shall be clearly highlighted/ brought to purchaser's notice and to be listed in the Technical Deviation Sheet as a part of the Technical Offer.

1.6.1 Scope of supply

a. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, General and Special Conditions of Contract, Technical Specifications, and Drawings.
b. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Purchaser and valued at the rates and prices bid in the priced Bill of Quantities.
c. A rate or price shall be entered against each item in the priced Bill of Quantities. The cost of Items against which the Contractor has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities.
d. The whole cost of complying with the provisions of the Contract shall be included in the Items provided in the priced Bill of Quantities, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related Items of Work.
e. General directions and descriptions of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. References to the relevant

sections of the Contract documentation shall be made before entering prices against each item in the priced Bill of Quantities.

f. Miscellaneous items like hardware, fixtures etc. shall be deemed to be included under the relevant BOQ items and bidders shall consider the same while quoting for BOQ items.

Bidder s*hall note the following:*

- BHEL shall lay single feeder for 220V DC upto control box in station control room. Bidder shall terminate this feeder in his control box and make his own arrangements to extend this supply elsewhere, if required, for monitoring system operation, automatic controls and remote operations. Control box should be complete with DC-DC converter for audio-visual alarm, indicating lights, switches, push buttons etc. suitable for tripping and signaling on 220V DC supply. The control box is to be installed in the control room of the substation based on control room lay out and feasibility. Necessary cables, cable laying, marshaling cabinets in control room, cabinets for fixation of control boxes etc are under the scope of Bidder.
- FE Cubicle shall comprise of Fire extinguishing Cabinet with base frame, consisting of:
  a. Nitrogen Gas cylinder of sufficient capacity with pressure regulator and manometer with sufficient number of adjustable NO contacts.
  b. Oil Drain Assembly
  c. Mechanical release device for oil drain and nitrogen release.
  d. Limit switches for monitoring the systems
  e. Panel lighting
  f. Flanges on top of the panel for connecting oil drain and nitrogen injection pipes for transformer / Reactor.
  g. Oil drain pipe extension of suitable size for connecting pipes to oil pit.
  h. Limit switch for pressure switch/ sensor.
- Signal box will be terminating cable connections from PRV/ pressure sensor, PNRV/POBV, fire detectors and circuit breaker trip signal.
- Pre-stressed non-return valve (PNRV)/ high speed pneumatically operated ball valve (POBV) shall be provided with sufficient number of NC contacts for remote alarm indication and with visual position indicator.
- Fire detectors will rated for heat sensing at 141°C or suitable temperature recommended by the manufacturer and each will fitted with two nos. PG 13.5 size cable glands.
- FRLS cable of size 12C X 1.5 mm^2 to be used or connecting signal box mounted on transformer / Reactor to Control Box in the station control room, Relay Panel to Control Box and Control Box to FE Cubicle.
- FRLS cable of size 4C X 1.5 mm^2 to be used for connecting PNRV / POBV to signal box, AC supply to FE Cubicle, AC & DC supply to Control Box, interconnection of AC & DC supply and connections in Relay Panel.
- Cable trays, if required, of suitable size as per the type of Cable used along with necessary hardware for fixing the same on walls or elsewhere shall be included by the bidders in their offers.
- Earthing of various equipment under his scope of supply shall be in contractor's scope, however GI flat (25 X 3 mm or 50 X 6 mm or 75 X 10 mm) shall be provided by BHEL on free issue basis. Bidders shall furnish their tentative requirements in their respective bids.

- Bidders shall consider only reputed makes of equipments. All makes shall be subjected to acceptance of final customer. No additional price implication shall be made to BHEL on account of non-acceptance of proposed makes during contract stage.
- Bidder shall consider following items also while quoting :
  i. Cable glands, lugs, marker, and cable ties etc. for termination of power and control cables.
  ii. Fixing hardware for mounting various equipments in the system and cable trays etc.
  iii. Civil work for FE cubicle plinth and pipe support.
  iv. Construction of Oil Pits as per relevant Transformer / Reactor Rating with provision of Oil Storage Tank of MS.
- ***Bidder shall also furnish a list of tools and tackles, which shall be brought to site for erection & commissioning purpose (to be returned after completion of work).***
- ***Bidder shall furnish the Size & capacity of Oil pits for Nitrogen Injection Fire Protection System with the Bid for each rating of Transformer / Reactor mentioned in this Specification.***

1.6.2 SCOPE OF SERVICES

1.6.2.1 CIVIL WORKS : The following shall be in the scope of Contractor:

a. Construction of foundation and plinth for fire extinguishing cubicle.
b. Construction of RCC / Brick Oil Pits with provision for placement of Oil Storage Tank of MS as per relevant Transformer / Reactor Rating.
c. Any minor Civil Work, supply of Inserts and Foundation Bolts required if any, any dismantling / breaking of existing RCC / Brick wall etc. required for complete and successful installation of Nitrogen Injection System including making the same good is in the scope of Contractor and is deemed to be included in the quoted prices.

1.6.2.2 Erection, Testing & Commissioning (ETC) requirements

a) The scope of ETC shall include erection of equipment /material at site including fabrication, equipment/ system testing and commissioning of the entire system.

b) Laying and termination of piping between transformer / Reactor, FE cubicle and drain pit along with supports and fittings.

c) Laying and termination of power and control cables for the equipment under the scope this specification.

d) Laying & fixing of cable trays on walls or elsewhere, if required.

e) Earthing of all the system components (equipments) to the nearest earth mat riser of the Owner / Purchaser.

f) The contractor shall arrange all machinery, tools & tackles and consumables required for erection of the system.

g) Contractor shall ensure that sufficient quantity of commissioning spares is made available for timely completion of commissioning of the system. The contractor shall furnish a list of commissioning spares that will be brought by him. The unused commissioning spares shall be returnable to the Contractor.

h) Water and 415 V power shall be made available by purchaser at one point. Contractor shall be required to make own arrangement for taking supplies from there.

i) It is the responsibility of the successful Bidder to obtain necessary approval/ clearance from statutory organizations wherever applicable for the equipment/ systems under the scope specified.

j) The contractor shall train engineers of Purchaser/ Owner so that they are fully conversant with both electrical and mechanical part of the package.

k) The contractor shall furnish the operation and maintenance manual for the system. The draft O&M manual shall be submitted within 4 weeks after award of contract.

The O&M manual shall contain the following information:

i) Description of the system and equipment with design particulars

ii) Scheme of operation for prevention of tank explosion and fire protection alongwith a flowchart showing sequence and time of operation of various devices of the system.

iii) Instruction for installation, operation, maintenance and repair at site.

iv) Recommended inspection practices and inspection schedule.

v) List of Recommended Spares.

vi) Ordering information for all replaceable parts.

1.6.2.3 Installation & pre-commissioning test of Nitrogen Injection Fire Protection System :

After installation the system pre-commissioning tests shall be carried out jointly before the system is put in service.

1.7 Provisions with Transformer / Reactor for installation of Nitrogen Injection Fire Protection System :

Following provisions shall be provided by BHEL with each Transformer / Reactor for installation of Nitrogen Injection Fire Protection System :

a. Oil drain opening with pipe, flange and manual gate valve at about 100 - 150 mm below the top cover.

b. Nitrogen Injection openings with suitable size of pipe with flanges and manual gate valves on tank sides at about 50 - 200 mm from the bottom plate.

c. Flanges on conservator pipe between Buchholz relay and conservator tank for fixing PNRV/ POBV.

d. Provision for temperature and pressure sensors if required.

e. Supply and welding of fire detector bracket on top cover.

f. Supply and welding of brackets for fixing signal box at a suitable location on top cover or tank side wall.

Bidder shall confirm adequacy of the above arrangements on transformer / Reactor. Any other requirement for modification needed in the Transformer / Reactor Design shall be brought out clearly in the bid itself. Bidder shall also provide relevant drawings for recommended / desired size of Brackets for mounting Fire Detectors, Brackets for fixing Signal Box etc. along with any other information as may be necessary to make required modifications on Transformer / Reactor for purpose of successful and complete installation of Nitrogen Injection Fire Protection System.

1.8 EXCLUSIONS

1.8.1 Supply of BUCHHOLZ relay.

1.8.2 Supply of GI flat for earthing of equipments.

1.8.3 Unloading and Storage at Site.

1.8.4 Construction of Safety Wall / fire wall for Transformer and Reactor.

1.8.5 Any Trench Related work for lying of Cables in Switchyard.

1.8.6 Set of Gate valves needed for Transformer / Reactor Package i. e. 25 NB Gate valves for Nitrogen Injection openings at a distance of about 50 - 200 mm from Bottom Plate and 150 NB Gate valve for Oil Drain on top about 100 - 150 mm below top cover.

(Apart from the Valves mentioned in Clause 1.8.6, all other Valves related to exclusively to **Nitrogen Injection System** in line with the Bill of Material, are to be included in Bidder's offer).

1.9 TECHNICAL QUALIFYING REQUIREMENT

The manufacturer for supply of N2 injection system must have type tested product & bidder should submit copy of type test report alongwith bid.
Bidder should also submit the list of utilities/project where the product is installed for our information.

1.10 INSPECTION & TESTING

All the equipments shall be inspected prior to dispatch in line with relevant IS, approved GTP/ drawing and technical specification, BHEL/ customer approved QAP.

1.11 QUALITY PLAN

The contractor shall carry out contract 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 / MPPTCL approval within 1 week of P.O. placement.

1.12 DRAWING AND DOCUMENTATION

All drawings, data, design calculations & printed erection, operation & maintenance manual and other documents will be submitted by the Contractor within 2 weeks after placement of order for customer approval.

1.13 HANDING AND TAKING OVER

It is the responsibility of Contractor to maintain the system till it is handed over to the owner. Pre commissioning tests shall be carried jointly with the Purchaser's / Owner's representative prior to handing over the system. Any additions/correction required for suitable operation of nitrogen injection fire prevention system before handing over to customer shall be done by contractor without any extra cost to BHEL.

1.14 BILL OF MATERIAL - As per following sheets from Page no. 9 to 12.

BILL OF MATERIAL FOR NITROGEN INJECTION FIRE PROTECTION SYSTEM

Sl. No.	Item Description	Unit	Qty.					TOTAL
			Balaghat	Badnawar	Bhopal	Chhegaon	Nagda	
1	Supply and Installation of Fire extinguishing Cabinet with base frame as per Customer Specification and Approved Drawings.	SET	02	03	01	01	01	08
2	Supply and Installation of Control box to be installed in control room as per Customer Specification and Approved Drawings.	Nos.	02	03	01	01	01	08
3	Supply and Installation of Signal box as per Customer Specification and Approved Drawings.	Nos.	02	03	01	01	01	08

Sl. No.	Item Description	Unit	Qty.					TOTAL
			Balaghat	Badnawar	Bhopal	Chhegaon	Nagda	
4	Supply and Installation of Pre-stressed non-return valve (PNRV)/ high speed pneumatically operated ball valve (POBV) as per Customer Specification and Approved Drawings.	**Nos.**	**02**	**03**	**01**	**01**	**01**	**08**
5	Supply and Installation of Fire detectors as per Customer Specification and Approved Drawings including necessary Cabling arrangement for Fire Detector with FS Cable of suitable size, cable trays and any other items required for its mounting.	**Nos.**	**24**	**36**	**12**	**12**	**12**	**96**
6	Supply and laying of FRLS cable of size 12C X 1.5 mm^2 in existing trenches along with Cable Trays of necessary sizes for connecting signal box mounted on transformer / Reactor to Control Box in the station control room, Relay Panel to Control Box and Control Box to FE Cubicle as per Customer Specification and Approved Drawings.	**Mtrs.**	**2000**	**3000**	**300**	**300**	**800**	**6400**

Sl. No.	Item Description	Unit	Qty.					TOTAL
			Balaghat	Badnawar	Bhopal	Chhegaon	Nagda	
7	Supply and laying of FRLS cable of size 4C X 1.5 mm^2 in existing trenches along with Cable Trays of necessary sizes as per Customer Specification and Approved Drawings.	**Mtrs.**	**200**	**300**	**100**	**100**	**100**	**800**
8	Supply and Installation of Oil drainpipe of suitable size for connection between outlet valve provided on transformer / Reactor tank and flange provided on top of FE cubicle as per Customer Specification and Approved Drawings.	**Mtrs.**	**24**	**36**	**12**	**12**	**12**	**96**
9	Supply and Installation of Oil drainpipe of suitable size for connection between oil drainpipe bottom (in FE cubicle) to the oil pit as per Customer Specification and Approved Drawings.	**Mtrs.**	**12**	**18**	**06**	**06**	**06**	**48**

Sl. No.	Item Description	Unit	Qty.					TOTAL
			Balaghat	Badnawar	Bhopal	Chhegaon	Nagda	
10	Supply and Installation of Nitrogen injection pipe of suitable size for connection between inlet openings on transformer / Reactor tank and flange provided on top of FE cubicle as per Customer Specification and Approved Drawings.	**Mtrs.**	**36**	**54**	**18**	**18**	**18**	**144**
11	Supply and Installation of pipe of suitable size for support to oil drain as per Customer Specification and Approved Drawings.	**Mtrs.**	**24**	**36**	**12**	**12**	**12**	**96**
12	Supply and Installation of OIL STORAGE TANK OF MS OF SUITABLE CAPACITY AS PER THE RATING OF RESPECTIVE TRANSFORMER / REACTOR ALONG WITH ASSOCIATED ACCESSORIES as per Customer Specification and Approved Drawings.	**LOT**	**02**	**03**	**01**	**01**	**01**	**08**

SECTION - 2

CUSTOMER SPECIFICATION

While furnishing details for the above sealing arrangement, the Bidders must confirm clearly that the size and capacity of sealing arrangement is adequate for the transformer and for the quantity of oil required for the transformers. Necessary calculation/documentary proof shall be furnished.

20.8 Air cell type oil preservation system included with each transformer shall ensure as under:

(a) The air inlet of COPS (Conservator Oil preservation System) shall be properly fitted on the conservator for leak proof arrangement to ensure that the air does not come in contact with oil under any circumstances.

(b) The size and capacity of the COPS (Conservator Oil preservation System) shall be selected to suit the design of Conservator and to ensure proper operation for the quantity of oil in the unit with the proper allowances. The COPS shall be of reputed make, proven design and of established performance. Details in this regard are to be submitted with the offer by the Bidder for verification . The Bidder is required to submit calculation with bid to prove adequacy of air cell & its size.

(c) The Bidder shall clearly indicate in the manual the procedure for installation of COPS and precautions to be taken at the time of first oil filling under vacuum in the transformer.

SECTION-2

20. 9 SPECIFICATION OF FIRE PROTECTION SYSTEM : Nitrogen injection type fire prevention & extinguishing system with flow sensitive conservator isolation valve shall be provided for all the transformers.

20.9.1 Nitrogen Injection Fire Protection System (NIFPS) shall be designed to prevent explosion of transformer tank and the fire during internal faults resulting from arc and also to extinguish the external oil fires on transformer due to tank explosion and/or external failures like bushing fires, OLTC fires and fire from surrounding equipments, etc. The system shall work on the principle of Drain & stir. On activation, it shall drain a pre-determined quantity of oil from the tank top through drain valve to reduce the tank pressure, isolate conservator tank oil and inject nitrogen gas at high pressure from the bottom side of the tank through inlet valves to create stirring action and reduce the temperature of oil below flash point to extinguish the fire. The quantity of oil removed from the tank shall be such that adequate amount of oil shall remain to cover active part, i.e. core coil assembly even after stoppage of oil drain. Electrical isolation of transformer shall be an essential pre-condition for activating the system. **The NIFPS shall conform to NEPA 70 standard titled " Fire protection of transformers & transformer vaults" and Tariff Advisory Committee (TAC) regulations .**

20.9.2 OPERATIONAL CONTROLS: The system operation shall be fully automatic and activate from the required fire and other trip signals. In addition to automatic operation, remote operation from control room/ remote

centre and local manual control in the fire extinguishing cubicle shall also be provided. System shall operate on following situations.

20.9.3 PREVENTION OF TRANSFORMER EXPLOSION AND FIRE: To prevent transformer explosion and fire in case of an internal fault, signals given by operation of Electrical protection relays and tripping of circuit breaker of transformer and operation of either Buchholtz relay, or pressure relief valve (PRV) **alongwith Rapid Pressure Rise Relay (RPRR) shall be used to activate the system and logic for RPRR for system activation should include for operation of Electrical protection relays and tripping of circuit breaker of transformer.** The exact logic for system activation shall be finalized during detailed engineering.

20.9.4 FIRE PROTECTION: In case of fire, sensed by fire detectors, the system shall be activated only after electrical isolation of the transformer, confirmed by breaker trip. If the fire detection is not associated with any other fault, the system activation shall be only manual. Manual operation switch shall be provided in the control room/ remote control centre with a cover to avoid accidental operation of it.

20.9.5 OPERATION OF SYSTEM: On receiving activation signal, the following shall take place:

i. Open the quick opening drain valve to drain the top layer oil

ii. Shut off the conservator isolation valve to prevent flow of oil from the Conservator tank to the main tank.

iii. Open the Nitrogen regulator valve to inject Nitrogen into the transformer tank to create stirring of oil.

There shall be interlock to prevent activation of the system if the transformer is not electrically isolated. There shall also be provision for isolating the system during maintenance and/or testing of the transformer.

20.9.6 TECHNICAL PARTICULARS: The supplier shall be responsible for the design of the complete system and shall submit the drawings and design calculations for the number of fire detectors, pipe sizing of drain pipe and Nitrogen injection pipe, Nitrogen cylinder capacity, number of injection points, etc. and get approval from purchaser. Facility shall be provided to test the system when the transformer is in service, without actually draining the oil and injecting Nitrogen. The Nitrogen regulator valve shall be designed in such a way that the Nitrogen shall not enter the transformer tank even in case of passing/ leakage of valve. The system shall work on station DC supply. MPPTCL shall give two distinct DC feeders in control. The control box of fire protection system shall have facility to receive these feeders for auto change over of supply. It shall be the contractor's responsibility to further distribute power to the required locations.

Following indications and alarms shall be provided in the cubicle as well as the control box:-

- Nitrogen cylinder pressure indication.
- Nitrogen cylinder pressure low.
- Fire in Transformer/ Reactor.
- Oil drain started.
- Conservator oil isolation valve closed.
- Nitrogen injection started.

20.9.7 DETAILS OF SUPPLY & WORK FOR SYSTEM EQUIPMENTS AND OTHER RELATED ACTIVITIES: The scope of supply shall include the following items, any other items required for safe & trouble free operation of the system and the scope of works include complete earthwork (i.e. excavation, backfilling etc.), scope of supply also includes services to be availed by the purchaser for erection and commissioning of NIFPS at EHV sub-stations of MPPTCL in MP. , civil work with civil material for the entire open/ buried piping for the fire protection system, construction of safety wall, construction of oil pits with provision of oil storage tank of MS and pipe supports for open/ buried, entrenched and overground piping. The system design shall also conform to TAC/NFPA norms.

(i) Fire extinguishing cubicle with base frame and containing at least the following:

- Nitrogen gas cylinder of sufficient capacity with pressure regulator and manometer with sufficient number of adjustable NO contacts.
- Oil Drain Assembly including oil drain pipe extension of suitable size for connecting pipes to oil pit.
- Mechanical release device for oil drain and nitrogen release.
- Limit switches for monitoring of the systems.
- Panel lighting.
- Flanges on top of the panel for connecting oil drain and nitrogen injection pipes for transformer.
- Limit switch for pressure switch/sensor.
- Pressure indicators for Nitrogen pressure in the cylinder and after Nitrogen regulator.

(ii) Control box to be installed in the control room of the station for monitoring system operation, automatic control and remote operation, with alarms, indication light, switches, push buttons, audio signal, suitable for tripping and signaling.

(iii) Conservator isolation valve which shall be flow sensitive and shut off when the flow in the pipe is more than the flow expected in the permissible normal operating conditions. It shall be provided with position indicator remote alarm indication.

(iv) Required number of fire detectors to be located in strategic locations to be finalized during detailed engineering.

(v) Flow Sensitive Conservator Isolation Valve.

(vi) All controls, alarms, panels, cables, cable trays (if required), junction boxes, Valves etc.

20.9.8 INSTALLATION AND PRE-COMMISSIONING TEST: After installation the system pre-commissioning tests shall be carried out jointly with the MPPTCL representative before the system is put in service.

20.9.9 In order to restrict the supply of oil in case of a fire in transformer, provision shall be made to isolate the conservator oil from the main tank.

20.9.10 A valve which shall be flow sensitive and shut off when the flow in the pipe is more than the flow expected in the permissible normal operating conditions. This valve shall be located in the piping between the conservator and the buchholz relay and shall not affect the flow of oil from and to the conservator in normal conditions.

20.9.11 When the flow from conservator to main tank is more than the normal operating conditions, the valve shall shut off by itself and will have to be reset manually. It shall be provided with valve open/close position indicator along with alarm indication in control room during closing operation of valve.

20.9.12 Necessary switches shall be provided in cooler control cabinet / common marshalling box for manual open / close operation of the valve.

Bidders shall offer Transformers completely fitted with Nitrogen Injection Fire Protection Systems, separately in their offer in schedule of prices .

20.10 ON LINE MONITORING DEVICE FOR TRANSFORMER

20.10.1 The Bidder should offer for a suitable on line monitoring device for regular monitoring of 3 key gases and moisture for condition assessment and fault detection of the 400 KV 315 MVA transformer . The device should measure 3 key dissolved gases viz. Hydrogen, Acetylene, Carbon mono oxide with accuracy of ±10%. The minimum range of measurement of dissolved gases shall be Hydrogen :5 to 500, Acetylene : 3 to 5000, Carbon mono oxide : 10 to 5000 . The moisture content shall be measured from 0 to 100 % RS (in ppm). The device shall have non volatile memory storage to prevent loss of data. The device shall be provided with user configurable at least six alarm contacts & two front panel LED arrays. The alarm setting screen shall be available for setting alarms based on level of 3 Key gases or moisture and rates of change for Key gases. For configuring the six alarm settings, suitable PC software shall be provided with the device. The device shall be supplied with two separate channels for remote communication plus local USB and Ethernet connections. The device should support communication Protocol viz MODBUS, DNP 3.0 and IEC-61850. It shall be possible to configure sampling rates to hourly/ daily. The alarm & Caution thresholds shall be user configurable. The device should support Load monitoring by analyzing results with loading of Transformer and device shall

Conservator and to ensure proper operation for the quantity of oil in the unit with the proper allowances. The COPS shall be of reputed make, proven design and of established performance. Details in this regard are to be submitted with the offer by the Bidder for verification . The Bidder is required to submit calculation with Bid to prove adequacy of air cell & its size.

(c) The Bidder shall clearly indicate in the manual the procedure for installation of COPS and precautions to be taken at the time of first oil filling under vacuum in the Reactor.

SECTION - 2

20. 9 SPECIFICATION OF FIRE PROTECTION SYSTEM : Nitrogen injection type fire prevention & extinguishing system with flow sensitive conservator isolation valve shall be provided for all the Reactors.

20.9.1 Nitrogen Injection Fire Protection System (NIFPS) shall be designed to prevent explosion of Reactor tank and the fire during internal faults resulting from arc and also to extinguish the external oil fires on reactor due to tank explosion and/or external failures like bushing fires and fire from surrounding equipments, etc. The system shall work on the principle of Drain & Stir. On activation, it shall drain a pre-determined quantity of oil from the tank top through drain valve to reduce the tank pressure, isolate conservator tank oil and inject nitrogen gas at high pressure from the bottom side of the tank through inlet valves to create stirring action and reduce the temperature of oil below flash point to extinguish the fire. The quantity of oil removed from the tank shall be such that adequate amount of oil shall remain to cover active part, i.e. core coil assembly even after stoppage of oil drain. Electrical isolation of Reactor shall be an essential pre-condition for activating the system.

20.9.2 OPERATIONAL CONTROLS: The system operation shall be fully automatic and activate from the required fire and other trip signals. In addition to automatic operation, remote operation from control room/ remote centre and local manual control in the fire extinguishing cubicle shall also be provided. System shall operate on following situations.

20.9.3 PREVENTION OF REACTOR EXPLOSION AND FIRE: To prevent Reactor explosion and fire in case of an internal fault, signals given by operation of Electrical protection relays and tripping of circuit breaker of Reactor and operation of either Buchholtz relay, or pressure relief valve (PRV) **alongwith Rapid Pressure Rise Relay (RPRR) shall be used to activate the system and logic for RPRR for system activation should include for operation of Electrical protection relays and tripping of circuit breaker of Reactor.** The exact logic for system activation shall be finalized during detailed engineering.

20.9..4 FIRE PROTECTION: In case of fire, sensed by fire detectors, the system shall be activated only after electrical isolation of the Reactor, confirmed by breaker trip. If the fire detection is not associated with any other

fault, the system activation shall be only manual. Manual operation switch shall be provided in the control room/ remote control centre with a cover to avoid accidental operation of it.

20.9.5 OPERATION OF SYSTEM: On receiving activation signal, the following shall take place:

i. Open the quick opening drain valve to drain the top layer oil

ii. Shut off the conservator isolation valve to prevent flow of oil from the Conservator tank to the main tank.

iii. Open the Nitrogen regulator valve to inject Nitrogen into the Reactor tank to create stirring of oil.

There shall be interlock to prevent activation of the system if the Reactor is not electrically isolated. There shall also be provision for isolating the system during maintenance and/or testing of the Reactor.

20.9.6 TECHNICAL PARTICULARS: The supplier shall be responsible for the design of the complete system and shall submit the drawings and design calculations for the number of fire detectors, pipe sizing of drain pipe and Nitrogen injection pipe, Nitrogen cylinder capacity, number of injection points, etc. and get approval from Purchaser. Facility shall be provided to test the system when the Reactor is in service, without actually draining the oil and injecting Nitrogen. The Nitrogen regulator valve shall be designed in such a way that the Nitrogen shall not enter the Reactor tank even in case of passing/ leakage of valve. The system shall work on station DC supply. MPPTCL shall give two distinct DC feeders in control. The control box of fire protection system shall have facility to receive these feeders for auto change over of supply. It shall be the contractor's responsibility to further distribute power to the required locations.

Following indications and alarms shall be provided in the cubicle as well as the control box:-

- Nitrogen cylinder pressure indication.
- Nitrogen cylinder pressure low.
- Fire in Transformer/ Reactor.
- Oil drain started.
- Conservator oil isolation valve closed.
- Nitrogen injection started.

20.9.7 DETAILS OF SUPPLY & WORK FOR SYSTEM EQUIPMENTS AND OTHER RELATED ACTIVITIES: The scope of supply shall include the following items, any other items required for safe & trouble free operation of the system and the scope of works include complete earthwork (i.e. excavation, backfilling etc.), scope of supply also includes services to be availed by the purchaser for erection and commissioning of NIFPS at EHV sub-stations of MPPTCL in MP. , civil work with civil material for the entire open/

buried piping for the fire protection system, construction of safety wall, construction of oil pits with provision of oil storage tank of MS and pipe supports for open/ buried, entrenched and overground piping. The system design shall also conform to TAC/NFPA norms.

(i) Fire extinguishing cubicle with base frame and containing at least the following:

- Nitrogen gas cylinder of sufficient capacity with pressure regulator and manometer with sufficient number of adjustable NO contacts.
- Oil Drain Assembly including oil drain pipe extension of suitable size for connecting pipes to oil pit.
- Mechanical release device for oil drain and nitrogen release.
- Limit switches for monitoring of the systems.
- Panel lighting.
- Flanges on top of the panel for connecting oil drain and nitrogen injection pipes for Reactor.
- Limit switch for pressure switch/sensor.
- Pressure indicators for Nitrogen pressure in the cylinder and after Nitrogen regulator.

(ii) Control box to be installed in the control room of the station for monitoring system operation, automatic control and remote operation, with alarms, indication light, switches, push buttons, audio signal, suitable for tripping and signaling.

(iii) Conservator isolation valve which shall be flow sensitive and shut off when the flow in the pipe is more than the flow expected in the permissible normal operating conditions. It shall be provided with position indicator remote alarm indication.

(iv) Required number of fire detectors to be located in strategic locations to be finalized during detailed engineering.

(v) Flow Sensitive Conservator Isolation Valve

(vi) All controls, alarms, panels, cables, cable trays (if required), junction boxes, valves etc.

20.9.8 INSTALLATION AND PRE-COMMISSIONING TEST: After installation the system pre-commissioning tests shall be carried out jointly with the MPPTCL representative before the system is put in service.

20.9.9 In order to restrict the supply of oil in case of a fire in Reactor, provision shall be made to isolate the conservator oil from the main tank.

20.9.10 A valve which shall be flow sensitive and shut off when the flow in the pipe is more than the flow expected in the permissible normal operating conditions. This valve shall be located in the piping between the conservator and the buchholz relay and shall not affect the flow of oil from and to the conservator in normal conditions.

20.9.11 When the flow from conservator to main tank is more than the normal operating conditions, the valve shall shut off by itself and will have to be reset manually. It shall be provided with valve open/close position indicator along with alarm indication in control room during closing operation of valve.

20.9.12 The necessary switches shall be provided in cooler control cabinet / common marshalling box for manual open / close operation of the valve.

20.9.13 Instruction plate incorporating operating procedure / cautions shall be provided with each NIFPS system.

Bidders shall offer Reactor completely fitted with Nitrogen Injection Fire Protection Systems .

20.10 ON LINE MONITORING DEVICE

20.10.1 The Bidder should offer for a suitable on line monitoring device for regular monitoring of 3 key gases and moisture for condition assessment and fault detection of the 400 KV Reactor . The device should measure 3 key dissolved gases viz. Hydrogen, Acetylene, Carbon mono oxide with accuracy of ±10%. The minimum range of measurement of dissolved gases shall be Hydrogen :5 to 500, Acetylene : 3 to 5000, Carbon mono oxide : 10 to 5000 . The moisture content shall be measured from 0 to 100 % RS (in ppm). The device shall have non volatile memory storage to prevent loss of data. The device shall be provided with user configurable at least six alarm contacts & two front panel LED arrays. The alarm setting screen shall be available for setting alarms based on level of 3 Key gases or moisture and rates of change for Key gases. For configuring the six alarm settings, suitable PC software shall be provided with the device. The device shall be supplied with two separate channels for remote communication plus local USB and Ethernet connections. The device should support communication Protocol viz MODBUS, DNP 3.0 and IEC-61850. It shall be possible to configure sampling rates to hourly/ daily. The alarm & Caution thresholds shall be user configurable. The device should support Load monitoring by analyzing results with loading of Reactor and device shall be provided with suitable software for graphical trending & diagnostic analysis of results. The device shall have minimum maintenance requirements.

On line monitoring unit shall not be mounted on the body of the Reactor. A separate mounting arrangement near the Reactor body with proper protective sheds & covers for protection against sun and rains be provided. The mounting cubical shall have provision for ventilation/cooling and also provision for reading of parameters by operators without opening the box. On line monitoring unit shall be complete with provision for remote monitoring alarm and indication in RTCC panel in control room. Complete details of offered device shall be submitted by the Bidder and explained by suitable manual/pamphlets.

External temperature range : 0 to 55 °C

SECTION - 3

GENERAL TECHNICAL REQUIREMENT AND TITLE BLOCK

SECTION 3
GENERAL TECHNICAL REQUIREMENT

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.
The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other respective sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	Madhya Pradesh power Transmission company Ltd.				
b)	Project Title	Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turn key basis (Lot no. 1) – Balaghat , Badnawar, Bhopal, Chhegaon and Nagda substation				
c)	Location	Balaghat	Badnawar	Bhopal	Chhegaon	Nagada
		Balaghat is Located in district of Balaghat of Madhya Pradesh . Distance between Jabalpur to Balaghat is 232 km by Road and 130 km by Rails.	Badnawar is Located in district of Dhar of Madhya Pradesh. Distance between Badnawar to Ujain is 70 km by Road .	Bhopal site is located 20 kM away from Bhopal city.	Chhegaon is located in Khandwa district of Madhya Pradesh . Distance between Chhegaon to Khandwa is 15 km by Road.	Nagda is located in Ujjain district of Madhya Pradesh. The road distance between Nagda to Ujjain is 47 km
d)	Transport Facilities	Road/Rail				

e)	Postal Address	To follow
SITE CONDITIONS		
a)	Maximum ambient air temperature	50°C
b)	Minimum ambient air temperature	1°C
c)	Average daily ambient temperature	35°C
d)	Maximum Relative humidity	95 %(sometimes approach saturation)
e)	Pollution Severity	Heavily Polluted
f)	Seismic level (horizontal acceleration)	0.3g
g)	Wind zone as per IS 802 (PART 1) - 1995velocity	4
h)	maximum wind pressure	150kg/sq.mts
i)	Average annual rainfall	1250 mm
j)	Maximum altitude above mean see level	1000m
k)	Isolceraunic level	90 days per year
l)	Climate	Moderately hot & humid tropical climate , conductive ti rust & fungus growth

AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V 50 Hz, 3-phase 4 wire, solidly earthed
1 phase A.C power supply	240V ,50 Hz, 1-phase , 2 wire
D.C. power supply	**220V , 2-wire ungrounded**, for all equipments and panels except PLCC of 400kV /220kV /132kV /33kV substation
D.C. power supply	48V , 2 wire system positively earthed for PLCC

The above supply voltage may vary as below and all devices shall be suitable for continuous operation over entire range of voltage.

i.	**AC supply**	**Voltage + 10 % to -25% , frequency ± 4%**
ii.	**DC supply**	**Voltage + 10 % to -20%**

SYSTEM PARAMETERS

Description parameters	400kV System	220kV System	132kV System	33kV System
System operating voltage	400 kV	220kV	132kV	33kV
Maximum operating voltage(rms)	420 kV	220kV	145kV	36 kV
Rated frequency	50Hz			
Full wave impulse withstand voltage (1.2/50 micro second)	1425kV P	1050kVP	650kVP	250kVP/ 170kVP
One minute Power frequency dry/wet withstand voltage (rms)	630kV/ 520kV	460kV	275kV	95kV/70k V
Switching Impulse withstand voltage (250/2500 micro sec.) dry and wet	1050kV P	-	-	-
Corona extinction voltage	320kV	156kV	105kV	-
Maximum radio interference voltage for frequency between 0.5MHz and 2 MHz at 320kV rms phase for 400kV system , 156kVrms for 220kV system & 92 kV rms for 132kV system	1000 Micro volt	1000 Micro volt	500 Micro volt	-
Rated short time current	40 kA for three seconds/one second as applicable			25 kA for three seconds/2 6.2kA for two second
Creepage distance @25mm/kV	10500m m	6125mm	3625m m	900mm
System Earthing	Effectively Earthed			

3.2 GENERAL TECHNICAL REQUIREMENT

3.2.1 TYPE TESTS

All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type. The Bidder / Contractor shall furnish the reports of all the type tests carried out in within last **five years from the date of bid opening (i.e. 20.11.13)** as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/similar components/equipment/systems to those offered/proposed to be supplied under this contract.

Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are

found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Contractor is not able to submit report of type test(s) conducted in last five years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

3.2.2 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.3 MATERIAL/WORKMANSHIP

3.3.1 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components 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 best engineering practice and suitable for the purpose for which they are intended.

The design of the Works shall be such that installation, future expansions, replacements 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 parts shall be accurately positioned and restrained 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 purchaser.

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 materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modem practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise

specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal 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 locations and tested for healthiness.

The Contractor 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 purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor 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 Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.3.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

3.4 COLOUR SCHEME AND CODES FOR PIPE SERVICE/PANELS

The contractor shall propose a color scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

Painting process shall be of powder coating type.All surface shall be cleaned , phosphated and given two coats of rust –resistant primer followed by two coats of finish paints . The interior of all panels cabinets and enclosures shall be finished with gloss white enamel. Two final powder coats of synthetic enamel paint of light grey shade(697 of IS-5) shall be given to exterior surface of all the panels. Sufficient quantities of touch paint shall be furnished for application at site. All The

indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.5 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.6 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the 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 interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.7 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be throughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for paintaing shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitabley wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade no. 697 of IS:5.

3.8 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised conforming to latest

version of IS:2629 & or 4759 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvasized. Minimum weight of zinc coating shall be **610 gm/sq.m** and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

3.9 PACKING

The following details are to be clearly indicated in the material forwarding documents:

a) Name and address of the consignee.
b) Purchase order number.
c) Name of supplier/s.
d) Description of equipment / material.
e) Net weight.
f) Gross weight.

All the equipments 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. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

Mandatory spares shall be packed in separate packing with clear identification.

3.10 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser’s information

only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.11 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

a) Installed out door: IP-55

b) Installed indoor in air conditioned area: IP-31

c) Installed in covered area IP:52

d) Installed indoor-in non air-conditioned area where possibilities of entry of water is limited:IP-41

e) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.12 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may required by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided. All measurements shall be in M.K.S units.

3.13 EARTHING

Circuit breakers, LA, Isolator, CVT , CT , BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels,

Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.14 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be **1100 V grade box** –clamp type and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be **non-disconnecting stud type equivalent to Elmex type CATM4**, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm, copper flexible.
All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible..

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. **At least 20 % spare** terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publictions, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

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

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of **CRCA** sheet steel of minimum 2.5 mm thickness. The thickness of door s/covers shall not be less than 2.5 mm. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled **Neoprene gaskets**. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be

designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.16 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 shall be provided for heater.

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 centered in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in 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.

3.17 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

3.18 DOCUMENTATION

3.18.1 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document

and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.18.2 DRAWINGS

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnection between various portions of equipments and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant ,the unit designation, contract no. , and the name of the Project .If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.18.3 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalised at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on Initial submission	Within 2 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of

		resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer enclosed sheet for details of Title block.

3.18.4 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

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

3.18.5 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1.	Drawings and Data Sheets	1	6	21	7 nos of all drawings / documents
2.	Drawings “As Built “	-	-	21	
3.	Type Test Reports	1	6	21	
4.	Erection Manuals	-	6	21	
5.	Operation and Maintenance Manuals	-	6	21	
6.	Manufacturing Quality Plan	1	6	21	
7.	Field Quality Plan	1	6	21	
8.	Inspection Test Reports	-	-	21	

Soft copies of drawings at contract stage shall also be submitted in **PDF format**.

Drawings will also be submitted in mini cartridges in AUTOCAD Release -14 package or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

FIRST ANGLE PROJECTION

DIN 'ISO'

REV.	DATE	REASONS FOR REVISION	DRN	PREPARED BY	CHECKED BY	APPROVED BY

OWNER

MADHYA PRADESH POWER TRANSMISSION COMPANY LIMITED

PROJECT

CONSTRUCTION OF NEW 400kV SUB STATION , TRANSMISSSION LINES AND AUGMENTATION WORK/FEEDER BAY WORK ON TOTAL TURN KEY BASIS (LOT NO. -1) -BALAGHAT, BADNAWAR, BHOPAL, CHHEGAON AND NAGDA

EPC PURCHASER

BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP

DEPT CODE		NAME	SIGN.	DATE
	DRN			
	DESN			
	CHD			
	APPD			

TITLE

CV	ME	EL	MC			DEPT.	SCALE	BHEL/SUB VENDOR DRG NO.
						SIGN		
						DATE	SHT. No	REV.

SECTION - 4

GUARANTEED TECHNICAL PARTICULARS AND LIST OF DRAWINGS

SECTION 4

Schedule 1 **Schedule of Guaranteed Performance & other Technical Particulars of Nitrogen Injection Fire Protection System**

Schedule 2 **List of Drawings**

Schedule 1

SCHEDULE OF GUARANTEED PERFORMANCE AND OTHER TECHNICAL PARTICULARS OF NITROGEN INJECTION FIRE PROTECTION SYSTEM FOR PREVENTION OF FIRE & EXPLOSION OF AUTO TRANSFORMERS

GUARANTEED TECHNICAL PARTICULARS N_2 INJECTION SYSTEM		
(Bidder should indicate the guaranteed technical data of all equipments/materials)		
1	Name of manufacturer, Address and country of origin	
2	Applicable Reference standards	
3	Details of system equipments	
	a. Fire extinguishing cubicle	
	i) Dimensions	
	ii) Weight	
	iii) Capacity of Nitrogen cylinder	
	iv) Pressure of Nitrogen filling	
	v) Minimum distance of FE cubicle from the transformer	
	vi) Method of mounting	
	vii) Whether the following items are provided in FE cubicle. If so furnish make, type & other details	
	- Contact manometer	
	- Pressure regulator	
	- Oil release unit	
	- Gas release unit	
	- Oil drain unit	
	- Pressure / limit switches	
	- No. of contacts & spare contacts(NO & NC)	
	viii) Oil drain valve	
	- Make	
	- Type	
	- Size	
	- Type of metal	
	ix)Nitrogen Injection valve	
	- Make	
	- Type	
	- Size	
	- Quantity required	
	x)Oil Drain pipe	
	- size	
	- Length	
	- Material	

	xi)Nitrogen Injection pipe	
	- size	
	- Length	
	- Number of openings in the transformer tank	
	- Material	
	b) Control Box	
	i) Dimensions	
	ii) Weight	
	iii) Type & Thickness of sheet steel	
	iv) Details of components provided in the control box	
	v) Control voltage	
	vi) Method of mounting	
	vii) Whether audio and visual alarms provided?	
	c) Pre-stressed non-return valve/Pneumatically operated ball valve (Main/Backup)	
	i) Make	
	ii) Type	
	iii) Location	
	iv) Whether suitable for pipe of size 80mm dia	
	v) No. of contacts & spare contacts (NO & NC)	
	d) Fire detectors	
	i) Make	
	ii) Type	
	iii) Quantity Required	
	iv) Method of Fixing	
	v) Effective head sensing area	
	vi) Temperature recommended for effective heat sensing	
	vii) Number of contacts NO/NC	
4	Necessity and condition of re-filling	
5	Drawings/ literature enclosed with the offer	
6	Whether approved by TAC of India	
	TECHNICAL PARTICULARS OF NITROGEN INJECTION FIRE EXTINGUISHING	
1	Power Supply	
	- Control Box	
	- Fire extinguishing cubicle	
2	Fire extinction period	
	On system activation	
	On commencement of nitrogen injection	

3	Fire extinguishing cubicle suitable for 315 MVA Transformer / 125 MVAR Reactor / 100 MVA Transformer	
	- Dimension	
	- Weight	
	- Nitrogen cylinder capacity	
4	Control Box	
	- Dimension	
	- Weight	
5	Fire detectors	
	- Heat sensing temperature	
6	From the moment of system activation to complete cooling	
7	On commencement of Nitrogen Injection	
8	"Heat/Fire Detector" heat sensing temp	
9	Shutter valve setting for operation	
10	Other Technical Particulars	

Date : SIGNATURE OF BIDDER

Place : SEAL

Schedule 2

LIST OF MINIMUM BASIC DRAWINGS / DOCUMENTS TO BE SUBMITTED DURING DETAILED ENGINEERING

In this section, the List of system drawings & documents that are required to be generated is furnished. The numbers to be accorded against each drawing in List of drawings is also given below.

The list furnished here is tentative and additional documents may be required during detailed engineering.

1.	General Arrangement of Fire System	TB-DRG-368-552-101
2.	Interconnection Diagram of Fire System	TB-DRG-368-552-102
3.	General Arrangement for Pipe Connection of Fire System	TB-DRG-368-552-103
4.	Details of Oil Pit for Transformer / Reactor	TB-DRG-368-552-104
5.	Details of Plinth for Fire Extinguishing Cubicle	TB-DRG-368-552-105

SECTION - 5

GUARANTEED TECHNICAL PARTICULARS AND LIST OF DRAWINGS

SECTION 5

ENCLOSURES TO SPECIFICATION

Schedule 1 Format of **Schedule of Deviations**
(to be submitted by Bidder at Tender Stage)

Schedule 2 Format of **Details of contact persons (technical & commercial)**
(to be submitted by Bidder at Tender Stage)

SCHEDULE – I

SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations / variations / exceptions from the specification:

Section	Clause No./ Page No.	Statement of deviation/ Variations/Exceptions

1) Certified that the following are the only deviations from the specification (for the equipment and the systems being offered)

2) In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract is deemed to be in compliance with the specification.

3) If there is NIL deviation, even then the format to be filled as **NIL DEVIATION**

4) Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Place — Signature of the authorized representative of Bidder

Name ----------

Date — Designation ----------

Company seal----------

SCHEDULE - II

DETAILS OF CONTACT PERSON BOTH TECHNICAL AND COMMERCIAL

Name

Address for correspondence

Phone No.

Fax No.

Email

Place

Date

Signature of the authorized representative of Bidder

Name----------

Designation----------

Company seal ----------

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.