NATIONAL THERMAL POWER CORPORATION LIMITED

GADARWARA STPP STAGE-I (2 x 800 MW)
TG PACKAGE

TECHNICAL SPECIFICATION
FOR

CONTROL VALVES WITH ACCESSORIES

(Pneumatically Operated)

FOR SEVERE SERVICE APPLICATION

SPECIFICATION No: PE-TS-394-145-I 104**A** `

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

1.0 The tender document contains three (3) volumes. The bidder shall meet the requirements of all the three volumes.

1.1 **Volume-I (CONDITIONS OF CONTRACT)**

This consists of four parts as below :-

Volume-IA	:	This part contains instructions to bidders for making bids to BHEL.
Volume-IB	:	This part contains general commercial conditions of the tender & includes provision that vendor is responsible for the quality of item supplied by their sub-vendors.
Volume-IC	:	This part contains special conditions of contract.
Volume-ID	:	This part contains commercial conditions for erection & commissioning site work, as applicable.

1.2 **Volume-II TECHNICAL SPECIFICATIONS**

Technical requirements are stipulated in Volume-II which comprises of :-

Volume-IIA	:	General Technical Conditions
Volume-IIB	:	Technical Specification including Drawings, if any.

1.2.1 **Volume-IIB**

This volume is sub-divided into following sections :-

Section-A	:	This section outlines the scope of enquiry.
Section-B	:	This section provides "Project Information".
Section-C	:	This section indicates technical requirements specific to the contract, not covered in Section-D.
Section-D	:	This section comprises of technical specifications of equipments complete with data sheet A, B and C.

Data Sheet - A specifies data and other requirements pertaining to the Equipment.

Data Sheet - B Specifies data to be filled by the bidder (Data Sheet-B is contained in Volume-III).

Data Sheet - C Indicates data/documents to be furnished after the award of contract as per agreed schedule by the vendor (as applicable).

1.2.2 **Volume-III TECHNICAL SCHEDULES**

This volume contains technical schedules and Data Sheets-B, which are to be duly filled by the bidder and the same shall be furnished with the technical bid as per instructions given in Document No. PE-SS-999-100-Q-002 in Volume-III.

2.0 The requirements mentioned in Section-C / Data Sheets-A of section-D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-D.

NATIONAL THERMAL POWER CORPORATION LIMITED

GADARWARA STPP STAGE-V (2 x 800 MW)
TG PACKAGE

TECHNICAL SPECIFICATION
FOR

CONTROL VALVES WITH ACCESSORIES

(Pneumatically Operated)

FOR SEVERE SERVICE APPLICATION

VOLUME II-B & III

SPECIFICATION No: PE-TS-394-145-I 104A

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

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SECTION – A

SCOPE OF ENQUIRY

SCOPE OF ENQUIRY

1. SCOPE

1.1 This specification covers the Design, Manufacture, Inspection and Testing at manufacturer's works, proper packing for transportation and delivery to site of the **Control Valves with Pneumatic Actuator along with Accessories, Start-up/Commissioning and Mandatory Spares** as mentioned in different sections of this specification for 2**X800 MW GADARWARA STPP STAGE-I - TG PACKAGE.**

1.2 The quality plan enclosed forms the minimum requirement but not limited to be adhered to by the bidder. Bidder to sign and stamp the same and submit along with the offer as an acceptance.

1.3 Bidder to note that CV test is required to be conducted on one type per size, CV value. Bidder to group such valves and indicates the same along with the price bid. Unpriced portion to be submitted to engineering.

1.4 Following signed & stamped documents with company seal to be submitted by bidder.

a) Complete offer including calculation sheets, catalogues etc.
b) Quality Plan
c) Datasheet A & B, duly filled
d) Schedule of prices & unit prices, inspection schedule
e) Schedule of submission of drawings/documents, equipment manufacture, inspection & dispatch.

2 GENERAL TECHNICAL INSTRUCTIONS

2.1 It is not the intent here to specify all the details of design and manufacture. However, the equipment shall conform in all respects to high standard of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to the customer / consultant, who will interpret the meaning of drawing and specification and shall be entitled to reject any component or material which in his judgment is not in full accordance herewith.

2.2 The omission of specific reference to any component / accessory necessary for the proper performance of the equipment's shall not relieve the supplier of the responsibility of providing such facilities to complete the supply within the quoted prices.

2.3 BHEL's / NTPC's representatives shall be given access to the shop in which the equipment's are being manufactured or tested and all test records shall be made available to them.

2.4 The Equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and Material Dispatch Clearance Certificate (MDCC) is issued by BHEL / NTPC.

SECTION – B

PROJECT INFORMATION

PROJECT INFORMATION

The site is located near villages Gangai & Umaraiya (about 9 Kms from Gadarwara town in Narsingpur district of Madhya Pradesh.The major cities Bhopal & Jabalpur are located at about 210 Kms & about 140 kms respectively from proposed project site. The nearest BG Railway Station, Gadarwara, on Jabalpur-Itarsi Section on central railway main Line is about 9 Kms from proposed project site.

The nearest commercial airport, Bhopal and Jabalpur are located about 240 Kms and about 155 Kms respectively from site. The plant latitude and longitude are 220 51' 42" Nand 7So 52' OS" respectively.

SECTION-C

SPECIFIC TECHNICAL REQUIREMENT

SPECIFIC TECHNICAL REQUIREMENTS.

The requirements in this section are specific for this project and shall over-ride the specification under section-D in case of any contradiction.

1) For Actuator selection, bidder to take care of clause no. 5.00.00 at Section III-C08, NTPC spec. Attached in subsequent part of this section (Section-C)

2) Bidder to note that data sheet-B, Format "Schedule of submission of Drawings / Documents, Equipment Manufacture, Inspection and Despatch" enclosed in Section-D, to be signed and stamped and submitted with the bid. Quality Plan enclosed in Volume-IIB should be furnished duly signed and stamped. NO DEVIATION IS ACCEPTABLE.

3) All the formats in Volume-III should be filled-up and furnished with the bid, complete in all respect. Catalogue, Leaflets related with the models of Control Valves as well as each Accessory must be furnished with the offer. In the absence of those, the bid would be considered incomplete and liable for rejection.

4) The Hook-up diagram for Control valve is attached in Section-C. The Bidder's scope starts from isolation valve at Inst. Air Supply header. The suitable Connector required for connection of pneumatic tubing to isolation valve at Inst. Air Header is also in bidder's scope. The connection details at inst air valve shall be furnished to the successful bidder after the award of contract.

5) Valve Body Sizes shall be quoted to take care of the specification requirements like parameters, and limitations of Fluid outlet velocities, Noise Level etc. **However Port (Trim) Sizes shall be selected to suit CV requirement for achieving percentage valve lift as per specification clause nos. 1.02.00 and its sub-clauses, furnished at section-C** (Control Valve and Actuators, Section III C-08, NTPC spec, Sec-VI, PART B, 8 sheets).

5a) **In case of any contradiction in requirements** of Control Valves between Spec. no. PES-145-06 enclosed in Section-D AND NTPC requirement of Control Valves at section-C (Control Valve and Actuators, Section IIIC-08, NTPC spec, Sec-VI, PART B), **the requirement of section -C shall prevail.**

6) Type of bonnet shall be according to the service condition. Extension bonnets shall be provided when the maximum temperature of the flowing fluid is greater than 280 Deg C.

7) Valve and actuator shall be designed for full differential pressure (Max. shut-off pressure).

8) Tolerances on end to end, center to center, center to face shall be in accordance with ASME B16.10.

9) Anticavitation trims shall be provided for valves with cavitation service and hardened trims for flashing service.

10) Valve type like cavitation/flashing/ high DP has been indicated in the data sheet. Bidder to offer the valve accordingly. However if process is Cavitating, although not indicated in the valve type, bidder to offer Anticavitation trim.

11) Noise abatement mentioned shall be obtained by valve body and trim design & not by any external means.

12) Control valve accessories shall be fitted on the valve body. Integral pneumatic tubing shall be $\frac{1}{4}$ " OD PVC coated copper, and fittings shall be of brass. Applicable accessories shall be terminated at the junction box (mounted on the body).

13) Type of flow action ("under the seat" or "over the seat") will be selected by the bidder. However wherever downstream side is subjected to vacuum, flow action shall be "flow to close" (over the seat). Specific mention for the same has not been made in the datasheets.

14) Trim material and body material has been specified in the Datasheets-A. Bidder to offer body material & trim material combinations equivalent or better than the material specified in Datasheets-A. Wherever there is deviation from the datasheets, bidder to furnish the documentary proof for confirming superior trim material/ body material selection along with their offer. BHEL/NTPC reserves the right to accept/reject any variation to the specification.

15) Trim supplied shall be suitable for quick changing and trim exit velocity shall be limited to avoid cavitation.

16) The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.

17) The End Connections Shall Be Socket Welded For Sizes Below 50NB And Butt Welded For Sizes 50NB And Above.

18) Stem material for all Control Valves shall be SS 316 STELLITED.

19) Facility to adjust the maximum travel of stem & starting point of travel shall be incorporated.

20) **Bidder to furnish the list of all control valves for which Cv test is to be carried. Cv test shall be carried out for each type of control valve(of same size,Cv,trim characteristics). Cv test reports shall be verified by BHEL/NTPC.Type test certificate shall also be acceptable.Bidder to note that only those type test reports for same type of control valves shall be offered for verification which are not older than 3 years from the date of Part 1 opening (receipt of technical unpriced offer).**

21) Calculation of Cv, noise level, valve outlet velocity, trim exit velocity, actuator sizing, data sheet-c in line with data sheet-A of specification, dimensional drawings / edge preparation details, etc shall be submitted for BHEL/NTPC review and approval, to reach BHEL within 15 days after receipt of LOI.

22) Selection of valves and actuators are bidder's responsibility. Any change in selection of type of valve / sizing / percentage opening, calculations, QP, etc., if desired by BHEL / customer during approval of the documents after award of contract, without major changes in process parameters as per tender specification, shall be carried out without any commercial implication and time delay.

23) Limit switch, position feedback shall be terminated up to JB by 0.5 mm2/PVC/Cu/1.1kv/FRLS shielded control cables. Solenoid valve shall be terminated by 2.5 mm2 size cable.

24) SS nameplate for control valve shall include tag no./kks no./sl. No./body material /size/press rating/trim material/trim type/action on air failure/diaphragm air pressure at full open and close condition.

25) Open to close and close to open time of pneumatic actuator (modulating type) shall be less than 10 sec. Bidder to include volume booster if required to achieve fast response time<10 sec.

26) Specification of electrical actuator shall not be considered.

27) Hand wheel shall have open/close direction.

28) Air filter regulator shall be designed for an inlet pressure of 5-8 kg/cm2.

29) Limit switch shall be designed for 1, 00,000 operations.

30) Expander/reducer shall be in BHEL's scope of supply.

31) JB shall be 36 ways as per enclosed hook-up diagram.

32) Pneumatic connection: for each control valve 12 meters length (for each leg of $\frac{1}{4}$" size light drawn tempered) copper tubing conforming to ASTM B75 shall be used. Thickness shall not be less than 0.065 inch and shall be PVC coated. Fittings to be used with copper tubes shall

be cast brass, screwed type including SS connection to suit 15 NB size screwed root valves (as per IS-554). Copper tubes shall be provided for connection between air filter regulators & root valves.

33) Inspection shall be carried out in line with approved drawing/ data sheet/ QP & specific technical requirements

34) Third party inspection: customer shall witness the inspection for control valves and Cv test at the manufacturer's works/ FCRI, PALAKKAD. Bidder to inform 15 days before the date of inspection.

35) In case during erection/commissioning of the control valve, any spares are required which have not been specified in the start-up/commissioning spares list, the same will have to be supplied by the bidder free of cost.

36) **SPARES:** The following spares are required to be offered

(A) **Mandatory spares to be considered as separate package. Mandatory spares to be packed in different colour & shipped separately. Marking on mandatory spares must be in different colour from main supply so that these are easily identifiable at site.**

(B) **Recommended Spares:**

In addition to the Mandatory spares mentioned, the bidder shall also furnish a List of Recommended spares for 3 years of normal operation of the Control valves / Accessories. BHEL/NTPC reserves the right to buy any or all of the recommended spares.

The prices of these spares will remain valid for a period of minimum 6 months after the placement of order.

(C) **Start-up & Commissioning Spares:**

Start-up and Commissioning spares are those spares, which may be required during the start-up and commissioning of the Control Valves. All start-up spares, which are supplied under this contract, shall be strictly interchangeable with the parts for which they are intended for replacements. The format for price schedule to be filled-up by the bidder is enclosed in Volume-III

The Start-up and commissioning spares indicated by the bidder shall be a part of the main Control valves supply. However bidder to indicate prices separately. The list of these spares required is enclosed in the section-D of this specification.

37) Bidder to indicate the service life expectancy period for the spare parts under normal working conditions. The spares shall be treated and packed for long storage, under climatic conditions prevailing at site. Small items shall be packed in sealed transparent plastic bags with desiccators' packs as necessary.

38) **SMART POSITIONER**

i) The smart positioner shall accept 4-20 mA signal from the control system as input and provide a compatible signal for driving the pneumatic actuator.

ii) In addition to the electrical-to-pneumatic signal conversion and positioning functions, it shall also perform detailed diagnostics & make available the actuator/control valve faults via hart interface. The hart signal for the detailed faults shall be superimposed on the 4-20 mA control signal itself. The faults to be covered shall include valve jamming, air supply failure, leakage etc.

iii) It shall have facility of characterisation of the valve (i.e. equal percentage, quick opening, linear, etc.) in the positioners itself.

iv) Bidder to include in their offer, if any software is required to be installed on the HMS PC (HMS in BHEL'S scope) to communicate with the smart positioners and to access the diagnostic features of the smart positioners. Bidder to furnish price for such software in their offer.

v) The positioner shall have the facility of detection of control signal failure and making the valve either stayput/open/close as per process requirement upon this condition.

vi) The smart positioner shall have the fail-freeze feature.

vii) Universal Hart Calibrator to be provided, One per Unit.

39) **Documentation:**

(A) Along with the bids: following documents for respective projects separately

a) Signed and stamped compliance certificates in attached format (VOL.-III).

b) Schedule of prices in attached format (VOL.-III).

c) **Schedule of submission of Drg. / Doc, Equip. Manufacture, Inspection and Dispatch.**

d) **Inspection schedule**

(B) After the award of contract:

The documentation as listed below will separate for respective projects

6 sets of the following documents + 3 sets of CDs to be enclosed with the bids for Approval:

a. Assembly (dimensional) drawings.

b. Valve Edge preparation details.

c. Data sheet-C completely filled-up..

d. Hook-up diagram of Control Valve with Actuator & Accessories.

e. Valve & Actuator assembly dimensional drawings with weights.

f. Quality Plan duly signed and stamped.

g. All calculations like CV, Noise Level, Valve Outlet Velocity, Actuator sizing etc.

h. All relevant catalogues for the models of the valves as well as accessories finalized.

i. Bar chart to indicate the time schedule for procurement, manufacture, testing and dispatch.

(C) Final documentation:

Copies of documents / drawings to be furnished by the successful bidder shall be as follows:

a. Assembly (dimensional) drawings, calculations, edge preparation details/datasheets/QP for approval – 15 sets.
b. Category-I & IV approved final drawings /datasheets – 15 sets with CD – ROMS.
c. Valve sizing calculations, noise level calculations and outlet velocity calculations – 15 sets with 2 CD – ROMS
d. Test certificates – 15 sets.
e. "As built" drawings – 15 sets.
f. Operation & maintenance manuals – 15 sets.

SUB–SECTION – IIIC - 08

CONTROL VALVES, ACTUATORS AND ACCESSORIES

CONTROL VALVES AND ACTUATORS

1.00.00 CONTROL VALVES, ACTUATORS & ACCESSORIES

1.01.00 General Requirements

1.01.01 The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification.

1.01.02 All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves.

1.01.03 This specification does not cover special type of control valves such as combined pressure and temperature control valve for Aux PRDS applications, Separator Drain Control Valves etc.

1.02.00 CONTROL VALVE SIZING & CONSTRUCTION

1.02.01 The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.

1.02.02 The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves trim exit outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer's approval during detailed engineering.

1.02.03 Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall

be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.

1.02.04 Control valves for application such as HP/LP heater Emergency level control, Emergency Make-up to Condenser hotwell, GSC minimum flow, Deaerator Drain to condenser hotwell, condensate spill to condensate reserve tank, condenser normal make-up and valve gland sealing supplying pressure control, CEPS minimum flow control, BFP recirculation control valve shall have permissible leakage rate as per leakage Class V. All other control valve shall have leakage rate as per leakage Class-IV.

1.02.05 The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.

2.00.00 VALVE CONSTRUCTION

2.01.00 All valves shall be of globe body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.

2.02.00 Valves with high lift cage guided plugs & quick-change trims shall be supplied.

2.03.00 Cast Iron valves are not acceptable.

2.04.00 Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.

2.05.00 Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.

2.06.00 All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing)

2.07.00 Valve characteristic shall match with the process characteristics.

2.08.00 Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.

2.09.00 Flanged valves shall be rated at no less then ANSI press class of 300 lbs.

3.00.00 VALVE MATERIALS

Sr. No.	Service	Body material	Trim Material
1	Non-corrosive, non-flashing and non-cavitation service except DM service	Carbon steel ASTM-A216 Gr. WCB for fluid temperature below 275 Deg. C Alloy steel ASTM-A217Gr. WC9 for fluid temperature above 275 Deg. C	316SS stellited with stellited facedguide posts and bushings.
2.	Severe flashing/cavitation services	Alloy steel ASTM-A217 Gr. WC9	440 C
3.	Low flashing/cavitation service	Alloy steel ASTM-A217 Gr. WC6	17-4 PH SS
4.	DM water service	316 SS	316 SS
NOTE	Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.		

However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.

4.00.00 END PREPARATION

Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalised during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

5.00.00 VALVE ACTUATORS

All control valves shall be furnished with pneumatic actuators. The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

6.00.00 CONTROL VALVE ACCESSORY DEVICES

6.01.00 All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

7.00.00 SPECIFICATIONS F OR MICROPROCESSOR B ASED ELECTRONIC POSITIONER

Electrical	Input Signal	4-20 mA
	Power Supply	Loop Powered from the output card of Control System.
	Hart Protocol	Compatibility For Remote Calibration & Diagnostics (Super-Imposed HART signal on Input Signal 4-20 mA)
	Valve Position Sensing	Position Sensing (Non Contact-Type), 4-20 mA O/P Signal For Control System to be provided
Environment	Operating Temp	(-)30 To 80 Deg. C
	Humidity	0-95 %
	Protection Class	IP-65 Minimum
Remote Configuration and Diagnostics	a. The following functions shall be provided in the positioner: Remote Configuration, Calibration and Testing of the Actuator and advanced Diagnostic Features Like Stroke	

	Counter or Travel Counter, Leakage In Actuators, On Line Partial Closure Test, Valve Signature Analysis, Step Response Test, Valve Friction/ Jamming Detection etc. (See Note* below) b. Factory Valve Signature Tests Reports (Pr Vs Valve Travel And Travel Vs I/P Signal) are to be provided.	
Tests Certificates	Test certificates as per Manufacturer Standard/Relevant Standard are to be submitted	
Configuration/	Remote Calibration, Auto & Manual Calibration Shall Be Possible	
Operating	Operating Range	Full Range & Split Range Signal Range
Modes	Valve Action	Direct & Reverse. Valve Action
	Flow Characterisation	Possible To Fit Valve Characteristic Curve Linear & Equal Percentage
Fail Safe/Fail Freeze	Fail Safe/Fail Freeze Feature is to Be Provided.	
Pneumatic	Air Capacity	Sufficient To Handle The Valves Selected/Boosters To Be Supplied If required.
	Air Supply Pressure	To Suit The Air Supply Pressure/Quality Available.
	Process Connection	1/4 Inch NPT
Performance	Characteristic Deviation	<=0.5 % Of Span
	Ambient Temp Effect	<=0.01 %/Deg C Or Better
EMC & CE Compliance	Required To International Standard Like EN/IEC.	En50081-2 & En50082 Or Equivalent
Accessories	In Built Operator Panel	Display With Push Buttons For Configuration And Display On The Positioner Itself (Password Protected/ Hardware Lock)

	Hand Held Hart Calibrator	Universal Hart Calibrator To Be Provided, One Per Unit
	Press Gauge Block	For Supply & Output Pr., Filter Regulator Other Accessories Shall Be Provided As On Required Basis For Making System Complete.
	Electrical Cable Entry	1/2-Npt,Side Or Bottom Entry To Avoid Water Ingress
	Valves Mounting Assembly	For Sliding Stem/Rotary/Single Acting/Double Acting On Required Basis

*** Note**:

Employer is providing a centralized HART management system including the HART multiplexing/interfacing system. The HART signals shall be picked up from marshalling terminals of DDCMIS (SG/TG DDCMIS as well as BOP DDCMIS), as applicable. The details of the above mentioned employer's HART management system are as below:

The following functionalities are provided through software of the HART management system:

1. For electronic transmitters, temperature transmitters and analysers:
   a. Constant scanning to monitor faults or changes to instrument configuration.
   b. Employer-defined and standard calibration and configuration procedures for all transmitters.
   c. Constant signal data collection facilities to maintain continuously updated records.
   d. Automatic tracking of configuration changes made in the field, such as may be introduced by hand-held communicator. All configuration function associated with hand-held communicators shall be available in the system.
   e. Event and log reports on screen as well as on printer.
   f. Any addition/deletion of transmitter will be reported on printer and logged in hard disk.

Above functionalities are achieved by the Employer's HART management system by providing industry standard softwares.

Further, the positioners shall be monitored from the above described HART management system. To achieve this, Bidder shall provide the necessary software

to achieve the functionalities described above under ”Remote Configuration and Diagnostics”, and this software shall be loaded in the Employer’s HART management system.

Bidder has to list out in his bid the softwares that are compatible with his electronic positioners.

8.00.00 TEST AND EXAMINATION

All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:

8.01.00 Non Destructive Test as per ANSI B-16.34.

8.02.00 Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.

8.03.00 Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above.

8.04.00 Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.

CV Test: Please refer Sub-section-IV:I10. (Type test requirements).

8.05.00 CONTROL VALVE QUANTITIES

Bidder shall furnish all the control valves under this main plant package as finalised during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.

9.02.00 Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.

9.03.00 Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, etc., which are required for maintenance of the system as per the type of termination used.

9.04.00 Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.

9.05.00 No splices shall be made in conductors for instrument and control circuits except where required at connections to devices equipped with factory installed pigtails. Such splices shall be made only in approved splicing boxes of fitting with removable cover. The splices shall be made with sufficient slack left in the wires to permit withdrawal of the splice from the splicing box for ease of future disconnection of the splices. All exposed conductor or connector surfaces shall be covered with a minimum of three half-lapped layers of all weather vinyl plastic electrical tape. Taping shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the other insulation or connections requiring insulation.

9.06.00 The Bidder shall be responsible for proper grounding of all equipment under C&I package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests. All the cables etc. required for grounding of all equipments supplied under this package are to be supplied by the Bidder.

9.07.00 The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.

10.00.00 FIELD MOUNTED LOCAL JUNCTION BOXES

(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.
(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).
(iii)	Type	Door gasket shall be of synthetic rubber.

(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass, included in Bidders scope of supply. Raceways shall be provided inside JBs for proper termination of cables.
(v)	Type of terminal blocks	Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm^2. A M6 earthing stud shall be provided.
(vi)	Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.
(vii)	Grounding	To be provided.
(viii)	Color	To be decided during detailed engineering & subject to Employer's approval.

11.00.00 CONDUITS

11.01.00 Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant lead coated steel, water leak, fire and rust proof. The temperature rating of flexible conduit shall be suitable for the following areas.

(i) Mills

(ii) Drum

(iii) Main steam, RH steam

(iv) Air heater

(v) Furnace, BFP DT's

And for remaining applications, water leak, fire & rust proof flexible G.I conduits shall be provided.

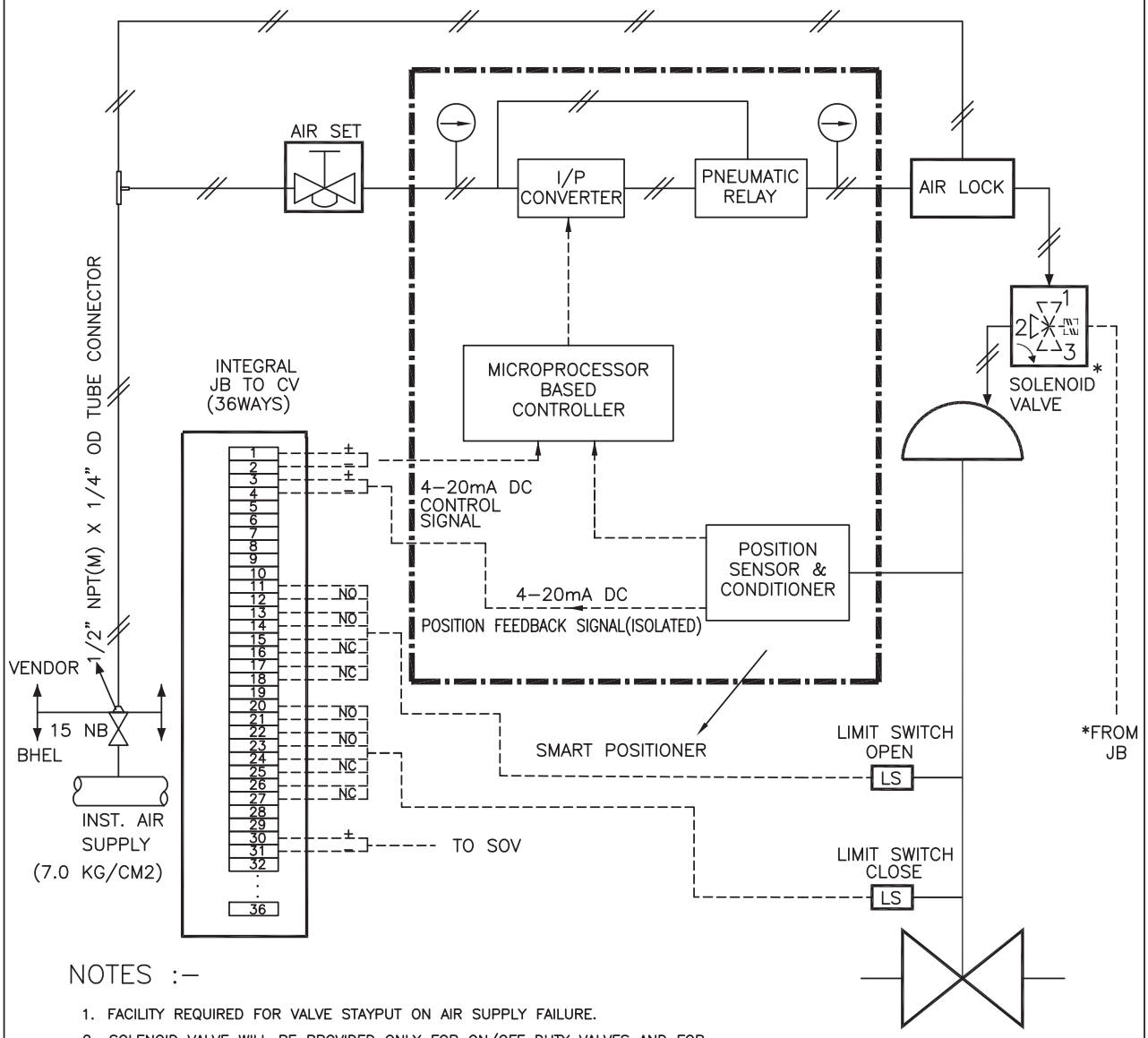
11.02.00 The Bidder shall install conduits according to the general routing as approved by Employer and shall coordinate conduit locations with other works.

11.03.00 All grounding bushings within all enclosures shall be wired together and connected internally to the enclosure grounding lug or grounding bus with 8 AWG bare copper conductor. Conduit runs to individually mounted equipment shall be grounded to the Employer's cable tray grounding conductor with 12 AEG bare copper conductor. All

GADARWARA STPP STAGE-I (2x 800 MW)

TG PACKAGE

HOOK–UP DIAGRAM WITH SMART POSITIONER



NOTES :–

1. FACILITY REQUIRED FOR VALVE STAYPUT ON AIR SUPPLY FAILURE.
2. SOLENOID VALVE WILL BE PROVIDED ONLY FOR ON/OFF DUTY VALVES AND FOR CONTROL VALVES WHERE OPEN/CLOSE INTERLOCK IS REQUIRED AND INDICATED IN RESPECTIVE DATA SHEETS.
3. SOLENOID VALVES PORTS CONDITION:
   PORT 1 AND 2 SHALL BE CONNECTED UNDER DE–ENERGISED CONDITION.
   PORT 2 AND 3 SHALL BE CONNECTED UNDER ENERGISED CONDITION.
4. GAUGES REQUIRED FOR AIR SUPPLY & OUTPUT(S).
5. MOUNTING ACCESSORIES AS REQUIRED.
6. POSITION FEEDBACK SIGNAL SHALL BE 4–20mA (ISOLATED SIGNAL)
7. JB TERMINALS SHALL BE CAGE CLAMP TYPE SUITABLE FOR 2.5 SQ. MM COPPER WIRE.
8. FOR ON/OFF DUTY PNEUMATIC CONTROL VALVES
   THE FOLLOWING ACCESSORIES SHALL NOT BE APPLICABLE:–
   a) SMART POSITIONER b) POSITION TRANSMITTER c) I/P CONVERTER
9. 12 METERS 1/4" PVC COATED COPPER TUBING & 1 SET OF FITTINGS TO BE SUPPLIED FOR EACH CONTROL VALVE FOR CONNECTION TO ISO VLV AT INST AIR HEADER ON ONE END AND TO AIR LOCK RELAY/AIR FILTER REGULATOR ON THE OTHER END. ALL THE BRASS FITTINGS SHALL BE DOUBLE COMPRESSION TYPE.
10. VOLUME BOOSTER SHALL BE PROVIDED IF REQUIRED

* SOLENOID VALVE– IF APPLICABLE AS PER DATASHEET

SECTION – D

- **EQUIPMENT SPECIFICATION**
- **DATA SHEETS – A & B**
- **DATA SHEETS FOR ACCESSORIES**
- **DATA SHEETS – C**
- **QUALITY PLAN**
- **BILL OF QUANTITY**
- **SPARES**
- **PAINTING PROCEDURE**
- **SCHEDULE OF SUBMISSION OF DRAWINGS / DOCUMENTS, EQUIPMENT MANUFACTURE INSPECTION AND DESPATCH**

SECTION-D

EQUIPMENT SPECIFICATION

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site of Control valve (with Pneumatic/Electric Actuator) for use in Utility/Captive Power Station/Combined Cycle Station.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 The Design and Materials used for the components shall also comply with the relevant National and International standards.

2.3 As a minimum requirement, the following standards shall be complied with :

Indian Boiler Regulation (IBR)		
Allowable Seat leakage	:	ANSI-B16.104 / FCI-70.2
Pressure & Temperature ratings	:	ANSI-B16.34
Enclosure class	:	IEC-144 / NEMA / IS-13947
Control Valves	:	ISA S-75
Electric Motor operated Actuators	:	IS-9334

3.0 TECHNICAL REQUIREMENTS

The Control valve, Actuator and the accessories shall be suitable for continuous operation under an ambient temperature of 0-55°C and Relative Humidity of 0-95% unless specified otherwise in volume IIB Section-B or Section-C.

3.1 Control Valve

The control valve shall be suitably designed for the operating conditions and system characteristics as specified in the Data Sheet-A.

3.1.1 The control valve shall be of globe body design with single port. The valve trim, shall be suitable for quick removal without any cutting or welding.

3.1.2 The material of body, internals and packing shall be as specified in the data sheets. Alternatives, considered more suitable for service specified may be given as alternative offer, along with adequate justification. However main offer shall totally meet specification requirements. Asbestos shall not be used for the packing or any other component.

3.1.3 The valve bonnet and packing shall be suitable for the service conditions as in Data Sheet-A. Gland sealed type bonnets are not acceptable. Double packing is mandatory for applications involving vacuum service. Bonnets having teflon packing shall have valve stem finished to 2- 4 microns. Packing material requiring lubrication will not be acceptable. Justification for proper selection of bonnet & packing shall be furnished in the bid.

3.1.4 The valve end connection as specified in Data Sheet-A shall conform to ANSI B16.25 for Butt Weld connection and ANSI B16.5 for flanged ends. End to end dimension shall be as per ANSI 16.10.

3.1.5 The valve seat leakage shall be as per ANSI B16.104 / FCI-70.2. The leakage class shall be as per Data Sheet-A.

3.1.6 The valve body shall have the direction of flow embossed on all valves.

3.1.7 The sizing shall conform to the requirements of ANSI/ISA(S75- 01), and the valve capacity shall be selected so as to meet the following:

Valve with Linear characteristic.	-	Normal Flow (Design Point)	:	70-75% valve lift.
	-	Max. Flow	:	90% valve lift.
	-	Min. Flow	:	>10% valve lift.
Valve with Equipercentage Characteristic	-	Normal Flow (Design Point)	:	75-85% valve lift.
	-	Max. Flow	:	90% valve lift.
	-	Min. Flow	:	>10% valve lift.
ON/OFF Quick open Characteristic	-	1.1 times the CV calculated on the basis of maximum flow condition.		

3.1.8 Calculation for valve sizing, velocity and noise shall be subject to purchaser's approval during contract stage. However responsibility of proper selection and design for the duties specified lies with the vendor. Any modifications required to be done on the valves or actuators & accessories to achieve satisfactory performance of the control system shall be done without any commercial implication.

3.1.9 Suitable justification and evidence shall be furnished regarding proper selection of the valve.

3.1.10 The valve outlet velocities shall be limited to the following values, unless otherwise specified in the Data sheet-A.

i) Liquid service <= 7 Metres/Sec.
ii) Steam service <= 1/3 Sonic velocity in the flow medium.

3.1.11 For flashing duty, the trim design shall be such that the vapour bubbles are kept away from valve body.

3.1.12 For cavitation service, the trim design shall be of multistage pressure drop type, so as to avoid cavitation altogether, instead of keeping cavitation away from valve parts.

3.1.13 In case of predicted noise level above 85 dBA, suitable low noise trim or inbuilt diffusers shall be provided to bring down the noise level below 85dBA.

3.1.14 The equivalent weighted sound level measured at 1.5M. above floor level in elevation and one metre horizontally from the control valve expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dBA (without pipe insulation). The offer shall include noise prediction calculations for each valve.

3.1.15 In case of wrong selection/mal operation of valve and for associated actuator during guarantee period, the vendor shall replace the valve suitably with a modified/new valve of design as approved by purchaser and all the expenses for replacement, rectification/modification including transportation both ways will be at vendor's expenses.

3.2 Pneumatic Actuator

The pneumatic actuators shall be employed for modulating or open/close duty, as specified in Data Sheet-A. The bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drops and shut off pressure.

3.2.1 The pneumatic spring opposed diaphragm actuator for modulating duty shall be capable of positioning the associated valve at desired opening for all the operating conditions specified.

3.2.2 The pneumatic actuator for open/close duty shall be suitable for fast opening/closing of the associated valve.

3.2.3 The actuator design shall allow valve assembly to be mounted at 45° inclination on either side in the vertical plane.

3.2.4 The actuators shall be suitably sized to ensure that the associated valve travel time from full open to full closed position and vice versa is less than 20 seconds under the most stringent service conditions.

3.2.5 The actuator shall be painted with epoxy based paint.

3.3 Accessories for Control valve with Pneumatic Actuator

The bidder shall offer all the accessories as specified in the Data Sheet - A for the Pneumatic Actuators under modulating or OPEN/CLOSE duty. The accessories specified shall be supplied duly mounted on the valve actuator and piped with PVC covered copper tube and flare less brass fittings (Refer typical hook up diagram in sheet 12 of 12).

3.3.1 Hand wheel

Hand wheel shall have OPEN & CLOSE direction marking and clockwise rotation as viewed from front shall close the valve. The hand wheel shall have a circular stainless steel plate with Tag number and service.

3.3.2 Local Position Indicator

Each actuator shall be provided with a mechanical pointer attached to stem, moving over a graduated scale with markings, for OPEN, 25%, 50%, 75%, CLOSE positions.

3.3.3 Position Transmitter

The position transmitter shall be supplied as indicated in Data Sheet-A. The electronic position transmitter shall be non-contact type with 4-20 mA DC 2-wire output suitable for 12-50V DC supply. The resistance type position transmitter shall have 0-100 ohm variation for valve position change of 0-100%. The position transmitters of both types shall have accuracy and enclosure class. Necessary cable glands shall be supplied.

3.3.4 Air Filter Regulator

Instrument quality air at suitable pressure of 5.5 Kg/Cm2(g) to 7 Kg/Cm2(g) shall be supplied to each valve through air filter regulator. The filter regulator shall include an inbuilt blow-down valve, 5 micron size filter. The design pressure for regulator shall be 7 Kg/cm2g. The Air filter regulator shall be selected to meet the requirements of positioner/actuator, E/P convertor and air-lock. The flow capacity of the Air filter regulator shall be variable with a knob. Output gauge shall be provided wherever pneumatic positioner is not specified for the valve.

3.3.5 Air Lock Relay

Air lock relay shall retain the valve position stayput, in case of air supply failure and shall reset automatically on resumption of air supply. Air lock shall have a threaded plug for evacuating diaphragm air if required for local manual operation.

3.3.6 Solenoid Valves

Solenoid valves are meant for interlock & protection purposes overriding the controller signal, and/or to result stayput action on controller signal failure. The Solenoid valve shall be 3-way Universal type and the valve internals shall be of stainless steel. The coil shall have class-H insulation and rated for continuous AC/DC duty as specified in Data sheet-A. The enclosure shall be to IP-55. Cable gland shall be provided for cable entry. The solenoid shall in general conform to IS-8935. The solenoid operation shall be universal type. The solenoid shall be suitable for 24V DC supply, unless specified otherwise in Data Sheet-A.

3.3.7 Limit Switches

Limit switches are required as specified in the data sheet-A. Each limit switch shall have 2NO+2NC contacts with contact rating of 5A at 240V AC/0.2A at 220V DC unless otherwise specified. The switch enclosure shall conform to IP-55. Each limit switch shall be supplied with cable glands.

3.3.8 I/P Converter

I/P Converters shall preferably be of force balance type and shall produce pneumatic output signal corresponding to input current signal, also specified in Data Sheet. Convertor electronics shall be protected against reverse connection of signal polarities and a separate external connection shall be provided to facilitate grounding of instrument casing. Cable glands with neoprene gromets suitable for PVC cables shall be provided. I/P convertor shall have span adjustment facility. I/P convertor enclosure shall conform to IP-55 enclosure class.

3.3.9 Positioner

Positioner shall be suitable for accepting controller output signal 0.2-1.0 Kg/cm2, 0.2-0.6 Kg/cm2 or 0.6-1.0 Kg/cm2 as specified and give an output suitable for the actuator. Pneumatic positioner shall have 3 gauges. All gauges shall have metric scales. The positioner input signal range shall be adjustable. Wherever applicable, it shall be possible to bypass the positioner by means of a switch. Linearity and Hysterisis shall be as indicated in Data sheet-A

3.3.10 Electro pneumatic Positioner

In place of separate E/P Converter and pneumatic positioner a combined electro pneumatic positioner can also be supplied. The electro pneumatic positioner shall have 2 gauges.

3.3.11 Junction Box

Wherever specified, an integral junction box with all electrical accessories conduited up to JB shall be supplied. The junction box shall have two (2) cable glands for outgoing cables. Junction box shall have enclosure class of IP-55.

3.4 Guarantee & Performance

3.4.1 The overall performance of the control valve with pneumatic actuator assembly shall be as follows:-

i)	Hysteresis	:	± 1% of span
ii)	Linearity	:	± 2% of span
iii)	Sensitivity	:	± 0.5% of span.
iv)	Repeatability	:	± 1% of span
v)	Accuracy (Overall)	:	± 2% of span

3.4.2 The guarantee for the control valve, pneumatic actuator & accessories shall be for 12 months continuous operation from the date of commissioning, unless specified otherwise in VOL-IIB Section-B or Section-C.

3.5 Electric Actuator

The electric actuator shall be employed for modulating duty.

3.5.1 The actuator assembly shall be complete with drive motors, gears, hand wheel, signaling & switching units, associated control, integral starter, (when specified) and other accessories as required.

3.5.2 The Electric Actuator shall be capable of positioning the associated valve at the desired opening for all the operating conditions.

3.5.3 The motor shall meet the requirements of Current, torque, Axial thrust, Accelerating & stall time as imposed by the driven equipment.

3.5.4 The motor shall be suitable for direct on line starting.

3.5.5 Motors shall be suitable for inching & plugging duty operations.

3.5.6 The motors shall be capable of starting and accelerating to rated speed at 85% of rated voltage.

3.5.7 The motors shall be rated for continuous operations for modulating duty.

3.5.8 The motor shall operate satisfactorily under the following conditions:

i) ±10% supply voltage variation at rated frequency.

ii) -5% to + 3% variation in frequency at rated supply voltage.

iii) Simultaneous variation in voltage and frequency, the sum of absolute percentage not exceeding 10%.

3.5.9 The Actuator shall be suitable for mounting directly on the valve and shall be suitable for mounting in any position. Supports required for inclined mounting shall form part of supply of valve assembly.

3.5.10 The actuator shall be capable of producing the required torque and thrust at the output shaft for satisfactory operation of the associated valve.

3.5.11 Each actuator shall have a hand wheel for emergency operation. The hand wheel shall be designed such that it is declutched automatically when the power supply to the motor is restarted.

3.5.12 The hand wheel shall be so arranged that when looking from hand wheel, the valve is closed by rotating the hand wheel in clockwise direction.

3.5.13 Motor shall be totally enclosed conforming to IP-65 or better as per data sheet. The enclosure shall be suitable to protect the motor from leakage steam, water or oil from valve joints and glands.

3.5.14 Where flameproof enclosures are specified, it shall meet the specification IS-2148.

3.5.15 Insulation shall be at least class-B or better and shall be tropicalised to withstand the atmospheric condition.

3.5.16 The actuator shall be provided with antifriction bearing in grease filled cartridge.

3.5.17 Each actuator shall be provided with a mechanical position indicator to indicate accurately the valve position.

3.5.18 The integral starter, if specified in data sheet-A, shall be provided in weatherproof enclosure with protection class not less than IP-65 or better as per data sheet.

The integral starter shall consist of:

i) Mechanical & Electrically interlocked reversing contractors suitable for class AC4 duty or Thyristor as pet data sheet.

ii) Thermal overload relay.

iii) Step down control transformer with fuses.

iv) Interposing relay.

v) Monitoring relay..

vi) Open, Close & Stop push buttons.

vii) Indicating lamps.

viii) Local-Remote lockable selector switch with spare potential free contacts, wired for remote interface.

ix) A potential free contact shall be provided for remote annunciation of power failure/overload condition. The contact shall be SPDT, rated for at 5A 240V AC or 0.2A at 220V DC.

3.5.19 The actuator shall be suitably time rated for the duty cycle involved with the necessary number of starts per hour, but in no case, less than 1200 starts per hour.

3.5.20 The actuator shall be provided with a suitable control unit for receiving 4-20 mA signal from remote controller.

3.5.21 The servomotor gear should have self locking or suitable brake so as to maintain it's last position as and when the motor power is switched off.

3.5.22 Thermostat/Thermistor as specified in the data sheet shall be provided for sensing the winding temperature and giving trip command. The trip contact shall be change over type. The contact shall be wired up to the actuator terminal box.

3.6 Accessories for Control Valve with Electric Actuator

3.6.1 Torque Switches

i) Each actuator shall be provided with at least one open and one close torque switches each with 2 NO+2 NC contacts. The contacts shall be rated for 5A at 240V AC or 0.2A at 220V DC.

ii) The torque switches shall have a minimum accuracy ± 3% of set value.

iii) The torque switches shall be provided with calibrated knobs for setting desired torque. Separate knobs shall be provided for close and open torque switches.

iv) The torque switches shall be provided with mechanical latching device to prevent operation when unsealing from the positions. The latching device shall unlatch as soon as the valve leaves the end position. If such provision is not possible, the torque switches shall be bypassed by end position limit switches, which open on valve leaving end position. These limit switches are additional to the number of limit switches specified elsewhere.

v) The torque switches or worm gear shall be self-locking type so that when torque switch operates it remains operated until the actuator is operated in the reverse.

vi) The torque switch enclosure shall conform to IP-55.

3.6.2 Limit Switches

Each limit switch shall have 2NO+2NC contact with contacts rated for 5A 240V AC/0.2A 220V DC unless otherwise specified. The switch enclosure shall conform to IP-55. Each limit switch shall be supplied with cable glands.

3.6.3 Space Heater

A space heater shall be provided in limit switch and starter compartments to prevent condensation. This shall be suitable for the power supply specified in the data sheet. Where integral starters are provided the space heaters shall be wired to control supply within the actuator.

3.6.4 Remote Position Transmitter

The position transmitter shall be supplied as indicated in Data Sheet-A. The electronic position transmitter shall be non-contact type with 4-20mA DC 2-wire output suitable for 12-50V DC supply. The resistance type position transmitter shall have 0- 100 ohm variation for valve position change of 0-100%. The position transmitters of both types shall have ± 1% accuracy. The enclosure shall conform to IP-55. Necessary cable glands shall be supplied.

3.6.5 Wiring

i) The actuator and the accessories will be neatly wired up to the terminal boxes.
ii) The internal wiring shall be minimum of 1 mm^2 stranded PVC insulated copper conductor.
iii) The wiring shall be identified by means of numbered ferrules on both ends of all wires.

3.7 Terminal and Terminal boxes

3.7.1 Motor Terminal Box

i) The terminals, terminal boards, terminal boxes, winding tails and associated equipment shall be suitable for connection to supply system having short circuit capacity specified in data sheet and clearance time determined by the associated fuses.

ii) The terminals shall be stud type insulated from the frame. The insulation shall not be porcelain. The studs shall be of brass or stainless steel or phosphor bronze of adequate size.

iii) The terminal box shall be totally enclosed conforming to degree of protection IP-65.

3.7.2 Actuator Terminal Box

i) All terminals of limit and torque switches, space heater, position transmitters, thermostat/thermister shall be brought to a common terminal box. The enclosure shall be to degree of protection IP-65.

ii) Terminal board with plug in connector shall be provided. Alternatively stud type or insertion type may be considered. Pinch screw type however will not be accepted. All terminals shall be shrouded to prevent accidental contact. Where stud type terminals are offered, it shall be as per clause 3.7.1 (ii).

iii) There shall be at least five terminals spare to terminate spare cores of cable.

3.7.3 Cable Glands

The motor terminal box and actuator terminal box shall be provided with required number of double compression nickel plated brass cable glands to suit cable type and associated size.

3.7.4 Earthing Terminal

Two earthing terminal shall be provided on either side of motor and actuator terminal box.

3.7.5 Painting

The Actuator shall be painted with epoxy-based paint.

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance plan to ensure that the equipments offered will meet the specification requirements in full.

4.2 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where purchaser would like to be associated for witnessing or verification of tests would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following test shall be conducted as a minimum requirement.

4.3.1 Control Valve

i) Radiographic tests on castings.
ii) Dye penetrant tests on machined surface.
iii) Ultrasonic tests for the forgings & bars of all valves with 60 Kg/cm^2 & higher ratings.
iv) Hydrostatic tests as per ANSI B 16.34 prior to seat leakage tests.
v) Valve closure and seat leakage tests as per ANSI B 16.104 / FCI-70.2.

4.3.2 Pneumatic Actuators

Functional test of actuator and each accessory.

4.3.3 Electric Actuator

i) Routine tests on motors as per IS: 325.
ii) Functional test on actuator and each accessory.
iii) Insulation resistance and high voltage test.
iv) Stall current & Stall torque test.
v) Output shaft speed and torque of actuator and corresponding current tests.

4.3.4 Control valve with Actuator & Accessories fully assembled

i) Functional tests of control valve operation along with actuator & accessories.
i) Dimension checks.

4.3.5 Type tests or Test Reports

i) Valve lift vs. Flow test (Cv Test)
ii) Degree of protection tests for the enclosures
ii) Temperature rise test (applicable for Electrical Actuator only).
iii) Type test for motor as per IS: 325.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder, for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3.5 above, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House/Laboratory approved by BHEL.

4.5 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

As part of the main equipment supply, the bidder shall supply all commissioning spares and consumables required during Start-up,

5.2 Mandatory Spares

The bidder shall offer along with main offer, the Mandatory Spares as specified in Volume IIB Section-C of the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3 Recommended Spares

The bidder shall furnish a list of Recommended Spares along with the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with unit rate against each item to enable BHEL / BHEL's Customer to place a separate order later, if required.

5.4 Special Tools & Tackles

The bidder shall furnish a list of Special Tools & Tackles included in the bid.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid:

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.1.2 Wiring diagrams for Electrical Actuators.

6.1.3 Hook up diagrams of Control Valve with Actuator & accessories.

6.1.4 Valve & actuator assembly dimensional drawings with weights.

6.1.5 Quality Plan

6.1.6 All relevant Catalogs with detailed technical information.

6.1.7 Bar-chart to indicate the time schedule for procurement, manufacture, testing and despatch.

6.2 The successful bidder shall furnish the following documents in required number of copies to BHEL during the contract stage:

6.2.1 For approval

i) Dimensional drawings.

ii) Installation drawings with overall dimensions of the completed equipment and clearances for operation and maintenance.

iii) Data sheet-C, completely filled-up along with all the enclosures including the sizing calculations & noise calculations.

iv) Quality Plan.

v) Test Certificates.

6.2.2 Final / As-built Drawings

Final / As-built drawings / CDs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O &M manuals shall also contain storage and commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel metal nameplate should be permanently fixed on each equipment giving its tag number and technical specifications.

7.2 Packing

All equipment / materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea water spray (where applicable) as well as rough handling and delays in transit and storage in open.

55

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Control Valve with Pneumatic Actuator : Data sheet no. PES-145-06-DS1-1
- Data sheet C for Control Valve with Pneumatic Actuator : Data sheet no. PES-145-06-DS2-1
- Data sheet A&B for Control Valve with Electric Actuator : Data sheet no. PES-145-06-DS3-1
- Data sheet C for Control Valve with Electric Actuator : Data sheet no. PES-145-06-DS4-1

SECTION – D

SPECIFICATION FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER (SMART)

(PES – 145 – 06A)

1.0 Electrical :

Input Signal	4-20mA
Power Supply	Loop Powered from the output card of Control System (12-30 V DC)
Hart Protocol	Compatibility for Remote Calibration & Diagnostic (Super-Imposed HART Signal on Input Signal to positioner (4-20mA)
Valve Position Feedback	4-20mA output signal for Position Feedback is to be provided to control system.

2.0 Environment :

Operating Temperature	(-) 30 To 80 Deg.C
Humidity	0-95%
Protection Class	IP-65 (Minimum)

3.0 Diagnostic Features :

Diagnostic / Test Features (to be available in Smart Positioner and shall be accessible through any HMS software)	**Minimum Diagnostic Features Like** • Measurement of Valve positioning timing, • Detection of actuator leakage, • Display of fault alarm. • Logging of alarms and history. • Valve friction/jamming detection. • Detection of valve wear & tear, • Valve stroke length and timing.
	Advanced Diagnostic Features Like (OPTIONAL, if specified in customer's specification) • On line partial closure test. • Valve signature analysis (online graphical/tabular representation of input signal Vs valve travel). • Step response test.

4.0 Software :

Software (to be supplied alongwith smart positioner)	• Windows based software to meet the requirement for configuration, diagnostics, calibration and testing of Valve and actuator. • Easily up-gradable with same hardware and compatible with any Hart Management Systems (HMS). • Shall be capable to cater to all the tags in the specification at the same time.

5.0 Hardware :

Hardware (As required)	1. PC with software for configuring and accessing diagnostic features of the positioners.
	2. Multiplexers for interfacing smart positioner with PC.
	3. Communication cable for interconnecting multiplexers with PC.
	4. RS232/RS485 converter (if required)

Note : Power supply for Multiplexer shall be arranged by the owner.

6.0 Valve Action :

Valve Action	**Direct & Reverse.** (Same positioner for Single Acting or Double Acting And no separate relays required for changing from Single acting to double).
	During Failure of input Electrical signal (4-20 mA), valve to attain fail Freeze position without any external hardware. (Sol valve, Power Supply etc.)

7.0 Flow Characterization :

Flow Characterization	Possible to fit valve characteristic curve linear & Equal percentage

8.0 Performance:

Characteristic Deviation	<=0.75% of span
Ambient temp effect	<=0.01%/Deg C or better.
Dead Band	Adjustable 0.1 to 10%.
Scan Time	10ms
Resolution	<=0.05%
Sensitivity/Linearity	0.3-0.4% of FS
Repeatability	0.32% of FS

9.0 Test Certificates:

Test Certificates/Test Reports for degree of protection, Accuracy and calibration test (as a minimum) to be submitted as per Manufacture Standard / Relevant Standard.

10.0 EMC & CE compliance

International Standard Like EN/IEC. To EN 50081-2 & EN 50082 or equivalent

11.0 Accessories

In Built Operator Panel	Display with push buttons for Configuration and display on the positioner itself
Hand Held Hart Calibrator (Optional)	Universal Hart Calibrator To Be Provided, One Per Unit.
Press Gauge Block	For Supply & Output Pr., Filter Regulator Other Accessories Shall Be Provided As per Control valve hook-up diagram.
Electrical cable entry	½ - NPT, side or bottom entry to avoid water Ingress.

SECTION-D

DATA SHEETS - A&B

INDEX

S.No.	SERVICE	Qty. / Unit	Qty. for 2 Units
1.	Low Load Feed Control (FDV-8)	01	02

Tag No. :…FDV-8… Qty.: …1 per Unit … Date Sheet No. PES-145-06-DS1-0

DATA SHEET – A & B

DATA SHEET – A FOR CONTROL VALVE (WITH PNEUMATIC ACTUATOR) (TO BE FILLED BY PURCHASER)			DATA SHEET – B (TO BE FILLED UP BY BIDDER)
GENERAL*	PROJECT	NTPC–2 X 800 MW GADARWARA STPP; TG PACKAGE	……
	SERVICE	LOW LOAD FEED CONTROL	……
	LOCATION	[■] INDOOR [] OUTDOOR	……
	DUTY	[] ON/OFF [■] MODULATING	……
	PIPE SIZE (inlet / outlet)	406.4 x 70 | 406.4 x 70	……
	PIPE MATERIAL (inlet / outlet)	SA 106 GR C | SA 106 GR C	……|……
BODY*	MODEL NO.	Bidder to specify	……
	TYPE OF BODY: GUIDING : NO. OF PORTS	[■] GLOBE [] ANGLE | [] TOP [■] CAGE | ONE	……|……|……|……
	BODY SIZE: PORT SIZE: DESIGN CV	Bidder to specify	……|……|……
	END CONNECTION & RATING (ANSI)	[■] BWE [] SWE [] FLANGED	……
	BODY MATERIAL	[] A216 WCB [■] A217 WC9 [] SS [] A217 CS	……
		[] A351 CF8M	……
	PACKING: MATERIAL SINGLE / DOUBLE	[] PTFE [■] GRAFOIL [] DOUBLE [■] SINGLE	……|……
	BONNET TYPE	[] STD [] EXTENDED [] FINNED	……
	TRIM FORM	[] LINEAR [■] EQ. PERCENTAGE	……
		[] QUICK OPEN (ON/OFF)	
	TRIM MATERIAL: SEAT | PLUG	17-4 PH SS | 17-4 PH SS	……|……
	: CAGE | GUIDE BUSH	17-4 PH SS | 17-4 PH SS	……|……
	FLOW	Bidder to specify	……
	OUTLET VELOCITY	[] < 7 M/SEC (WATER) | [] MAC NO. < 1/3(STM)	……
	REQUIRED LEAKAGE CLASS	[] II [] III [■] IV [] V [] VI	……
	NOISE LEVEL (dBA) (spec. 3.1.14)	LESS THAN 85 dBA	……
	VACUUM SERVICE	[] YES [■] NO	……
	ANTI CAVITATION TRIM	[■] YES [] NO	……
PNEUMATIC ACTUATOR	MODEL NO. & SIZE	Bidder to specify	……|……
	CLOSE AT : OPEN AT (KG/CM2g)	1.0 | 0.2	……|……
	*TRAVEL TIME FOR	<10sec	……
	OPEN TO CLOSE, CLOSE TO OPEN	|	……
	*VALVE POSN. ON SIGNAL AIR FAILURE	[■] TO OPEN [] STAYPUT [] TO CLOSE	……
	*VALVE POSN. ON SUPPLY AIR FAILURE	[■] STAYPUT	……
ACCESSORIES	POSITIONER(SMART)	[■] REQUIRED (WITH HART PROTOCOL)	……
	AIR FILTER REGULATOR	[■] REQUIRED [] NOT REQUIRED	……
	AIR LOCK RELAY	[■] REQUIRED [] NOT REQUIRED	……
	POSITION LIMIT SWITCH	[■] REQUIRED [] NOT REQUIRED	……
	POSITION TRANSMITTER	PART OF POSITIONER	……
	SOLENOID VALVE	[] REQUIRED [■] NOT REQUIRED	……
	E/P CONVERTER	PART OF POSITIONER	……
	JUNCTION BOX	[■] REQUIRED [] NOT REQUIRED	……
	HAND WHEEL (SIDE MOUNTED)	[■] REQUIRED	……
	LOCAL POSITION INDICATOR	[■] REQUIRED	……
			……

Tag No. :…FDV-8… Qty.: …1 per Unit … Date Sheet No. PES-145-06-DS1-0

DATA SHEET – A & B

DATA SHEET – A FOR CONTROL VALVE (WITH PNEUMATIC ACTUATOR) (TO BE FILLED BY PURCHASER)			DATA SHEET – B (TO BE FILLED UP BY BIDDER)
PERFORMANCE OF VALVE	LINEARITY HYSTERISIS SENSITIVITY ACCURACY (OVERALL)	± 1% ± 1% ± 0.5% ± 1%	…… …… …… ……

SERVICE CONDITION*

SL. No. +	LOAD	FLOW (T/HR)	INLET PR. KG/CM2(A)	OUTLET PR. KG/CM2(A)	TEMP DEG (C)	CALC ULATED CV	% VLV LIFT	VLV O/L VELOCITY
1.	5% MCR (MIN.SPEED)	130	167	21	111			
2.	15% MCR	390	165	72	111			
3.	30% MCR	780	172	105	111 TO 138			
4.	40% MCR	950	185	148	157			
5.	40% Boiler Min R/c	1040	143	20	111			

VALVE TYPE	[■] CAVITATION [] FLASHING [■] HIGH DP
* MAX SHUT OFF PRESS (KG/CM2g) 450 * BODY DESIGN : PRESS (KG/CM2g) | TEMP (DEG C) 450 | 200 * IBR FORM III-C [■] REQUIRED [] NOT REQUIRED	…… ……|…… ……
TOTAL WEIGHT (VALVE + ACTUATOR + ACCESSORIES) Kg	……

NOTES:

1. + DESIGN CV SHALL BE BASED ON SERVICE CONDITIONS INDICATED AT SL. NO. ___2____ AND SHALL BE CHECKED FOR ALL OTHER CONDITIONS.

SECTION – D

DATA SHEETS – ACCESSORIES FOR CONTROL VALVES

	DATA SHEET FOR CONTROL VALVES (WITH PNEUMATIC ACTUATOR)	Specification No.:
		Volume
		Section
		Rev. No. 00 — Date :13.06.2013
		Sheet 48 of 74

Tag No: FDV-8 **Quantity: As required** Data Sheet No. PES-145-06-DS1-0

Applicable for tag nos. wherever statement "REQUIRED" indicated in the individual CV data sheets

DATA SHEET – A & B for ACCESSORIES
DATA SHEET – A FOR CONTROL VALVE (WITH PNEUMATIC ACTUATOR)

SMART POSITIONER (HART PROTOCOL BASED)	MFR. & MODEL NUMBER			Bidder to Specify		
	BYPASS	GAUGES	ENCL. CLASS	☐ YES ■ NO	☐ THREE ■ TWO	■ IP – 65
	INPUT SIGNAL			4- 20 mA DC		
	OUTPUT SIGNAL (Kg / Cm^2)			TO SUIT ACTUATOR		
AIR FILTER REGULATOR	MFR. & MODEL NUMBER			Bidder to Specify		
	AIR SUPPLY PRESS (MAX.) (Kg / Cm^2 g)			■ 5.0 - 8.0		
	OUTPUT PRESS (Kg / Cm^2 g)			TO SUIT ACTUATOR		
	OUTPUT GAUGE			■ REQUIRED (2 Inch) ☐ NOT REQUIRED		
AIR LOCK	MFR. & MODEL NUMBER			Bidder to Specify		
	SET PRESS (Kg / Cm^2)					
	SUPPLY PRESS (MAX.) (Kg / Cm^2)			■ 5.0 - 8.0		
	RESET TYPE			AUTO		
	VENT PLUG			REQUIRED		
LIMIT SWITCH	MFR. & MODEL NUMBER			Bidder to Specify		
	OPEN posn	INT posn	CLOSE posn	1 NO.	---	1 NO.
	CONTACT TYPE			SPDT		
	RATING (AC / DC)			5A 240V AC AND 0.5A 220V DC		
	ENCLOSURE CLASS			☐ NEMA-4 ■ IP-65		
POSITION TRANSMITTER	MFR. & MODEL NUMBER			Bidder to Specify (Part of SMART Positioner)		
	TYPE			■ Electronic (2-Wire) Contactless ☐ OTHER		
	SUPPLY			■ 24V DC ☐ 220V DC ☐ 110V AC ☐ 240V AC		
	OUTPUT RATING			■ 4-20mA ☐ 0-100 ohms		
	ACCURACY +			_ 2% FS		
	ENCLOSURE CLASS			☐ NEMA-4 ■ IP-65		
SOLENOID VALVE	MFR. & MODEL NUMBER			ROTEX / ASCO		
	RATING			■ 24V DC ☐ 220V DC ☐ 240V AC ☐		
	OPERATION Q	UANTITY		☐ Stayput ■ Interlock	■ 1 ☐ 2	
	COIL INSULATION CLASS			CLASS - H		
	ENCLOSURE CLASS			☐ NEMA-4 ■ IP-65		
	BODY & TRIM			SS BAR STOCK & AISI SS-316 respectively		
JUNCTION BOX	NO. OF WAYS			☐ 24-WAYS ☐ AS REQUIRED ■ 36-Ways		
	SIZE AS			REQUIRED		
	CABLE GLANDS (Size / Quantity)			AS REQUIRED (Double Compression Type).		
	ENCLOSURE CLASS			☐ NEMA-4 ■ IP-65		
I/P CONVERTER (Part of SMART Positioner)	INPUT SIGNAL	POWER SUPPLY		4-20mA DC	24V DC	
	SPLIT RANGE			☐ YES ☐ NO		
	ENCLOSURE CLASS			☐ NEMA-4 ■ IP-65		
	Accuracy	Repeatability		± 0.5 % FS	± 0.5 % FS	
Cu. Tubing & Fittings / per CV	**This is in addition to cu. Tubing and fittings which are integral part of CV as per ASTM B68 to B75 (USA)**			12 Meters of ¼ " PVC coated annealed Cu. Tubing, with 1 set of Fittings for each CV for connection to IA Header on one end and accessories on another end of CV.		

SECTION-D

DATA SHEETS -C

	NAME
	SIGNATURE
	DATE

Tag No……. Quantity……. Data Sheet No. PES-145-06-DS2-0

DATA SHEET C

DATA SHEET – C FOR CONTROL VALVE (WITH PNEUMATIC ACTUATOR)
(TO BE FILLED BY THE BIDDER AFTER THE AWARD OF CONTRACT)

GENERAL	PROJECT	
	SERVICE	
	LOCATION	
	DUTY	
	PIPE SIZE (inlet / outlet)	
	PIPE MATERIAL (inlet / outlet)	
BODY	MODEL NUMBER	
	TYPE OF BODY : GUIDING : NO. OF PORTS	
	BODY SIZE : PORT SIZE : DESIGN CV	
	END CONNECTION & RATING (ANSI)	
	BODY MATERIAL	
	PACKING MATERIAL SINGLE / DOUBLE	
	BONNET TYPE / MATERIAL	
	TRIM FORM	
	TRIM MATERIAL : SEAT | PLUG	
	TRIM MATERIAL : CAGE | GUIDE	
	FLOW	
	OUTLET VELOCITY	
	REQUIRED LEAKAGE CLASS	
	NOISE LEVEL (dBA) (Spec. 3.1.14)	
	VACUUM SERVICE	
	ANTI CAVITATION TRIM	
PNEUMATIC ACTUATOR	MODEL NO. & SIZE	
	CLOSE AT : OPEN AT (Kg / Cm^2g)	
	TRAVEL TIME FOR OPEN TO CLOSE, CLOSE TO OPEN	
	VLV POSN. ON SIGNAL ELEC FAILURE	
	VALVE POSN. ON SUPPLY AIR FAILURE	
ACCESSORIES	POSITIONER	
	AIR FILTER REGULATOR	
	AIR LOCK RELAY	
	POSITION LIMIT SWITCH	
	POSITION TRANSMITTER	
	SOLENOID VALVE	
	E / P CONVERTER	
	JUNCTION BOX	
	HAND WHEEL (SIDE MOUNTED)	
	LOCAL POSITION INDICATOR	
	ELECTRO PNEUMATIC POSITIONER	
	PRESSURE GAUGES	

Tag No……. Quantity……. Data Sheet No. PES-145-06-DS2-0

DATA SHEET C

DATA SHEET – C FOR CONTROL VALVE (WITH PNEUMATIC ACTUATOR)
(TO BE FILLED BY THE BIDDER AFTER THE AWARD OF CONTRACT)

PERFORMANCE OF VALVE	LINEARITY	
	HYTERSIS	
	SENSITIVITY	
	ACCURACY	

SERVICE CONDITION*	**SL.+ NO.**	**LOAD**	**FLOW (T/HR)**	**INLET PR. (KG/CM^2 (A)**	**OUTLET PR. (KG/CM^2 (A)**	**TEMP DEG. C**	**CALCULA TED CV**	**% VALVE LIFT**	**VALVE O/L VELOCITY**
	VALVE TYPE								
	* MAX SHUT OFF PRESS (**(KG/CM^{2}g)**								
	* BODY DESIGN : PRESS (**(KG/CM^{2}g)** **| TEMP (DEG. C)**								
	* IBR FORM III-C								

TOTAL WEIGHT (VALVE + ACTUATOR + ACCESSORIES) KG.

SECTION-D

QUALITY PLAN

	Manufacturer's Name	QUALITY PLAN (Applicable for mentioned three projects)		
BHEL	APPROVED VENDORS AS PER LOA (Refer Note - 1)	ITEM : CONTROL VALVE (Pneumatic)	BHEL QP No. PE-QP-999-145-I 006 A	PROJECT: 2X 800 MW GADARWARA STPP
			REV. No.: 00	PACKAGE: TG PACKAGE
		SUB SYSTEM :	DATE: 11-11-2009	CONTRACT NO.: 9172
		Power Cycle and Water System	PAGE 1 of 3	

Sl No	Component & Operations	Characteristics	Class	Type of check	Quantum of check M	Quantum of check C,N	Reference Document	Acceptance Norms	Format of record		Agency M	Agency C	Agency N	Remarks
1	2	3	4	5	6		7	8	9	D*	10			11
1	RAW MATERIAL AND BOUGHT OUT ITEMS													
1.1	Body and Bonnet, (Casting/ Forgings), Plug, Stem, Acutator Stem and Seat Rings	a) Physical and Chemical Properties	Maj.	Physical and Chemical Tests	1/ Heat (HT Batch)	1/ Heat (HT Batch)	Tech. Specification/ Approved Drawing	Tech. Specification/ Approved Drawing	TC	√	P	V	V	
		b) Heat Treatment	Maj.	Review of HT chart	Each HT	Each HT	Tech. Specification/ Approved Drawing	Tech. Specification/ Approved Drawing	TC	√	P	V	V	
		c) Internal Quality of casting	Maj.	RT for Body and UT for Bonnet	100%	100%	ANSI B 16.34	ANSI B 16.34	TC	√	P	V	V	Refer NOTE : 2
		d) Surface Quality	Maj.	Visual	100%	100%	MSS SP 55	MSS SP 55	TC	√	P	V	V	
		e) Pressure Test for Shell	Maj.	Hyd. Test	100%	100%	ANSI B 16.34	ANSI B 16.34	TC	√	P	V	V	For Body and Bonnet after machining
1.2	Diaphragm	a) Surface Quality	Maj.	Visual	100%	-	Mfr. Standard	Mfr. Standard	TC		P	V	-	
		b) Hardness	Maj.	Measu.	100%	-	Mfr. Standard	Mfr. Standard	TC		P	V	-	
		c) Endurance/ Life	Maj.	10,000 Cycles	1/ Type	-	10,000 Cycles / As per Mfr. Standard	No Damage	TC		P	V	-	
1.3	Springs	a) Composition	Maj.	Chemical	1 sample/lot	1 sample/lot	Material Spec./ Mfr. Std.	Material Spec./ Mfr. Std.	TC		P	V	-	
		b) Mechanical Properties	Maj.	Mech.	1 sample/lot	1 sample/lot	Material Spec./ Mfr. Std.	Material Spec./ Mfr. Std.	TC		P	V	-	
		c) Dimension	Maj.	Measu.	1 sample/lot	1 sample/lot	Mfr. Std.	Mfr. Std.	TC		P	V	-	
		d) Performance	Maj.	Stiffness Ratio	100%	100%	Approved Drg./ Material Spec.	Approved Drg./ Material Spec.	TC		P	V	-	
		e) Endurance Test	Maj.	Cyclic Test (Endurance)	1/ Type	1/ Type	Approved Drg./ Material Spec.	Approved Drg./ Material Spec.	TC		P	V	-	
1.4	Functional test (Limit switches, Solenoids, Positioner, AFR, ALR, Position Transmitter)	a) Routine Test	Maj.	HV, IR and Continuity	100%	100%	Mfr. Standard	Mfr. Standard	TC		P	V	-	
		b) Type tests	Maj.	Review of TC	1/ Type	1/ Type	Mfr. Standard	Mfr. Standard	TC		P	V	-	
		c) Degree of protection	Maj.	Review of TC	1/ Type	1/ Type	Mfr. Standard	Mfr. Standard	TC		P	V	-	
		d) Functional Test	Maj.	Verifiaiton of Operation	-	-	-	-	-	√	V	V	V	During Final Testing
1.5	Pressure Gauge	a) Performance	Maj.	Review of Calibration TC	100%	100%	Mfr. Standard	Mfr. Standard	TC		P	V	-	
		d) Marking and Dimension	Maj.	Visual	100%	100%	Approved Drg./ Tech. Spec.	Approved Drg./ Tech. Spec.	TC		P	V	-	

LEGEND : RECORDS, IDENTIFIED WITH " √ " SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
M: MANUFACTURER, SUB SUPPLIER, C: MAIN SUPPLIER, N: NTPC, P: PERFORM , W: WITNESS and V: VERIFICATION AS APPROPRIATE, D*: DOCUMENT SHALL BE SUBMITTED BY IN COLUMN "N" AS "W", ADS - Approved Data Sheet., TC - Test Certificate, TR - Test Records.

CONTRACTOR'S SIGNATURE: 11/11/09

Dy. Manager
Bharat Heavy Electricals Limited
Power Sector - Project Engineering Management
PPEI Building, HRD & ESI Complex
Plot No. 25, Sector - 16A,
NOIDA - 201 301 (U.P.)

FOR NTPC USE :
REVIEWED BY : 11/11/09

Dy. General Manager (QA)
एनटीपीसी लिमिटेड / NTPC
A-8A, Sector-24, Noida-201301 (U.P.)
NAME & SIGNATURE OF APPROVING AUTHORITY and SEAL
Engg. Div/QA & I

	Manufacturer's Name	QUALITY PLAN (Applicable for mentioned three projects)		
भा ए उ प्र BHEL	APPROVED VENDORS AS PER LOA (Refer Note - 1)	ITEM : CONTROL VALVE (Pneumatic)	BHEL QP No. PE-QP-999-145-I 006 A	PROJECT: 2X 800 MW GADARWARA STPP
			REV. No.: 00	PACKAGE: TG PACKAGE
		SUB SYSTEM :	DATE: 11-11-2009	CONTRACT NO.: 9172
		Power Cycle and Water System	PAGE 2 of 3	

Sl No	Component & Operations	Characteristics	Class	Type of check	Quantum of check M	Quantum of check C,N	Reference Document	Acceptance Norms	Format of record		Agency M	Agency C	Agency N	Remarks
1	2	3	4	5	6		7	8	9	D*	10			11
2 INPROCESS INSPECTION														
2.1	Body and Bonnet after machining, Plug with actuator stem	a)Surface Flaws (MPI for Body and Bonnet only)	Maj.	MPI/ PT	All assessible surfaces	All assessible surfaces	ANSI B 16.34	ANSI B 16.34	TR		P	V	V	Butt weld shall be included
		b) Dimensional Check	Maj.	Measu.	100%	–	Mfr. Std	Mfr. Std	Log Sheet		P	-	-	
		c) Hardfacing (Whereever applicable)	Maj.	Hardness Measu.	1 Sample/ Lot	1 Sample/ Lot	Mfr. Std	Mfr. Std	TR		P	V	V	Hardfacing is to be done as per Mfr. Std.
2.2	Guide Bush (Wherever applicable)	a) Dimension	Maj.	Measu.	100%	–	Approved Drg.	Approved Drg.	-do-		P	-	-	
2.3	Lapping	a) Machining surface contact (Blue Matching)	Maj.	Visual	1 Sample/ Lot	–	-	Proper Physical Contact	-do-		P			
3 TESTS ON COMPLETED VALVES														
3	CV TEST (TYPE TEST)	Valve characteristics Pr. Virsus Discharge and Discharge Virsus Opening.	Maj.	Measu.	1/ Type		As per Specifiation and Approved Drawing	As per Specifiation and Approved Drawing	TC	√	P	V	V *	* - NTPC Engg. clearance for CV test shalll be reviewed during final inspection.
3.1	Acttuator Chamber	a) Strength and leakage	Maj.	Pneu. Test	100%	10%	No leakage	No leakage	TR	√	P	W	W	
3.2	Body	a) Leak and Pressure Test	Maj.	Hydro test	100%	10%	ANSI B 16.34	ANSI B 16.34	TR	√	P	W	W	
3.3	Seat leakage test	a) Seat Leakage	Maj.	Hydor/ Pneu. Test	100%	10%	ANSI B 16.104	ANSI B 16.104/ Approved Data Sheet	TR	√	P	W	W	
3.4	Operation tests	a) Valve Traval	Maj.	Measu.	100%	10%	Spec./ ADS / Approved Drawings	Spec./ ADS / Approved Drawings	TR	√	P	W	W	
		b) Opening and Closing Time	Maj.	Measu.	100%	10%	Spec./ ADS / Approved Drawings	Spec./ ADS / Approved Drawings	TR	√	P	W	W	
		c) Linearity / CAM charactristics	Maj.	Measu.	100%	10%	Spec./ ADS / Approved Drawings	Spec./ ADS / Approved Drawings	TR	√	P	W	W	
		d) Hysterisis	Maj.	Measu.	100%	10%	Spec./ ADS / Approved Drawings	Spec./ ADS / Approved Drawings	TR	√	P	W	W	
		d) Operation of limit switch and solenoids and other accessories	Maj.	Measu.	100%	10%	Spec./ ADS / Approved Drawings	Spec./ ADS / Approved Drawings	TR	√	P	W	W	
		d) Predifined valve positon in case of air and signal failure	Maj.	Visual	100%	10%	Spec./ ADS / Approved Drawings	Spec./ ADS / Approved Drawings	TR	√	P	W	W	

LEGEND: RECORDS IDENTIFIED WITH " √ " SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
M: MANUFACTURER/ SUB SUPPLIER, C: MAIN SUPPLIER, N: NTPC, P: PERFORM , W: WITNESS and V: VERIFICATION AS APPROPRIATE, CHECKED BY NTPC SHALL IDENTIFY IN COLOUM "N" AS "W", ADS - Approved Data Sheet., TC - Test Certificate, TR - Test Records.

CONTRACTOR'S SIGNATURE: Dilip Mehrotra, Dy. General Manager (QC), Bharat Heavy Electricals Limited, Power Sector - Project Engineering Management, PPEI Building, HRD & ESI Complex, Plot No. 25, Sector - 16A, NOIDA - 201 301 (U.P.)

FOR NTPC USE : REVIEWED BY : 11/11/09

NAME & SIG. OF APPROVING AUTHORITY and SEAL: एस. सामंता / S. SAMANTA, उप महाप्रबंधक (QA), Dy. General Manager (QA), एनटीपीसी लिमिटेड / NTPC Limited, A-8A, Sector-24, Noida-201301 (U.P.), Engg. Div/QA & I

	Manufacturer's Name	QUALITY PLAN (Applicable for mentioned three projects)			
BHEL	APPROVED VENDORS AS PER LOA (Refer Note - 1)	ITEM : CONTROL VALVE (Pneumatic)	BHEL QP No. PE-QP-999-145-I 006 A	PROJECT	2X 800 MW GADARWARA STPP
		SUB SYSTEM :	REV. No.: 00	PACKAGE	TG PACKAGE
		Power Cycle and Water System	DATE: 11-11-2009	CONTRACT NO.	9172
			PAGE 3 of 3		

Sl No	Component & Operations	Characteristics	Class	Type of check	Quantum of check M	Quantum of check C,N	Reference Document	Acceptance Norms	Format of record		Agency M	Agency C	Agency N	Remarks
1	2	3	4	5	6		7	8	9	D*	10			11
3.5	Final Inspection	a) Overall Dimension	Maj.	Measu.	100%	10%	Approved Drawings	Approved Drawings	TR	√	P	W	W	
		b) Cleanliness and Stamping	Maj.	Visual	100%	100%					P	V	-	
		c) Painting	Maj.	Measu.	100%	-	Spec./ ADS	Spec./ ADS	TR		P	-	-	

NOTE : 1 - As on Date agreed sub suppliers are as follows.

1) M/s IL, Palakkad -	**For all pneumatic operated valves up to 2500 Class and up to 500 MW except BFP Recirculation vavle**
2) M/s Fisher Controls, UK/ USA -	**For all pneumatic operated valves of 500 MW**
3) M/s CCI, USA -	**For all pneumatic operated valves of 500 MW**
4) M/s NIPPON FISHER, JAPAN -	**For all pneumatic operated valves of 500 MW except BFP Recirculation valve**
5) M/s EMERSON, FRANCE -	**For all pneumatic operated valves of 500 MW**
6) M/s MIL CONTROLS, ALWAYE -	**For all pneumatic operated valves up to 2500 Class and up to 500 MW except BFP Recirculation vavle**
7) M/s DRESSER MASOLENIEN, FRANCE -	**For all pneumatic operated valves of 500 MW**
8) M/s COPES VULCAN, UK -	**For all pneumatic operated valves of 500 MW except BFP Recirculation valve**
9) M/s FISHER SANMAR, CHENNAI -	**For all pneumatic operated valves up to 2500 Class and for 200 MW and PRDS valves of 500 MW.**

NOTE : 2 - Only for rating class 900 & above and applicable for Body and Bonnet only. Valve stem for dia > 40 MM UT shall be done on 100 % basis as per ASTM A-388 A and ASME B 16.34. For lower rating as per specification. M/s BHEL to mentioned in the endorsement sheet if any changes are made in the NDT requirement as per specification.

NOTE : 3 - A) Air Filter regulator to be procured from M/s Plaka and M/s Shavo norgen. B) Smart Positioner (If applicable) to be procured from Siemens, Yokogawa, ABB, Dressor, Fisher, Smar, Masolenien. C) All other bought out items/ accessories are procured from Valve Manufacturer approved sources.

NOTE : 4 - IBR Cetificate in Form III C shall be submitted if called for in the specification/ Data Sheet.

NOTE : 5 - Copies of all TC for materials duly correlated with Heat numbers, TC for electrical items and mechanical tests (Leak/ Operation) shall be furnished to BHEL for verification and acceptance.

11/11/09 CONTRACTOR'S SIGNATURE.	LEGEND : * RECORDS, IDENTIFIED WITH " √ " SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. M: MANUFACTURER/ SUB SUPPLIER, C: MAIN SUPPLIER,,N: NTPC, P: PERFORM , W: WITNESS and V: VERIFICATION AS APPROPRIATE, "CHP" : NTPC SHALL IDENTIFIY IN COLOUM "N" AS "W", ADS - Approved Data Sheet., TC - Test Certificate, TR - Test Records.	FOR NTPC USE : REVIEWED BY : 11/11/09	NAME & SIG. OF APPROVING AUTHORITY and SEAL Engg. Div/QA & I

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A-8A, Sector-24, Noida-201301 (U.P.)

SAMPLE COPY for BHEL QP NO - PE-QP-999-145-I006 A

Rev-00 dt. 11/11/09.

TABLE-1

NDT REQUIREMENTS FOR PRESSURE RETAINING COMPONENTS OF VALVES

Valve size NB in mm	ANSI Class upto 300	ANSI Class above 300 upto 600	ANSI Class above 600 below 900	ANSI Class 900 & above & below 4500
Less than 50	Visual	visual	Visual	MPI
50 & above but below 100	Visual	visual	MPI	MPI & RT (on 10% of valves on 100% area)
100 & above but less than 300	Visual	MPI	MPI & RT (on 10% of valves on changes of section & weld ends)	MPI & RT (on 100% area)
300 and above	MPI	MPI	MPI & RT (on change of sections & weld ends)	MPI, RT (on 100% area)

Note:

For body and bonnet forgins UT with MPI may be adopted in place of RT.

For austenitic steel MPI may be replaced by LPI.

1.01.07 **Non Pressure Bearing Attachments**

Load bearing welds shall be subjected to examination by ultrasonic testing (UT) and magnetic particle inspection (MPI) techniques after stress relief (SR). No load bearing welds shall be subjected to MPI after stress relief. The toes of the welds adjoining the drum shall be ground smooth prior to stress relieving before carrying out this examination.

1.01.08 **Steam coil air preheater and fuel oil heater**

Hydraulic pressure test shall be carried out on the heating coils. All pipes, valves steam traps and mountings shall be subjected to hydraulic test as called for under IBR, BS or other approved codes.

1.01.09 **Soot Blowers**

(a) Butt weld between nozzle and lance tube shall be subjected to 100 % radiography tests.

(b) Soot blower shall be subjected to operational checks as below:

(1) Smooth operation

11/11/09

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SECTION-D

BILL OF QUANTITY

BILL OF QUANTITY

[A] CONTROL VALVES COMPLETE WITH SMART POSITIONER AND ALL ACCESSORIES MOUNTED, TUBED AND TERMINATED ON JB

S. No.	TAG NO.	SERVICE/ ITEM DESCRIPTION	QTY/UNIT	Total Qty (2Units)
1	FDV- 8	LOW LOAD FEED CONTROL	1	2

BILL OF QUANTITY

[B]	**¼" COPPER TUBING (PVC COATED) (To be supplied Loose)**		**25** METERS	50 METERS
[C]	**FITTINGS:** **(To be supplied Loose)**	**(i)** BRASS FITTING for Connection to Air Filter Regulator	1 Lot	2 Lot
		(ii) BRASS FITTING for Connection to Air Lock Relay	1 Lot	2 Lot
		(iii) BRASS FITTING for Connection to IA Header isolation valve	1 Lot	2 Lot
		(iv) BRASS EQUAL TEE	1 Lot	2 Lot
[D]	**SOFTWARE & ACCESSORIES**			
1	VALVE CONFIGURATION,DIAGNOSTIC, CALIBRATION AND TESTING SOFTWARE		1 Set	2 Sets.

SECTION-D

SPARES

LIST OF COMMISSIONING SPARES

S.No.	ITEM DESCRIPTION	QUANTITY
1.	Body & Bonnet Gaskets	One (1) set with each control valve Tag
2.	Gland Packings	One (1) set with each control valve Tag

LIST OF MANDATORY SPARES

S.No.	ITEM DESCRIPTION	QUANTITY (Lot price for applicable items)
1.	Valve Tr im (including cage, plug, stem , seat rings, guide bushings etc.)	1 set for each type of Control Valve.
2.	Diaphragms, 'O ' rings, seals etc.	1 set for each actuator.
3.	Pressure Gauges of all ty pes, make, rating etc. (if applicable)	10% or 2 Nos. of each type whichever is more.
4.	Solenoid Valves (if applicable)	10% or 2 Nos. of each type whichever is more.
5.	Control Valve positioners and its accessories	10% o r 2 Nos. o f eac h t ype, mod el and rat ing wh ichever is more.
6.	Pneumatic Actuator Assembly	10% or 2 Nos. of each type, model and rating whichever is more.

NOTES:

Wherever % is indicated, the quantity shall be calculated for % of supply for total quantity of 2 unit of 2X800 MW, unless otherwise specified. The quantity to be reckoned for % indicated shall be rounded off to the next higher whole number. For example if the % of total quantity arrived is 0.2, the quantity to be supplied shall be 1 and if the % of total quantity is 5.1, the quantity to be supplied shall be 6.

SECTION-D

PAINTING

14.00.0 PAINTING

a) All un-insulated equipments, pipes, valves etc covered in this sub-section shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 micron.

The paint shall be applied in three stages i.e primer, intermediate and finish coats in following manner.

- Primer coat -Epoxy based Zinc phosphate
- Intermediate- Epoxy based TiO2 pigmented coat
- Finish Coat- Epoxy based Finish coat.

b) Equipment, pipes etc with high temperature shall be painted with Heat Resistant Aluminium Paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 microns.

c) Surface Preparation before painting shall be carried out according to requirement indicated in Sub Section A-9 (Power Cycle Piping) of Part-B and international standard.

SCHEDULE OF SUBMISSION OF DRAWINGS / DOCUMENTS, EQUIPMENT MANUFACTURE INSPECTION AND DESPATCH

1.	**ZERO DATE**	**DATE of LOI / FOI / TOI**
2.	Submission of Data Sheets / documents / catalogues / Valve sizing calculations / Noise calculations for approval.	2 Weeks from the Zero date.
3.	Technical finalisation, freezing of inputs of manufacture by way of vetting of documents and technical discussions and resubmissions of documents (if required)	6 Weeks from the Zero date.
4.	Inspection of Equipment as per Approved (Category-I) drawings / documents.	24 Weeks from the Zero date.
5.	Release of MDCC by BHEL	26 Weeks from the Zero date.
6.	Dispatch (Packaging & Dispatch)	26 Weeks from the Zero date.
7.	Final documents submission as per Contract	28 Weeks from the Zero date.

NOTE: Delays due to non-fulfillment of the requirements of approved Quality Plan and approved Data sheets, Drawings, Catalogues and Sizing Calculations observed during inspection shall be to the Vendor's account.

Delays due to INCOMPLETE (Partly) submission of Data sheets, Drawings, Catalogues and Sizing Calculations also be considered as **"DOCUMENTS NOT SUBMITTED"**

(Signature and Stamp of the Bidder)

NATIONAL THERMAL POWER CORPORATION LIMITED

GADARWARA STPP STAGE-I (2 x 800 MW)
TG PACKAGE

TECHNICAL SPECIFICATION
FOR

CONTROL VALVES WITH ACCESSORIES

(Pneumatically Operated)

FOR SEVERE SERVICE APPLICATION

VOLUME III

SPECIFICATION No: **PE-TS-394-145-I 104A**

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

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SCHEDULE OF DRAWINGS, DATASHEETS, DOCUMENTS, CATALOGUES SUBMITTED WITH THE BID

PARTICULARS OF THE BIDDER / AUTHORISED REPRESENTATIVE				
NAME DES	IGNATION	SIGNATURE	DATE	COMPANY SEAL

SCHEDULE OF PRICES

S.NO.	ITEM	DESCRIPTION	QTY FOR ONE UNIT	PRICE FOR ONE UNIT	TOTAL PRICE FOR 2 UNITS
[A]	CONTROL VALVES COMPLETE WITH SMART POSITIONER AND ALL ACCESSORIES MOUNTED, TUBED AND TERMINATED ON JB				
S. No.	TAG NO.	SERVICE/ ITEM DESCRIPTION			
1	FDV-8	LOW LOAD FEED CONTROL	1		

SCHEDULE OF PRICES

		PRICE FOR ONE UNIT	TOTAL PRICE FOR 2 UNITS
[B]	25 METERS OF Cu. TUBING (Per Unit) FOR CONNECTION BETWEEN IA HEADER ON ONE END AND ACCESSORIES ON THE OTHER END OF CV		
[C] (i)	1 LOT OF BRASS FITTINGS FOR CONNECTION TO AIR FILTER REGULATOR(AS PER HOOK-UP DIAGRAM)		
(ii)	1 LOT OF BRASS FITTINGS FOR CONNECTION TO AIR LOCK RELAY(AS PER HOOK-UP DIAGRAM)		
(iii)	1 LOT OF BRASS FITTINGS FOR CONNECTION TO IA HEADER ISOLATION VALVE(AS PER HOOK-UP DIAGRAM)		
(iv)	1 LOT OF BRASS EQUAL TEE(AS PER HOOK-UP DIAGRAM)		
[D]	START-UP/COMMISSIONING SPARES (SEPARATE SHEET WITH BREAK UP TO BE ATTACHED)		
(i)	1 SET OF BODY AND BONNET GASKETS FOR EACH CV		
(ii)	1 SET OF GLAND PACKINGS FOR EACH CV		
[E]	SOFTWARE FOR CONFIGURATION , DIAGNOSTIC, CALIBRATION & TESTING		
[F]	MANDATORY SPARES AS PER LIST ENCLOSED IN SECTION D (SEPARATE SHEET WITH BREAK UP TO BE ATTACHED)		
[G]	Cv TEST CHARGES FOR EACH TYPE OF CONTROL VALVE		

PARTICULARS OF THE BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

CV TEST CHARGES

S.NO. I	TEM DESCRIPTION		CV TEST CHARGES
S. No.	TAG NO.	SERVICE	
1	FDV -8	LOW LOAD FEED CONTROL	

NOTE: a) Charges to be indicated against each tag no.

b) CV test to be conducted for one per type per size , cv value , tag nos. to be grouped accordingly and indicated

c) CV Test needs to be conducted for all types of valves. However, if the bidder has CV Type Test Certificate for a similar model/Size/CV and the certificate is not more than three years old from the date of part-1 opening (receipt of technical unpriced offer), the certificate shall be acceptable .

d) In case the submitted CV Test certificates are found non-acceptable to BHEL/Customer, bidder shall conduct the CV type test without any price implication to BHEL.

SCHEDULE OF UNIT PRICES

CONTROL VALVE ACCESSORIES

S. No.	ITEMS	UNIT PRICE
1. $	POSITIONER EACH MODEL AND TYPE	
2.	AIR FILTER REGULATOR	
3.	AIR LOCK RELAY	
4. $	POSITION LIMIT SWITCH OF EACH MODEL AND TYPE	
5.	ELECTRONIC POSITION TRANSMITTER OF EACH MODEL AND TYPE	
6.	SOLENOID VALVE	
7.	VOLUME BOOSTER (PNEUMATIC RELAY)	
8. $	PRESSURE GAUGES OF EACH TYPE	
9.	JUNCTION BOX (36 WAYS)	
10.	HANDWHEEL	
11. $	ACTUATOR OF EACH TYPE	
12.	BRASS FITTING FOR CONNECTION TO AIR FILTER REGULATOR	
13.	BRASS FITTING FOR CONNECTION TO AIR LOCK RELAY	
14.	BRASS FITTINGS FOR CONNECTING TO AIR HEADER	
15.	BRASS EQUAL TEE	
16.	COPPER TUBING PER METRE	
17. $	VALVE STEM WITH PLUG & SEAT RING EACH SIZE & TYPE	
18. $	GASKET OF EACH SIZE AND TYPE	
19. $	BODY SEAL GASKETS OF EACH SIZE AND TYPE	
20. $	CAGE OF EACH SIZE AND TYPE	
21. $	GLAND PACKING EACH SIZE AND TYPE	
22. $	VALVE TRIM OF EACH SIZE AND TYPE	
23. $	DIAPHRAM OF EACH SIZE AND TYPE	
24. $	SEAL BOX “O” RING OF EACH TYPE AND SIZE	
25. $	COLOR “O” RING OF EACH TYPE AND SIZE	
26.	POSITION TRANSMITTER	
27.	HAND HELD UNIVERSAL HART CALIBRATOR	
28.	DIAGNOSTIC SOFTWARE	

NOTE

$: Separate list to be attached for each size and type of these control valve accessories.

PARTICULARS OF THE BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

INSPECTION SCHEDULE

(PLACE & ADDRESS OF TESTING/ INSPECTION AND ITS SCHEDULE DATE & DURATION IN NUMBER OF DAYS ITEM/COMPONENTWISE TO BE LISTED)

PARTICULARS OF THE BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

DEVIATION SCHEDULE

PARTICULARS OF THE BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL