	<b>HYDRO PROJECTS ENGINEERING DIVISION</b>	<b>SPECIFICATION NO.</b>	<b>REV 00</b>
	<b>TITLE : ULTRASONIC FLOW MEASUREMENT SYSTEM</b>	<b>241534891</b>	<b>Page 1 of 8</b>




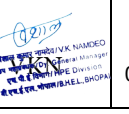
**PROJECT: PUNATSHANGCHU-II HEP, BHUTAN****1. SCOPE:**


SL NO.	ITEM DESCRIPTION	QUANTITY
1.	Supply of 8-path insertion type externally mounted ultrasonic flow measurement system as per detailed scope of supply clause no. 3	6 Sets
2.	Installation of all the above 6 sets sensors at Punatshangchu-II HEP, Bhutan	1 Lot
3.	Commissioning of 6 sets of 8-path Ultrasonic flow measurement system at Punatshangchu-II HEP, Bhutan	1 Lot

**2 APPLICATION:**

8-path Ultrasonic Flow Measurement System (Acoustic type) asked in this specification are to be used individually for continuous on-line monitoring of flow passing through the Turbine in all the 6 units. Externally Mounted Insertion Type Turbine Flow Meter in '4-Planes 8-Paths with 16 sensors' shall be provided in each Penstock for measurement of flow. The Turbine Flow Meter shall be supplied, installed and commissioned in accordance with IEC-60193, Appendix J for each Turbine for measurement of flow. The supplied instrument shall be compliant to IEC 60041-1991 and shall be suitable for dam/river water applications with high silt content.

The flow meter system supplied shall include all the equipment and interconnecting wiring required to measure the flow rate & flow velocity for display the measured values. The interconnecting cables between the transducers (sensors) and the flow meter system shall be properly shielded to keep the transducer signal free of undesirable noise normally encountered in a Hydro Power House. The Flow meter shall measure Flow velocity and totalize the volume of Flow to a **guaranteed accuracy of  $\pm 1.0$  %** or better compliant to IEC- 60041 requirement.


REV.NO.		DISTRIBUTION.	QTY.	APPROVED:			
PREPARED				MS 			
CHECKED		HTE	01	PREPARED	CHECKED	ISSUED	DATE
APPROVED		MM(H)	04	 DALPAT BORANA General Manager (Design) Hydro Projects Engineering Division Bhutan Hydro Electric Corporation Ltd. BHOPT.	 NK NAMDEO General Manager Hydro Projects Engineering Division Bhutan Hydro Electric Corporation Ltd. BHOPT.	 NK NAMDEO General Manager Hydro Projects Engineering Division Bhutan Hydro Electric Corporation Ltd. BHOPT.	05-10-23

	<b>HYDRO PROJECTS ENGINEERING DIVISION</b>	<b>SPECIFICATION NO.</b>	<b>REV 00</b>
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The equipment shall indicate flow rate through each Penstock via local display at flow meter console, the path velocity, signal strength and mean velocity in the pipe, 4-20 mA DC analogue output for the flow rate of each pipe and suitable communication port for data transfer and PC interface.

### **3. DETAILED SCOPE OF SUPPLY:**

<b>SL. NO.</b>	<b>ITEM DESCRIPTION</b>	<b>QUANTITY</b>	<b>EACH SET COMPRISING OF</b>
1	8-Path Insertion Type Externally Mounted Ultrasonic Flow Measurement System	6 Sets	<p>(a) <b>Flow Meter Console</b> - With Digital Signal Processing, IP65/NEMA 6 X Wall Mounted Enclosure, 2 Line Front Panel Display, 8-Path Flow Measurement Capacity, Measuring Range For Up To <math>\pm 15</math> m/S, Cabinet to be inclusive of internal Surge Protection, 4-20mA isolated Output Channels, Communication Modbus RTU, Modbus TCP, IEC 60870-5-104, Embedded Computer Module, Internal Data Logger, Watchdog Timer, Web Interface / browser, no software required, independent of operating system.</p> <p>(b) <b>16 Number Insertion Type Sensing Feed Through Transducers (Sensors)</b> suitable for - 40 bar pressure, Penstock Wall Thickness 36 mm, <math>\pm 15</math> m/sec Velocity, Frequency based on application and also suitable for partially filled pipe.</p> <p>(c) <b>16 Sets of Connectors each with 50 Meter Long cable</b> and all the necessary hardware like cable conduits, clamps, Junction Boxes and other accessories etc required for connection of cables to Flow meter Console.</p> <p>(d) <b>Common Items for 6 Units:</b> Programming Tool with Software, Special Tools &amp; Tackles required for Installation &amp; Commissioning (Like Hydraulic Jack etc), Technical Interface Manual for O&amp;M.</p>

	<b>HYDRO PROJECTS ENGINEERING DIVISION</b>	<b>SPECIFICATION NO.</b>	<b>REV 00</b>
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2	Installation of all the above sensors (6 Sets) at PUNATSHANGCHU-II HEP, BHUTAN	1 Lot	As per Clause 7.0
3	Commissioning of 6 Sets of 8-Path Ultrasonic Flow Measurement System at PUNATSHANGCHU-II HEP, BHUTAN	1 Lot	As per Clause 7.0

#### **4. SYSTEM DESCRIPTION:**

##### **a. Flow Meter Console:**

The Flow Meter console shall be an embedded computer based multi-path, acoustic transit-time type system with digital ISP technique or equivalent.

The Flow Meter shall be capable of operating 8 acoustic Paths for Measurement of Flow.

The Processing unit should have the **embedded processor** and it shall be of the latest processor utilized by the manufacturer with real time OS (Operating Software).


The flow meter console shall measure discrete acoustic travel times to arrive on an average velocity for each of the acoustic paths. The consoles shall evaluate each acoustic signal based on digital signal processing where the processor will have advance knowledge of the shape of the signal, which is expected, and then carries out correlation to identify the correct reflected signal and filter out all those which are distorted by reflections or reverberations.

The flow meter console shall be equipped with an Automatic Gain Control feature to ensure that all received acoustic signals are continuously amplified to useable levels without noise interference. The console shall have the feature to increase the system sensitivity if the processor detects weak signals because of silt/solid deposition on any sensor.

The console shall evaluate and display each acoustic signal received. Each travel time resulting from accepted signals shall be checked to ensure that the measured time is within user-selectable limits.

These velocity data points shall be integrated to determine the flow rate through the pipe. The method of measuring and computing water velocity shall be independent of the speed of sound in water. The calculation must include the correction of protrusion effects, change in area of cross section, etc.

Flow meter console should be equipped with the integration method for flow and average velocity calculation software as per IEC-60041 recommendation. Flow profiles influenced by size and shape of pipe, by approach flow conditions or by eddies, swirls and wall roughness etc. shall be taken into account for flow calculation.

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The flow meter shall provide Web interface / browser. The user shall be able to enter all site-specific and operational parameters via notebook locally or remote. Parameter entry shall be aided by menu-driven, English language prompts on the unit display or through equivalent HMI application.

The Console shall be capable of storing all measurement values for a minimum time period of one year. It shall be possible to download all values from this database.

The console shall be installed in an enclosure suitable for wall mounting. The console shall be equipped LED / LCD Display with control panel. The display shall be mounted inside of the enclosure and shall be visible without opening the front door of the enclosure.

The system shall have the capability to display individual path variables inclusive a message that indicates the type and path location of a signal interruption or transducer failure.

The system shall have the capability to display individual received signals without using a separate analogous or digital oscilloscope.

The flow meter console shall have a self-test routine that periodically checks for proper operation of the flow meter transceiver, processor, and timing functions. The system shall alert the user to any self-test or acoustic path failure by displaying an error message on the flow meter display. The flow meter shall also provide a message indicating the type and location of any acoustic path problems.


The system shall provide analogous outputs of 4-20 mA current loops representing flow rate, mean velocity, mean signal strength and water temperature in the pipe. The instrument shall provide relay outputs contact closure. An Ethernet port for use with PC type computer shall be provided.

RTU & TCP slave console shall be provided. The RTU & TCP interface shall make flow rate variable including but not limited to flow volume path velocities, gains signals to noise ratio available using standard TRU protocol.

The flow meter console shall be designated to return to full operation following a short term power interruption with all stored operational parameters value retained.

#### **b. Insertion Type Feed-through Transducers (Sensors):**

The ultrasonic transit time sensing transducer faces shall be of wetted type in direct contact with the flowing water. Sensing transducer assemblies and mountings shall be constructed of 316L type stainless steel. Maximum design pressure rating of the feed through sensing transducer shall be 40 bars.

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The sensor feed through assembly must have safety interlock in order to prevent accidental removal under pressure.

**The sensors offered shall necessarily be of Stainless Steel.**

Special water resistance connectors must be used for the sensors. The sensors should be capable of operating in high silt conditions (silt concentration of 5000 ppm).

**c. Transducer Cables:**

The flow meter supplier shall furnish all cables between the transducers and the flow meter console, which shall be the Co-axial cable which are suitable for long term monitoring in the specified application. Further, all the lugs, ferrules, clamps, Junction Boxes conduits or any other items required for the installation of the system shall be in the scope of the vendor.

**d. Programming tool/ Laptop and Windows Interface:**

The vendor shall supply a common suitable programming tool containing necessary software for running the system. This web application independent of operating system shall allow the flow meter operator to easily configure the flow meter for specific operational conditions, provide capability for flow data retrieval, storage & display. Web – application independent of operating system.


**5. PENSTOCK DIAMETER AND DISCHARGE:**

Please refer to the enclosed drawing SKETCH-PS-P-II-JULY-2023 for details of Penstock and proposed location of Ultrasonic Flow Measurement System:

The un-concreted straight length available and access to the respective installation location has been elaborated in the Zone-1 & Zone-2.

In addition, kindly refer the drawing no. HPE/GC/04 Rev. 03 for the details of connection of MIV inlet pipe with the penstock in Zone-1 of main drawing.

Penstock Diameter	:	3860 mm
Un-concreted Straight Length available	:	1000mm (Zone-2) & Minimum. 500mm (Zone-1) For further details refer above mentioned drawings.
Rated Discharge	:	85.1 cubic meter / sec
Max. Discharge (at min. head)	:	100.0 cubic meter / sec
Rated Net Head	:	241 meters
Max. head during pressure rise	:	356 meters
Ambient Temperature Range	:	8 to 45 degrees Celsius
Humidity	:	95%

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	<b>TITLE : ULTRASONIC FLOW MEASUREMENT SYSTEM</b>	<b>241534891</b>	<b>Page 6 of 8</b>

## **6. FLOW ACCURACY AND STANDARDS APPLICABLE:**

As per contractual requirement, a Flow Accuracy of  $\pm 1$  % shall be required from both the system. The equipment shall be compliant to IEC 60041-1991 and shall be in accordance with IEC-60193, Appendix J.

## **7. INSTALLATION & COMMISSIONING:**

The installation and commissioning of the system shall be carried out at PUNATSHANGCHU-II HEP, BHUTAN. The project site is located at a distance of 100 km from Thimpu, the capital of Bhutan.

Complete installation of all the sensors in six units shall be carried out by the vendor in one single first visit. Vendor shall be given 4 weeks advance intimation for deputation of installation engineer to site for carrying out the complete installation (6 units). The Penstock shall be dry and water filling / Penstock charging will not be done during this stage.

Commissioning of 6 units of 8- Path System shall be done by the vendor for which minimum two visits are to be considered. Based on the Penstock filling schedule of the end customer, vendor shall be given advance intimation of 2 weeks for deputing their service engineer for commissioning of the system.

**All the activities related to installation / commissioning/ parameterization should be completed by the vendor in the above visits.**

Vendor shall offer lump-sum price of Installation /Commissioning under respective head. Offer of installation / commissioning on per day charge basis/number of visits basis/ to-and-fro fare basis etc shall not be accepted.


The installation /commissioning of the equipment shall be completely in the scope of vendor. All the manpower & material required for installation including boarding /lodging and local transport, Visa , Airport Charges etc shall be borne by the vendor.

Vendors are advised to get necessary information regarding site conditions before submitting their offer.

## **8. DOCUMENTS REQUIRED WITH THE OFFER:**

The vendor shall submit complete Technical Details/catalogues/write-up of the model offered complying to the specification. Detailed arrangement drawing for installation of sensors shall be required with the offer for our review. The relevant electrical wiring diagrams shall also be included with the offer.

The above documents shall include Sensor Installation and Simulation Procedure. Further, BHEL may ask for other relevant documents related to the offered model during technical evaluation of the offer.

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### **9. DOCUMENTS REQUIRED AFTER PLACEMENT OF ORDER:**

After award of contract, vendor shall submit following drawings / documents for end customer approval within 6 weeks of PO placement:

1. Sensor Installation Drawing of 8-Path System
2. GA Drawing of Flow Meter Console
3. Complete Datasheet of Flow Meter
4. Wiring Diagram of Ultrasonic flow meter

The resubmission of revised drawings/ documents shall be within 1 week of comments. The vendor shall submit calibration certificates, material test certificates and applicable type test reports for BHEL approval and dispatch clearance as per enclosed QA Plan.

### **10. GUARANTEE:**

Instrument shall bear suppliers warranty for trouble free operation and good workmanship for a period of 24 Months from the date of dispatch or 12 months from the date of commissioning. Supplier should undertake to replace free of charge any material / components found defective in operation during warranty period.

### **11 PACKING AND O&M MANUALS:**

Instruments shall be packed in with silica gel packet and placed in a cartoon, or case adequate cushioning material, and water proof cover in minimize the movement of internals and ensure that the instrument is capable of withstanding the transit condition without damage.

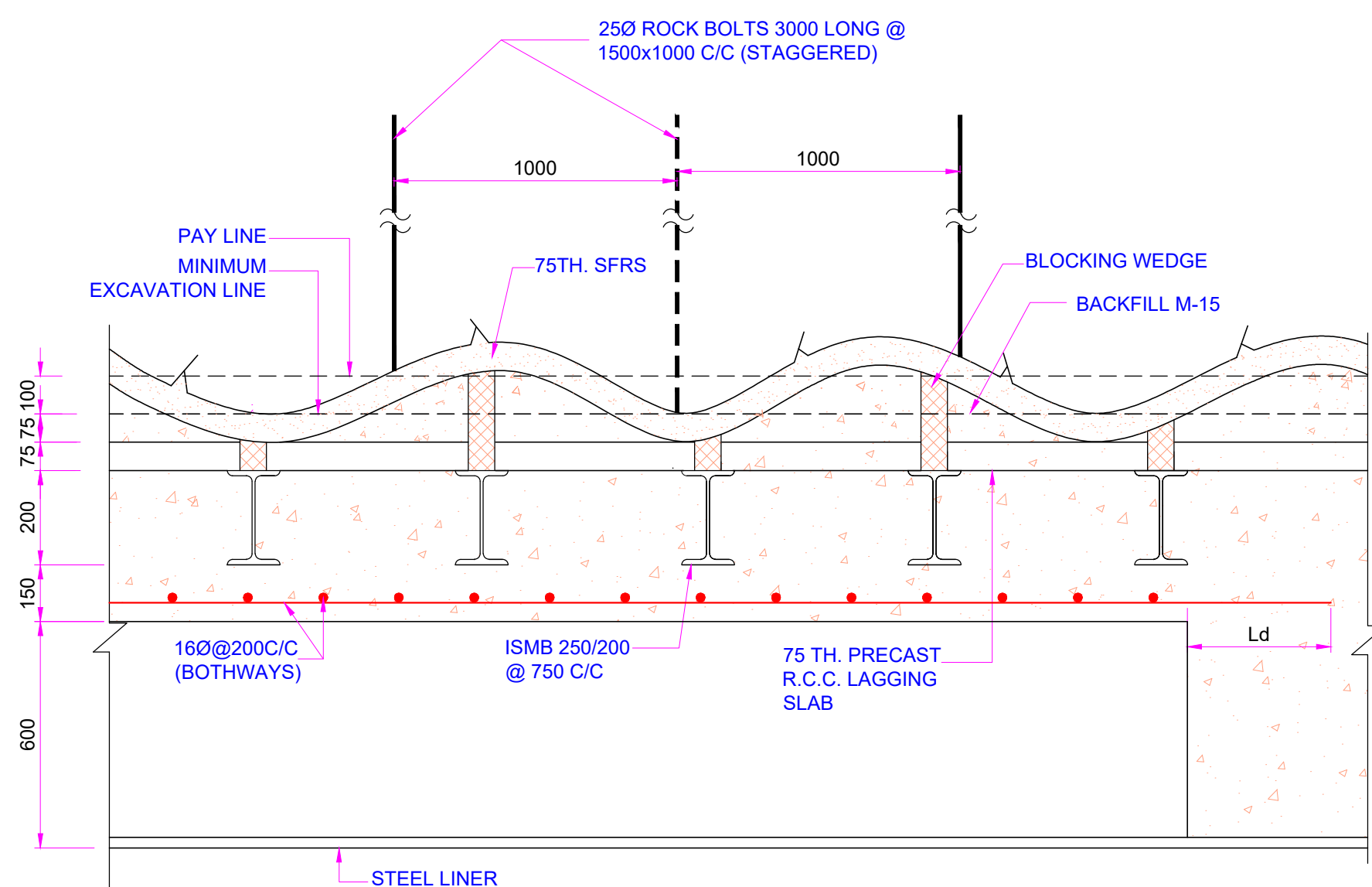
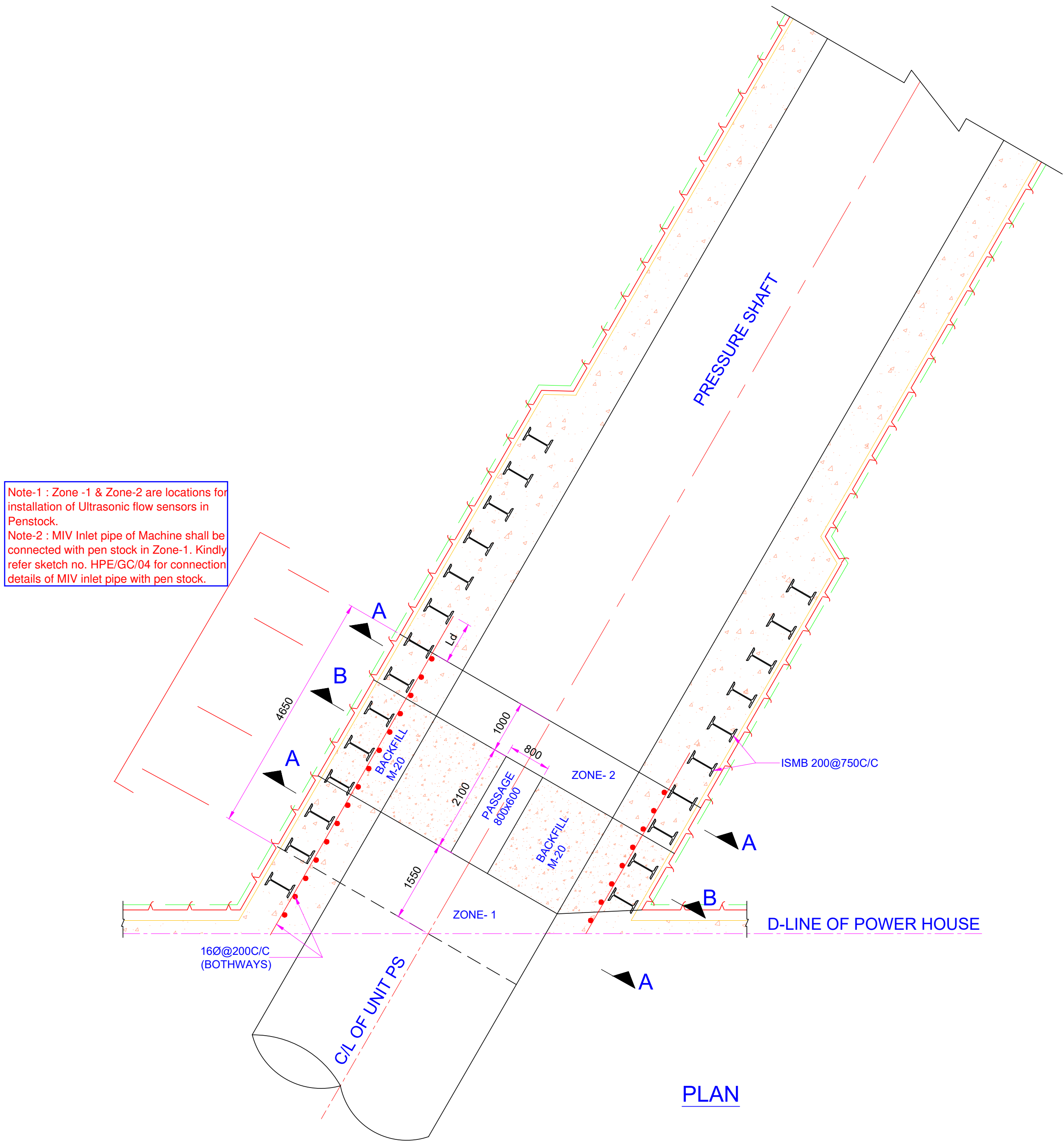
The vendor shall provide one CD (soft copy of O&M Manuals) with the equipment. The box containing the equipment shall clearly mention PUNATSHANGCHU-II HEP, BHUTAN and other relevant details of the equipment inside the box including the Bill of Material.

### **12 DEVIATIONS FROM THE SPECIFICATION:**

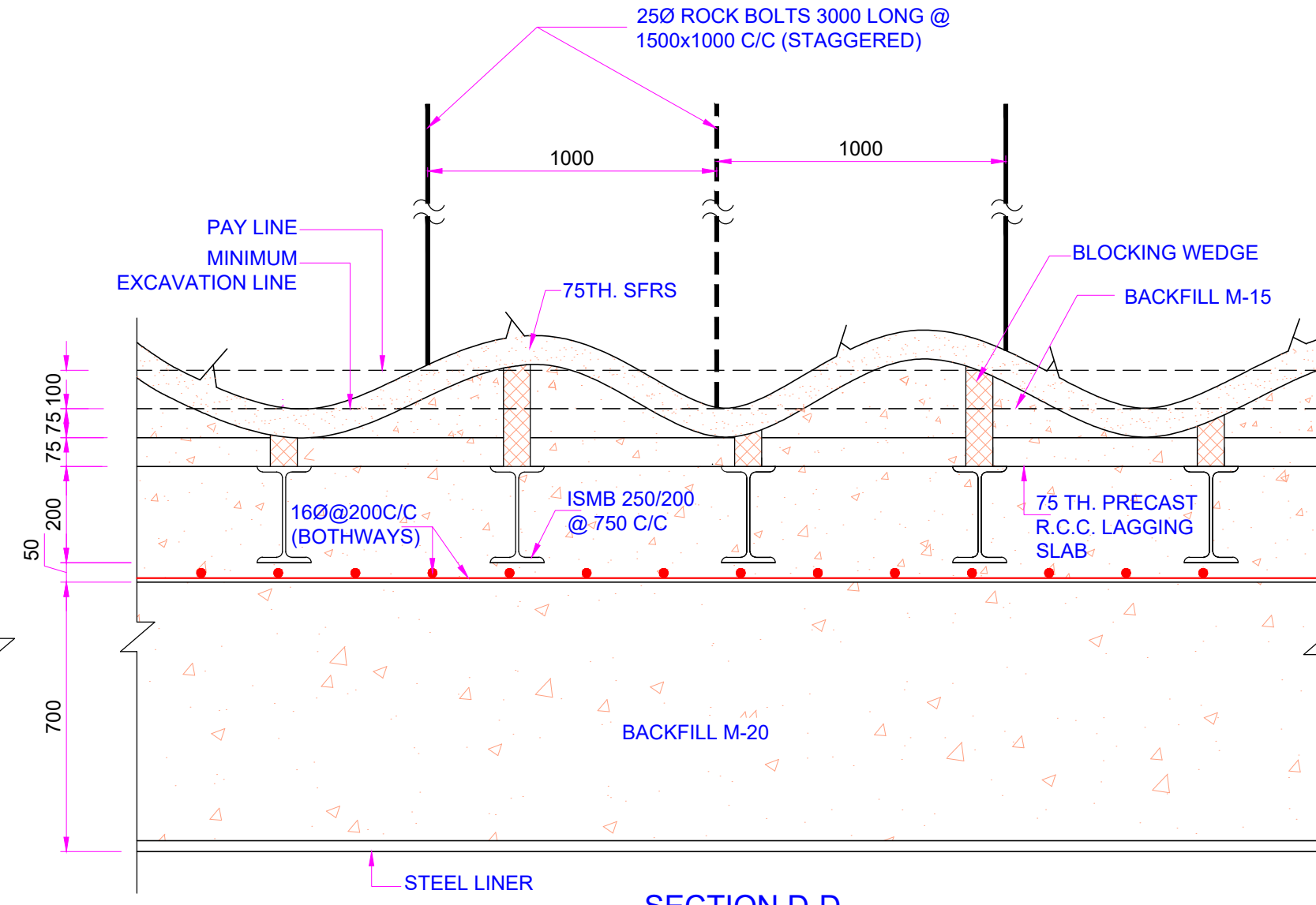
All the vendors have to strictly comply to BHEL's specification while offering the instruments. However, deviations (if any) and exclusions in the scope of supply, installation and commissioning shall be categorically enumerated separately by the vendor in the offer.



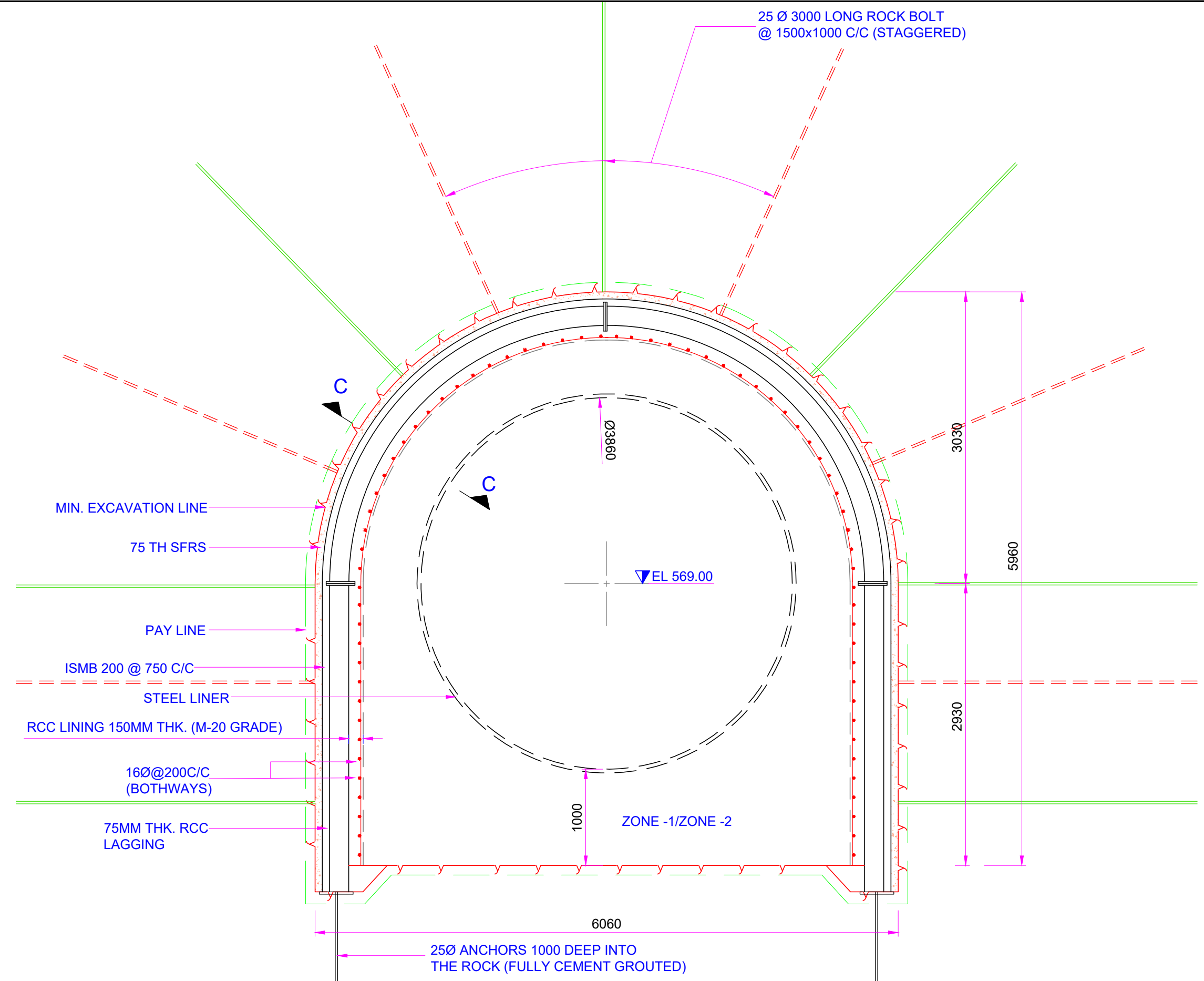
Note-1 : Zone -1 & Zone-2 are locations for installation of Ultrasonic flow sensors in Penstock.  
Note-2 : MIV Inlet pipe of Machine shall be connected with pen stock in Zone-1. Kindly refer sketch no. HPE/GC/04 for connection details of MIV inlet pipe with pen stock.



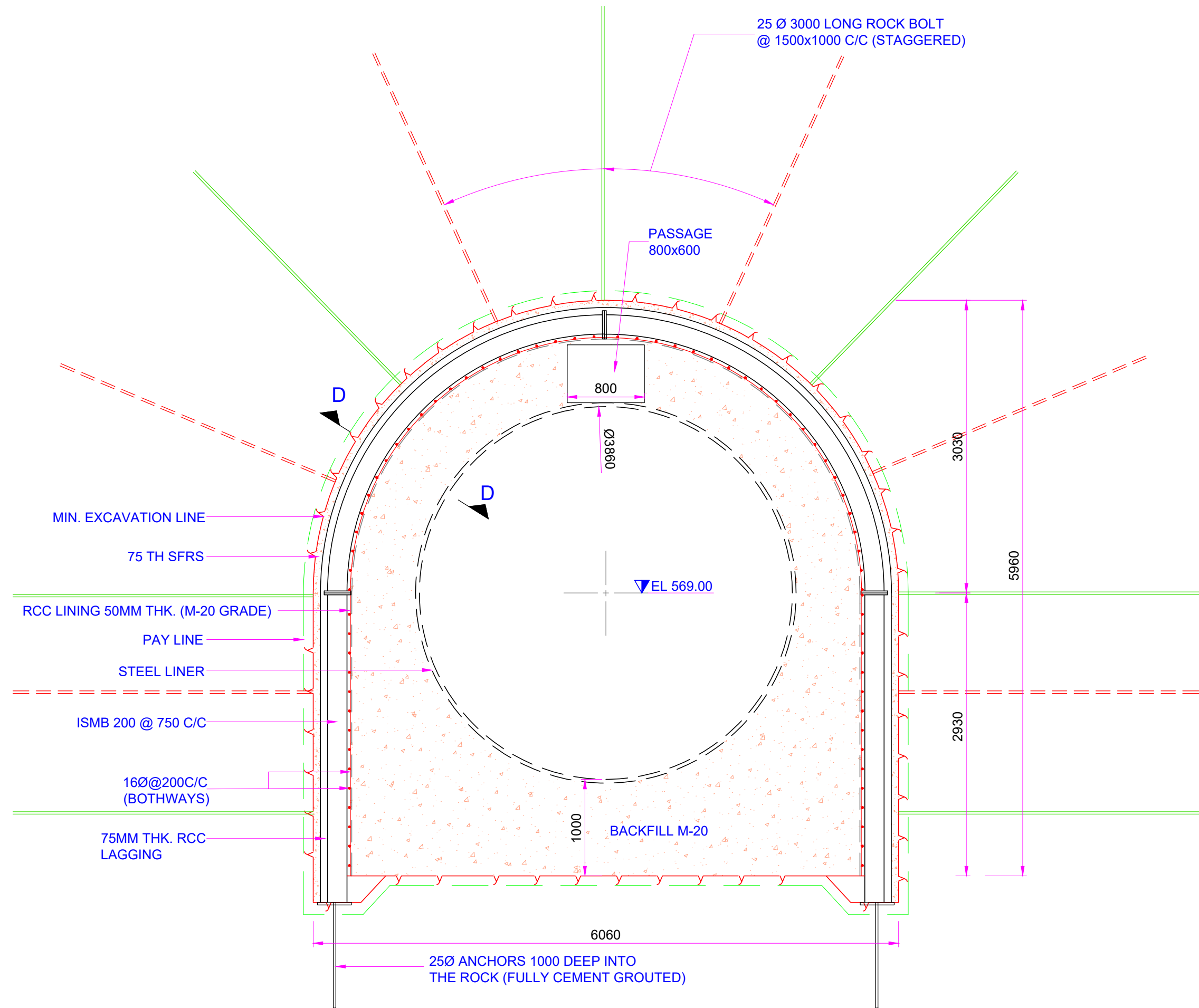
SECTION C-C



SECTION D-D



SECTION A-A



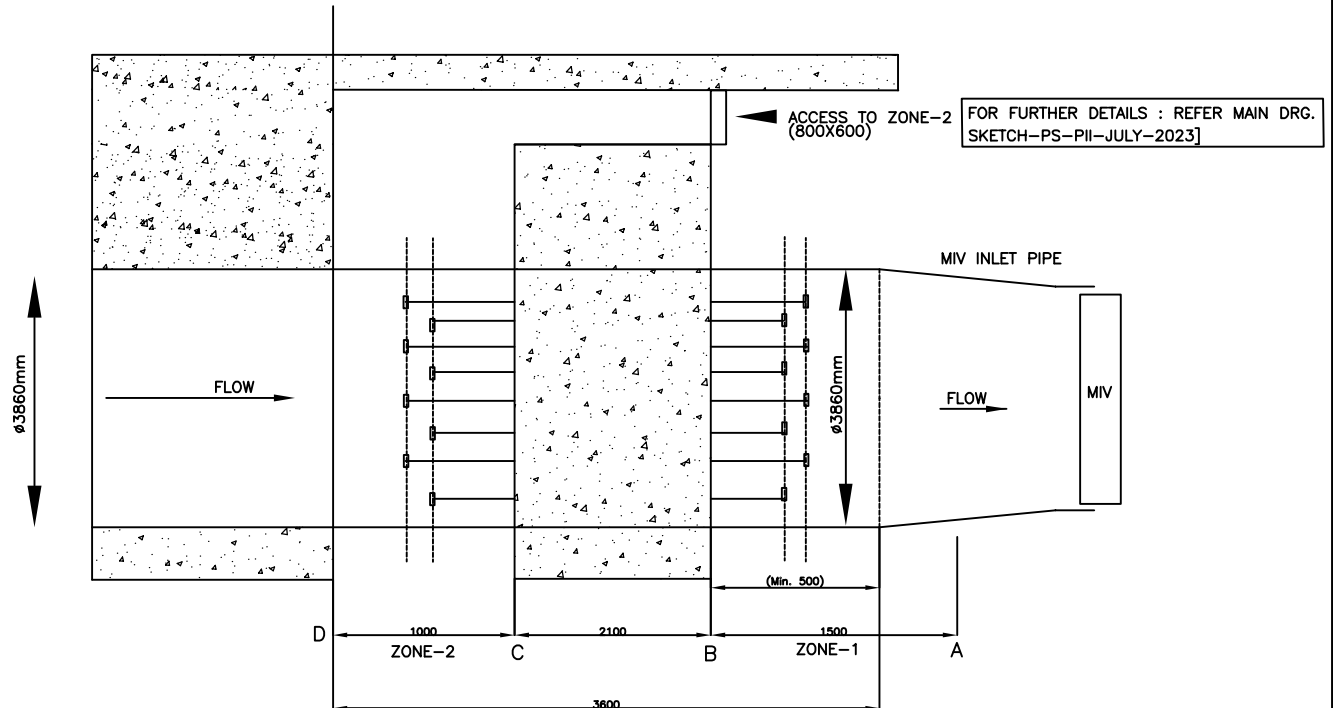
SECTION B-B

SKETCH SHOWING THE LINING OF PRESSURE SHAFT BEHIND D- LINE



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REV.	DATE	ALTERED	REV.	DATE	ALTERED	ADDITIONAL INFORMATION
		CHECKED			CHECKED	
		APPROVED			APPROVED	
						STATUS OF DRAWING
						DISTRIBUTION OF PRINTS



AD : TOTAL ZONE FOR INSTALLATION OF ULTRASONIC FLOW SENSORS  
 AB : ZONE-1 : 500 MM UN-CONCRETED STRAIGHT LENGTH  
 BC : CONCRETED LENGTH OF 2100 MM  
 CD : ZONE-2 : 1000 MM UN-CONCRETED STRAIGHT LENGTH

FOR FURTHER DETAILS : REFER MAIN DRG. DRG. SKETCH-PS-PII-JULY-2023]

REF. DRG. NO.

SIGN. & DATE




BHARAT HEAVY ELECTRICALS LTD.  
BHOPAL

NAME	SIGN	DATE	NO. OF VAR.
DRN GLD		25.04.23	
CKD VN		25.04.23	
APPD AP		25.04.23	

INVENTORY NO.

DEPT. HPE	UNTOL.DIMS. GR.	SCALE	WEIGHT(K.G.)	REF. TO ASSY. DRG.	ITEM NO.	NO. OF ITEM
CODE 415		NTS				
TITLE				DRAWING NO.	REV.	
PUNATSHANGCHHU-II HEP : ARRANGEMENT OF CONNECTION OF MIV INLET PIPE WITH PENSTOCK				HTE/GC/04	03	
				SHT. No. 01	NO. OF SHT.	

1777856/2023/HEP-HPE41500

SL. NO		COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT / ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS
1.		2.	3.	4.	5.	6.	7.	8.	1	2	10.
<div> <div> MANUFACTURER'S Logo MANUFACTURER'S Name and Address </div> <div> <b>SAMPLE QUALITY ASSURANCE PLAN</b>  Item : Ultrasonic Flow measurement system  SUB-System: Governing system  QP No. : 241534891-QAP  Rev.No. : 00  Date : 10.11.2023  page : 01 OF 01 </div> <div> Project : PUNATSANGCHHU-2 HEP  Indent No: 241534891 </div> <div>  </div> </div>											
<b>(A) ULTRASONIC FLOW MEASUREMENT SYSTEM (8 Path):</b>											
1.1	A) Flow Meter Console B) Insertion Type Sensing Feed Through Transducers	<ul style="list-style-type: none"> <li>CALIBRATION CERTIFICATE / FUNCTIONAL TEST CERTIFICATE</li> </ul>	Major	Performance	100%	Technical Specification, Approved Drawings & Approved Data Sheet	TC	P	R	TC	
1.2	ULTRASONIC FLOW MEASUREMENT SYSTEM	<ul style="list-style-type: none"> <li>PACKING &amp; IDENTIFICATOIN</li> </ul>	Major	Visual	100%	Technical Specification, Approved Drawings & Approved Data Sheet	TC / COC	P	R		
		<b>LEGEND:</b> 1: MANUFACTURER/SUB-SUPPLIER 2: BHEL/ NOMINATED INSPECTION AGENCY P: PERFORM W: WITNESS AND V: VERIFICATION R – REVIEW OF RECORD IR – INTERNAL RECORD JIR – JOINT INSPECTION REPORT									
QA-HYDRO		ENGINEERING- HPE									
(PREPARED & REVIEWED)							Accepted by (Vendor' QC representative)				

**NOTE : VENDOR HAS TO SUBMIT THE MANUFACTURER'S QUALITY ASSURANCE PLAN INLINE WITH BHEL SAMPLE QUALITY PLAN AFTER PLACEMENT OF PO FOR APPROVAL.**

## Project: - Punatsangchhu-II HEP


**P.I. No. 241534891**


### **Pre-Qualifying Criteria for 8-Path Insertion Type Ultrasonic Flow Measurement System**


1. Vendor (Trader/OEM/Authorized Dealer/Channel Partner) should have supplied, installed and commissioned 8-Path (or better) Ultrasonic Flow Meters (with wet type sensors) of offered make for a 'minimum pipe size of **1930 mm** or more' in Power Plant or sub-stations or Industrial Utility in **last 10 years** from the date of bid opening.

Vendor (Trader/OEM/Authorized Dealer/channel partner) has to submit a copy of unpriced PO/ Delivery Challan/ Invoice/ Commissioning report etc as a documentary evidence along with the offer as a proof of supplying, installation/commissioning of the instrument. Supportive documents for Clamp-on type Ultrasonic Flowmeters shall not be acceptable.

2. Vendor (Trader/OEM/Channel Partner) should be authorized dealer of offered make of the instrument and shall submit Authorization letter from OEM along with offer. It is not applicable for OEM.
3. The OEM of the instrument should have ISO certificate.

  
दलपत बोराणा / DALPAT BORANA  
प्रबंधक (अभियंता) / Manager (Design)  
एच.पी.ई. विभाग / H.P.E. Division  
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

  
विक्रम कुमार नामदेव / V.K. NAMDEO  
उप महाप्रबंधक / Dy. General Manager  
एच.पी.ई. विभाग / H.P.E. Division  
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

  
मनीष साह / MANISH SAH  
सि.उप महाप्रबंधक / Sr.Dy.General Mang.  
एच.पी.ई. विभाग / H.P.E. Division  
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

### **Annexure to Conflict of Interest:-**

A bidder shall not have conflict of interest with other bidders. Such conflict of interest can lead to anti-competitive practices to the detriment of Procuring Entity's interests. The bidder found to have a conflict of interest shall be disqualified. A bidder may be considered to have a conflict of interest with one or more parties in this bidding process, if:

- a) they have controlling partner (s) in common ; or
- b) they receive or have received any direct or indirect subsidy/ financial stake from any of them;  
or
- c) they have the same legal representative/agent for purposes of this bid; or
- d) they have relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the bid of another Bidder,  
or
- e) Bidder participates in more than one bid in this bidding process. Participation by a Bidder in more than one Bid will result in the disqualification of all bids in which the parties are involved. However, this does not limit the inclusion of the components/ sub-assembly/ Assemblies from one bidding manufacturer in more than one bid; or Page 1 o/2
- f) In cases of agents quoting in offshore procurements, on behalf of their principal manufacturers, one agent cannot represent two manufacturers or quote on their behalf in a particular tender enquiry. One manufacturer can also authorize only one agent/dealer. There can be only one bid from the following:
  - 1. The principal manufacturer directly or through one Indian agent on his behalf; and
  - 2. Indian/foreign agent on behalf of only one principal, or
- g) A Bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the contract that is the subject of the Bid, or
- h) In case of a holding company having more than one independently manufacturing units, or more than one unit having common business ownership/management, only one unit should quote. Similar restrictions would apply to closely related sister companies. Bidders must proactively declare such sister/ common business/ management units in same/ similar line of business. "

## **Make in India Certificate**

In line with Government Public Procurement (Preference to Make in India), Order 2017, P-45021/2/2017-PP (BE-II) dated 16.09.2020 and subsequent clarification No P-45021/102/2019-BE-II-Part(1) (E-50310) dated 04.03.2021, we hereby certify that we **M/s** \_\_\_\_\_, are local supplier meeting the requirement of minimum local content \_\_\_\_\_ (in %) as defined in above order for the material against **Enquiry No.** \_\_\_\_\_.

Details of location at which local value addition will be made is as follows:  
\_\_\_\_\_ (Place).

We also understand, false declarations will be in breach of the Code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules for which a bidder or its successors can be debarred for up to two years as per Rule 151 (iii) of the General Financial Rules along with such other actions as may be permissible under law.

The above declaration does not include services such as transportation, insurance, installation, commissioning, training and after sales service support like AMC/CMC etc as local value addition.

(Vendor's Seal & Sign)