

**VOLUME-2**  
**PART- I**  
**Section-14**  
**Drainage and**  
**Dewatering**  
**Systems**

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## 14. Drainage and Dewatering System

### 14.1 Scope of Work

The intent of these specifications is to define and cover the scope of work under this section which includes the provision of labour, tools, plants, materials and performance of work necessary for the design, manufacture, quality assurance, quality control, shop assembly, shop testing, delivery at site, site storage and preservation, installation, commissioning, performance testing, acceptance testing, training of Purchaser's personnel, handing over to Purchaser Limited and guarantee of equipment for drainage and dewatering system for Keyi H. E. Project, Arunachal Pradesh as per the specifications hereunder, each complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation.

It is not the intention to specify the minute details/smallest items to deliver a functional system or to define the standard manufacturing practice but to outline the performance, constructional, operational and guaranteed requirements. It is the responsibility of the contractor to ensure these requirements.

For details of the scheme, please refer attached schematic of Drainage and Dewatering system.

The design shall be such that the pumps for dewatering system can also be used for drainage of water in case of need and vice versa.

### 14.2 Scope of Supply

#### 14.2.1 Material

- Two (2) submersible pumps (1 main and 1 standby of continuous duty) of adequate capacity with starter panel, submersible cables and associated accessories for automatic operation of powerhouse drainage system
- Two (2) submersible pumps (1 main and 1 standby of continuous duty) of suitable capacity with starter panel, submersible cables and associated accessories for dewatering of the draft tubes. The dewatering sump shall be dry type.
- Necessary valves, piping, fittings, air scouring arrangement, all types of consumables and other materials.
- Necessary pressure gauges, pressure switches, flow sensing devices, flow meter, level controller etc.
- One (1) set chain pulley block of adequate capacity complete with all accessories to handle the pump of largest capacity
- Water sealed glands for pump riser pipes and level controller cables for dewatering sump
- drainage sump water level indicators
- Necessary pipings, valves and provisions for connecting dewatering sump with drainage sump for drainage purpose also.

- Necessary control panels.
- Coordination and provision of necessary contacts and/or ports for integration with plant SCADA system.
- Spare parts.
- Special Tools and instruments, if applicable

#### **14.2.2 Services**

- Transportation and delivery to site including all logistics and proper site storage and preservation as per manufacturer's recommendation.
- Site installation and commissioning
- Field / touch-up painting including all painting materials
- Performance and field acceptance testing as per the relevant clause of this section and submission of report
- Training of Purchaser's personnel including operation and maintenance staff
- All the technical documentation including preparation and submission of O & M manuals

### **14.3 Specific Parameters and Layout Conditions**

#### **14.3.1 Dewatering System**

The unit dewatering system is provided to dewater the unit waterway and keep it in dry condition for inspection and maintenance of turbine, spiral case and draft tube water way. The system will ensure dewatering the whole waterway of each unit, comprising: water remaining in spiral case, and turbine draft tube, leakage water from gates within no more than Six (06) hours;

The 2 nos. submersible pumps along with pipes, valves are proposed for the dewatering purpose.

Dewatering sequence for removing the water for any maintenance work will be as under:

When one unit needs to be dewatered and other unit is running at full load:

- Stop the unit. Guide vane, Main inlet valve & MIV by-pass shall be in close condition.
- Open spiral dewatering valve provided in pipeline.
- Close downstream gate at the end of draft tube of that unit.
- Lower the portable pump in the opening for dewatering pump at tailrace.
- Water will be pumped out to the tailrace through pump and flexible hose beyond the draft tube gates above the max. Tail water level.

When all units need to be dewatered:

- Stop the units.
- Close Intake gate on Penstock.

- Dewater through the machine until water level in the penstock reaches the tail water level.
- Close downstream gates at the end of draft tube.
- Close guide vanes and open penstock dewatering valve provided.
- Water will be pumped out to the tailrace through pump and flexible hose beyond the draft tube gates above the max. Tail water level.

Necessary interconnecting pipes with valve with the drainage sump shall be provided so that the dewatering pumps can also be used for drainage purposes in case of emergency.

#### 14.3.2 Drainage System

The powerhouse drainage system shall be designed to take care of normal drainage / leakage /seepage in powerhouse to avoid any potentially disastrous effects. For this purpose all seepage and leakage water from different floors of the power house shall be channelized into power house drainage sump.

The drainage sump shall have continuous duty submersible pumps with level switches for auto starting and stopping of pumps. Two submersible pumps installed in drainage sump shall discharge water into one common header and shall finally discharge through an outlet line into tailrace above maximum flood level or as per actual requirement.

#### 14.4 Rating and Functional Characteristics

##### 14.4.1 Drainage and Dewatering System

The total pumping and sump capacity of the drainage system shall be designed to handle the seepage & leakage for the entire power house using one pump only with second pump remaining as standby.

All the pumps shall be submersible type having minimum discharge capacity at a dynamic head. The Contractor shall do necessary calculations proving the adequacy of the selected pump- motor rating. The pumps shall be suitable for continuous operation, capable of pumping water with heavy silt, directly driven by electric motor rotational speed of which shall preferably be not more than 1450/1500 rpm.

| S. no. | Description                                       | Nos. of Pumps | Rating of each pump |  |
|--------|---|---------------|---------------------|--|
|        |   |               | LPM (min.)          | Indicative Discharge head including losses |
| 1      | Submersible pump for power house drainage system, | 2             | 1500                | as per requirement                         |
| 2      | Submersible pumps for dewatering system           | 2             | 1500                | as per requirement                         |

## 14.5 Performance Guarantee

The drainage and dewatering system along with all auxiliaries and accessories shall be capable of performing intended duties under specified conditions. The Contractor shall guarantee the reliability and performance of the individual equipment as well as of the complete system.

## 14.6 Design and Construction

### 14.6.1 Standards

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

| Standards | Description   |
|-----------|---|
| IS 4721   | Code of Practice for Drainage and Dewatering of Surface/Underground Hydroelectric Power Station |

### 14.6.2 Pumps

The drainage and dewatering pumps shall be of submersible type with motors of continuous duty.

The pump impeller and casing shall be of stainless steel and cast iron respectively. The material for shaft and fasteners shall be stainless steel. The pump impeller shall be properly balanced along with other rotating parts on proper balancing equipment to prevent vibration.

Pumps shall be complete with continuous duty electric motors with class F insulation, starter for auto operation for drainage system, power cable, discharge piping and hardware, anchor bolts and other mounting materials. The pumps shall be suitable for 415 V  $\pm$  10%, 50 Hz  $\pm$  5% with contacts for remote operation / indication.

The bearing shall be anti-frictional ball bearing and permanently grease lubricated type. The thrust bearing shall be designed to carry all the thrust and shock load that could be imposed by the pump. Seals of suitable design shall be provided to prevent water from entering into the motor.

Flow meters with suitable nos. of potential free contacts for remote indication, alarm and start blocking shall be provided for each pump for drainage system. Shut-off valves and check valves shall be provided to allow disconnection and switching of each pump without emptying pipes. Each pump shall be provided with pressure gauge with isolating valve in the discharge side. The pumps shall be provided with arrangement to prevent reverse rotation.

For maintenance, the pumps shall be provided with lifting lugs. The bidder shall also include Chain Pulley Block of adequate capacity complete with monorail to handle the Pump/Motor Sets to be installed.

### 14.6.3 Valves, Piping and Floor drains

All required pipes, valves, flanges, fittings, supports, fasteners, and related material shall be supplied as part of this contract. All embedded and exposed piping shall be of medium -duty class. Minimum pipe wall thickness shall be as per relevant standards. Various control and check valves shall be of cast steel of pressure class 12 kg/cm<sup>2</sup>. The valves shall be of modern sleek design with minimum space requirement for installation & easily operable type. The piping shall be ERW type of carbon steel of medium duty type.

The contractor shall do necessary coordination and shall make detailed layout drawings for routing of the pipes etc. and submit the same for approval of the Engineer during detailed engineering. Silent type check valves shall be used in pump discharge lines.

The velocity in the pipe shall not exceed 2.5 m/s and 3 m/s at suction & delivery side respectively.

All required pipes, valves, flanges, fittings, supports, fasteners, and related material shall be supplied as part of this contract.

Valve body of all type of valves shall be preferably of cast steel except smaller valves (50 mm and lower).

### 14.6.4 Switchgear and Control

The switchgear and controls shall be mounted in metal enclosed cubicles and shall be suitable for automatic and manual operation of the pumps. Manual control of the pumps motors shall be provided from local control panel. It shall be possible to select any of the pumps as "Main" and other as "Standby" at any time.

The switchgear and controls shall comprise of moulded case circuit breakers (MCCB), suitable motor starters, auxiliary relays, thermal and overload protection, single phase prevention devices, selector switches, push buttons, meters, status indicating lamps etc.

The switchgear and control panels shall be installed at machine hall or higher floors

Facility for selection of control either from Local Control Cubicle or Local Control Board or plant SCADA system shall be provided in the Local Equipment Panel or Local Control Board.

The Contractor shall make provision of contacts and/or ports in local control cubicles for interfacing with SCADA system for control and monitoring.

The Contractor shall provide and install all the sensors and operating devices necessary to fulfil the functional requirement of the specification for control system.

All drainage pumps shall be automatically controlled based on the sump level sensed by adequate level control switch and instrumentation.

The local control cubicles for drainage and dewatering systems shall be installed at machine hall or higher floor level.

Following local controls, but not limited to, shall be provided for each drainage and dewatering pump:

- Selector switch to assign any of the pumps as main and other as standby

- Manual/Automatic switch for manual/automatic operation of each pump,
- Remote/ local selector switch for each pump,
- Start/stop push buttons for each pump,
- Automatic start and stop of pumps on the basis of high and low water level in the sump,
- Lamp test push buttons,

#### **14.6.4.1 Indication & Alarms**

The Contractor shall supply suitable instruments and gauges for achieving desired control logic. Indicating instruments as required shall be installed on local control panel and indications may be replicated in Local Control Board/ control room for common services.

Following indications & alarms, but not limited to, shall be provided for each drainage and dewatering water pump:

- Pump running/stop/trip for each pump,
- “No flow” for each pump,
- Very high and very low water level (sump) alarms
- Other indications, if any.

#### **14.6.4.2 Protection**

The motor for each pumping unit shall be provided with at least the following device:

- Overload protection,
- Under voltage protection,
- Single phasing protection,

### **14.7 Drawings, Documents and Design Calculations**

#### **14.7.1 Design memorandum**

The Contractor shall submit to Purchaser a design memorandum prepared in accordance to “Section 1- General Technical Specification (GTS)” of the proposed equipment /system fulfilling the contract specification/requirement for approval prior to submission of drawings and documents. The design memorandum shall include the design philosophy, methodology, system description, input parameters for design, standards and codes, design & selection criteria, equipment data, material specification, major technical features, basic arrangement / layout etc.

#### **14.7.2 Drawings and documents**

The Contractor shall submit all the drawings and documents in accordance with requirements stipulated in “Technical Documents” of “General Technical Specification (GTS)”.

These drawings and documents shall include at least the following:



- Schematic drawing of Penstock Scroll case Dewatering System
- Schematic drawing of Drainage System of Powerhouse
- Installation details of Pumps in sumps
- Piping layout drawing of drainage & dewatering systems
- Electrical control schematics for Drainage & Dewatering system
- Material specifications of drainage and dewatering equipment
- Literature and illustrative details of various equipment used in the drainage and dewatering systems
- Pump operating characteristics for discharge vs head
- Efficiency characteristics for pumps
- Dimensional details of pumps and other equipment used in the system

#### 14.7.3 Design calculation

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

- Calculation for selection of pump motor rating for drainage & dewatering system
- Calculations for head loss in various systems
- Calculations for fixation of Dynamic heads for pumps
- Any other calculations required during detailed engineering

#### 14.8 Delivery, Installation and Commissioning

The Contractor shall follow the requirements of Delivery, Installation and commissioning elaborated in clause 1.7 “Delivery, Installation and commissioning” of “General Technical Specification.”

#### 14.9 Spare Parts

The spare parts shall be as per the list below for supply.

| Sl. No. | Description                    | Quantity         |
|---------|--------------------------------|------------------|
| 1.      | Valve of each type used        | 1 nos. each type |
| 2.      | Pump impeller each type used   | 1 nos. each type |
| 3.      | Pump shaft seal of each type   | 2 sets           |
| 4.      | Rings and gaskets of each type | 2 sets           |
| 5.      | Pressure gauge each type used  | 2 set            |

**14.10 Special Tools**

The Contractor shall propose the list of recommended special tools (other than those included under "Tools and Appliances" above) including their make and detailed specification as recommended by manufacturer(s) and to be accepted by the Purchaser.

**14.11 Quality Assurance and Testing**

The bidder shall submit the quality assurance plan along with bid for approval of the purchaser. The Contractor shall follow the quality assurance and testing requirements as per quality assurance plan approved by the purchaser.

**14.12 Guaranteed and Technical Particulars**

Guaranteed and Technical Particulars as called for in Vol. VI shall be furnished along with the bid. Bids lacking in this may be considered unresponsive. Particulars subject to guarantees shall be clearly marked.

**14.13 Completeness of Equipment**

All fittings and accessories of the Drainage and Dewatering equipment and associated auxiliary and ancillary equipment that may not have been specifically mentioned in these specifications but are usually necessary for completion of above equipment, shall be deemed to be covered by the specification and shall be indicated and furnished by the contractor without any extra charges to the purchaser.

**14.14 Deviation from Specifications**

While the purchaser does not bind himself to accept any deviation, due consideration will be given to any special devices or equipment put forward by the supplier with a view to increase the efficiency of the equipment and minimize the maintenance cost of the equipment as a whole.

Should the supplier wish to depart from these specifications, he shall submit a complete and itemized list of such deviations, together with full particulars of the reasons for the deviations in a separate schedule with special reference to clause and paragraph nos. of this specification. Unless this is done and also the purchaser's concurrence in respect of such deviations is obtained in writing, the equipment offered shall be deemed to comply in every respect with these specifications.