

# DAMODAR VALLEY CORPORATION

TECHNICAL SPECIFICATION FOR RENOVATION & MODERNISATION OF MAITHON HYDEL STATION UNIT # 1 & 3 (20 MW)

> VOLUME - II (MECHANICAL & CIVIL)

> > PREPARED BY



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# **VOLUME – II:**

## **TECHNICAL SPECIFICATION**

(MECHANICAL & CIVIL)



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



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**SECTION "A":** 

**TECHNICAL SPECIFICATION** 

(MECHANICAL)



CHAPTER NO - 01





#### 01.0 PREAMBLE

#### Maithon Hydel Power Station.

Maithon Hydel Station (MHS) of the Damodar Valley Corporation (DVC) is the third of the three multi-purpose projects taken up in the first phase of development. It is located on the river Barakar about 12.9 km above its confluence with the Damodar river near the border of Dhanbad & West Burdwan districts of the states of Jharkhand & West Bengal respectively. The unique feature of this is that it is located underground at the depth of 184 ft below the road way at the top of the dam in the left bank of the river and is the first of its kind in India. Earlier, the power station has a total generating capacity of 60 MW with three (3) units of 20 MW each. Later on DVC renovated and up-rated unit # 2 to 23.2 MW capacity in the year 2002-2006. Unit # 1, Unit # 2 and Unit # 3 were commissioned in the year October 1957, May 1958 and December 1958 respectively.

As Unit # 1 & 3 of Maithon Hydel Station has outlived its service life and failing frequently, Damodar Valley Corporation (DVC) decided to renovate and modernized Unit # 1& 3.

The Technical Specification (**Volume-II, III & IV**) shall be read in conjunction with the Commercial Specification (**Volume-I)** of Tender Document. **Volume-II** of Technical Specification deals with the Technical Specification for Mechanical and Civil works including dismantling of Turbine, Generator, electrics and all equipment, Renovation of embedded parts, Supply, erection, testing commissioning and demonstration of Performance Guarantee of Turbine generator, Excitation System, other auxiliaries whereas as **Volume-III** deals with Technical Specification for Generator & Electrical and Control & Instrumentation for Turnkey Installation of Unit # 1 & 3 of Maithon Hydel Station of DVC in District West Burdaman, West Bengal, India. All the available drawings are enclosed in **Volume IV** of the specification.

#### 01.01 Location details

Maihon Hydel Station is underground power house located on the river Barakar in the border of Dhanbad and West Burdaman districts of Jharkhand and West Bengal respectively. 24 km from Asansol, 45 km from Dhanbad Nearest Railway stations are at Kumardhubi, Barakar (small station) Asansol and Dhanbad

Longitude : 86°81' E Latitude : 23°78' N

# INTENT OF SPECIFICATION

CHAPTER NO - 02



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



## 02.0 INTENT OF SPECIFICATION

This specification is intended to carry out scope of work & services and technical requirements for renovation and modernization works of Unit # 1 & 3 by bidder. Detailed design, engineering, manufacturing, inspection and testing at bidder's works, packing for dispatch / shipment, freight and insurance, port handling including custom clearance, if any, transportation to site, storing at site, complete erection of all the components to be replaced, start-up, commissioning, performance guarantee testing and handing over of Unit # 1 & 3 of Maithon Hydel Station, Damodar Valley Corporation (DVC). Bidder shall study the specification and satisfy him/herself regarding the workability of the proposed system and shall take full responsibility for the design and engineering of the system & equipment, quality of material, workmanship, guaranteed operation and smooth performance of the system & equipment.

If bidder wishes for clarification from this specification, the same shall be clearly brought out with justification in the format provided. However, reduction / change in scope will not be entertained

# SPECIAL INSTRUCTIONS TO TENDERERS

CHAPTER NO - 03





#### 03.0 SPECIAL INSTRUCTIONS TO BIDDERS

This part of the specification describes the general technical rules to be followed while carrying out the work of Unit # 1 & 3 with installation of new Turbine Generator including auxiliaries of Maithon Hydel Station.

All such items, even though not specifically mentioned in this Tender specification (TS), but considered necessary for safe & satisfactory operation and guaranteed performance of the offered system & equipment, shall be considered included in the offer.

Bidder shall visit and carefully examine the site and surroundings to satisfy himself about the nature and condition of all existing facilities, general site condition, etc. and all other matters affecting the works for executing this contract, before quoting against this specification.

As the Units are 65 years old, only limited numbers of drawings are available with DVC. Bidder has to visit site to collect available drawings and bidder should satisfy himself for caring out R&M job with available inputs.

Reverse Engineering to be done by bidders where the drawings are not available as per requirement.

Owner will provide all cooperation to the representative of bidder in obtaining required information during the visit to site. Condition of the plant, equipment and system shall be carefully assessed by the bidder for assessing scope of work. Information on the plant and system given in this specification, Sub-Section of the specification shall not be construed in any manner whatsoever, so as to limit the scope of work by the bidder for achieving the Turbine generator performance.

Claim and objection due to ignorance of site condition/non receipt of information shall not be considered after submission of offer.

All equipment, system and works covered under this specification shall comply with all latest regulations and safety codes as applicable at Maithon Hydel Station, West Bengal, India. All systems and equipment shall comply in all respects with the requirements of the latest editions of the related IS, IEC, IEEE, VDE, DIN, JIS or any other approved international codes and standards. The electrical equipment shall also conform to the latest Indian Electricity rules, Electricity Act as well as Jharkhand Government rules.

Other standards are acceptable if they are established to be approved equal or superior to the listed standards subject to approval by the Purchaser. Bidder shall provide English



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version of the codes and standards as applicable.

Proposals not meeting the above stipulations of the codes and standards may not be acceptable.

Bidder shall study the quality of water at site for suitable design of submerged components of the turbine and material shall be so selected that cavitations and corrosion are minimised. However preliminary water analysis indicated in the Tender document (chap. 06)

Special instructions indicated in Volume - I are complimentary to the above mentioned instructions and bidder to consider all instructions as a whole.

# **GENERAL TECHNICAL RULES**

CHAPTER NO - 04



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



#### 04.00 GENERAL TECHNICAL RULES:

#### 04.01 Introduction

This part of the specification describes the general technical rules to be followed while carrying out the work of Unit # 1 & 3 with installation of new Turbine Generator of Maithon Hydel Station. The technical requirement for electrical and instrumentation works are described in Volume - III of the Tender Specification.

The purpose of this 'General Technical Rules' is to provide the bidder with certain general information on the location and conditions existing at site and to lay down common guidelines and specifications which Bidder shall follow in designing the plant and execution of work. Adherence to the 'General Technical Rules' shall, however, not relieve bidder of his responsibility regarding type, quality of materials, workmanship and requirement as specified by the Purchaser/Consultant under 'Technical Specifications' 'Invitation to Tender'.

Bidder shall satisfy himself regarding the site conditions and other relevant matters by visiting site. It is desirable, for compelling reasons, to deviate from these instructions; bidder is required to obtain prior approval from the Purchaser/Consultant.

All equipment to be supplied and/or engineering services and technical services to be rendered shall be manufactured/executed in accordance with the best trade/ engineering practices judged by the established standards and as given in the Technical Specification. Wherever the codes are not mentioned, the best international standards to be approved by the Purchaser/Consultant shall be followed.

Any supplies and services which might have not been specifically mentioned in the Technical Specification, but are necessary for efficient and smooth operation and maintenance of the work under Indian conditions, unless expressly excluded from the scope of supplies and services shall be supplied/provided by Bidder without any extra cost to the Purchaser/Consultant.





#### 04.02 Plant and Equipment

#### a. General

The selection, design and manufacture/fabrication of plant and equipment shall be suitable for the intended service and duty conditions and ensure maximum interchangeability of components and least maintenance. The units shall be complete in all respect.

All the equipment, technological structures, pipes, valves, fittings, etc shall be subjected to inspection and testing as per accepted national or international standards and practices. All the components shall be subjected to inspection and testing as per standard practices of the manufacturer prior to offering them for inspection by the Purchaser/Consultant/his authorized representative.

All equipment shall be complete with approved safety devices, wherever a potential hazard to personnel and/ or equipment exists. There shall be adequate provision for safe access of personnel to and around the equipment for operational and maintenance functions.

All equipment shall be complete in all respect including all accessories essential for proper installation, operation and maintenance irrespective of whether such items are specifically mentioned in the specifications or not.

All working parts shall be arranged for convenience of operation, inspection, lubrication and ease of repair and replacement of parts and sub-assemblies with minimum downtime.

Suitable working platforms, walkways, hand railing, cross over, ladders, lifting tackle and tools required for the above shall be provided.

The fabrication and assembly areas shall be kept clean and free from contamination. During assembly of major components, a polythene covering shall be maintained in position to prevent ingress of dirt, grease, etc from overhead cranes or other equipment.

During fabrication, equipment, pipes, etc shall be kept sealed to the extent possible to avoid entry of foreign matter and contamination by dirt.

Piping shall be degreased after fabrication and maintained sealed until the end is presented for welding or jointing.





All equipment will be visually inspected in the presence of an inspector immediately before closure. A system of physical identification and accountability will be used to account for all tools, test equipment, shipping blanks and other items used during assembly to obviate the possibility of their being left inside vessels or equipment.

On completion of manufacture, each pressure vessel shall be pressure tested at room temperature at site/ manufacturing works in accordance with the appropriate code. On completion of construction/erection at site, the entire assembly shall be leak tested as above.

## b. Design Considerations

Life of the Electro-mechanical generating equipment i.e., turbine, generator, transformers, auxiliaries, etc. shall not be less than forty (40) years

Unit shall be designed for unconstrained operation over maximum net head and minimum net head and full range of ambient and other environmental conditions.

The turbine settings shall be as available and indicated in Chapter-6 of this Volume.

Speed rise, pressure rise, run away speed shall be governed by the limits specified in relevant IS.

Chemical analysis of water and data including the petro graphic analysis shall be taken into consideration while designing the turbine and other auxiliary equipment susceptible to abrasive effects of silt. Suitable materials, protective coatings and painting shall be provided to resist silt abrasion as per site conditions.

The operation of the Unit shall be smooth and quiet. The noise level shall not be more than 90 dBA at a distance of one (1) metre from any equipment.

## c. Layout Considerations

Layout of equipment shall be developed considering the proper utilisation of space and functional requirements. The equipment layout shall be compact so as to economise use of materials.





#### d. Operating Capability of the Generating Unit

Unit shall be capable of giving the rated output continuously as specified by the manufacturer at the rated design head and rated discharge and shall be capable of operating between the minimum and maximum head specified in this specification (Vol-II) and ambient temperature at site specified.

The maximum continuous over load capacity of the unit at the generator terminals during the high head conditions or high discharge conditions or both as guaranteed by the manufacturer shall be based on the hydraulic parameter of the station

Unit and associated auxiliaries shall be suitable for continuous operation without any restriction within a frequency range of -5% to +3% (47.5Hz to 51.5 Hz). All the equipment driven by the electric motors shall give their rated performance even at a power supply frequency of 47.5 Hz.

Provision shall be made for starting the Unit in auto mode upto synchronisation by a single command and loading of the unit to full load quickly. The design of the equipment and control system shall permit participation of the unit in auto frequency control mode.

The Unit and all its associated auxiliaries shall be designed for trouble free operation up to maximum rating of the unit for complete range of operation for active power and reactive power output

The redundancy in the Unit auxiliaries and station equipment shall be provided so that the generating unit continue to operate even in the event of outage of a part of the auxiliary system.

#### 04.03 Manufacturing and fabrication

#### a. General

All forgings, castings and structural materials shall conform to the relevant BIS/International standards/ equivalent ASTM/EN/DIN.

Special non-ferrous materials required for manufacturing parts subject to heavy pressure, severe working conditions, and/or requiring high tensile strength, toughness and resistance





to corrosion shall be used.

Bronze used for manufacturing parts such as bearings, shall preferably be forged or centrifugally cast.

#### b. Working Stresses

For rotating parts the unit stresses due to run away speed of turbine shall not exceed two third of the yield strength of the material of construction.

Stresses for other materials will be as per OEM standard conforming to relevant standard shall also be acceptable

#### 04.03.01 Bearings

All parts subject to reciprocal motion and rubbing against other parts shall be provided with bronze or other suitable liners to minimise wear. The liners shall conform to IS;318 or as detailed against the particular equipment capable of being adjusted to compensate for wear. All rotating parts supported on frames shall have proper bearings depending upon speed, torque, load condition, etc.

#### 04.03.02 Machine frames and bases

All machine bases shall be designed for maximum strength and rigidity consistent with good design.

Base plates shall be of welded steel construction. Those shall be designed with sufficient depth and stiffness to ensure rigidity of assembly.

If bases are made of two or more parts to make up height, locating pins shall be provided. Machined bolts shall be used in drilled and reamed holes for connecting the parts.

The machine frames shall have suitable eye bolts or hooks in requisite numbers for lifting purposes during erection and maintenance.

#### 04.03.03 Nuts, Bolts, Studs and Washers

Machining and manufacturing of all the nuts, bolts, studs and washers shall conform to International Standards.



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Nuts and bolts for pressure parts shall be of the best quality steel. Nuts, bolts and studs shall be of materials most suitable for the service operating conditions and designed to ensure the stresses arising in normal operation. For bolts used in critical areas the bidder shall provide the following details:

- i) Allowable elongation
- ii) Recommended torque

Fitted bolts shall be a close fit in the reamed holes they occupy, and shall be marked in a conspicuous position to ensure correct assembly.

The threaded portion of any bolt or stud shall not project more than 1.5 threads above the surface of its mating nut.

Where practicable the use of slotted head screws shall be avoided in machinery component assemblies, hexagon socketed screws being preferred.

## 04.03.03 Steel Forging

The bidder shall supply a list of all important forgings and draw up material specification for each one. Copies of this list and specifications shall be supplied to the Purchaser/Consultant for his use. In each case the quality and inspection requirements shall be clearly stated.

Whenever possible steel forgings shall be in accordance with the requirements of IS/ International Standards. Forgings shall be free from cracks externally or internally, extensive non-metallic inclusions and surface defects. Bidder shall carry out nondestructive testing of forgings during machining to verify that no unacceptable defects are present.

Repairs by welding or other means shall not be undertaken on forgings at any stage of the production cycle.

Each forging shall be suitably branded with an identification number which shall be transferred throughout all final machining stages. The identification number shall be marked on all documents and test certificates relative to the forging.



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#### 04.04. Castings

#### a. General

All castings shall be homogeneous, free of shrinkage, undersizing, porosity or voids. Welding, filling, interlocking or plugging of defective parts shall be done with the approval of Purchaser/Consultant in writing. All repairs shall be subjected to non- destructive examination after heat treatment.

#### b. Steel Castings

The Bidder shall prepare material purchasing specifications for all important castings. Each document shall indicate fully the quality and inspection requirements for the component casting covered. Copies of the Specification shall be issued to Purchaser/Consultant for his use.

Castings may be repaired by welding provided written approval of the Purchaser/Consultant is obtained in advance. The Bidder shall submit drawings, sketches or photographs showing the location and principal dimensions of the defects together with the proposed weld repair procedure.

Only welders who have passed an appropriate qualification test shall be employed on the repair of castings. All repairs shall be carried out by the metal arc process.

Ultrasonic inspection shall be applied to all important castings to locate the extent of subsurface defects and to check the wall thickness.

All castings shall be identified by stamped, or cast-on reference marks which shall be entered on all relevant documents and test certificates.

The Purchaser/Consultant may require that certain castings shall be examined using radiographic inspection to locate the extent of sub- surface defects and to check the wall thickness.

#### c. Cast Iron Castings

Cast iron shall not be used for any part of equipment which is in tension or which is subjected to impact.



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#### d. Aluminium Bronze Castings

The Bidder shall prepare material purchasing specifications for all important aluminium bronze castings. Each document shall indicate fully the quality and inspection requirements for the component casting covered. Copies of the Specification shall be issued to the Purchaser/Consultant for his use. The inspection and quality requirements shall include an analysis of each cast, mechanical testing of test bars from each cast, pressure testing, penetrant flaw detection and radiographic examination of selected critical areas.

#### 04.05 Hydraulic system

Hydraulic systems required for various units referred herein generally cover the following: Hydraulic fluid reservoir, pumps of various kinds, valves, accumulators, Hydraulic cylinders, oil coolers, Hydraulic motors, various accessories such as filter, strainers, hydraulic pipe work, fittings, flexible hose supporter for equipment, sealing devices, instruments for indicating, recording and integration of various parameters such as pressure, temperature, velocity etc., control devices for manual and automatic operation of the system, safety devices and alarms for abnormal operating condition, interlocks for sequencing and safe operation.

Hydraulic fluids shall be used on the basis of proven performance, operating condition, operating costs and easy availability.

The Hydraulic power system shall be suitable in every way for the service intended and shall be oriented forwards maximum interchangeability of component and minimising maintenance.

Hydraulic systems shall have filters at various points with adequate capacity and necessary filtration rating so as to keep the hydraulic fluid within permissible limits of contamination to achieve maximum life of the components.

Each hydraulic circuit shall be designed to minimise surge pressures, etc.

The hydraulic system shall be designed taking into account the maximum pressure encountered. Also one must ensure while designing the system the components of hydraulic systems are compatible with the hydraulic fluid selected at operating condition in the plant and under atmospheric conditions prevalent at Maithon Hydel Station. First fill of the hydraulic shall be in tender scope. The hydraulic units will be of standard make.OEM must has sufficient experience with the hydraulic unit manufacturer.



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#### 04.06 Lubrication

Bidder shall provide for proper lubrication systems for all moving parts of the equipment supplied.

All oil lubrication systems shall preferably be of circulating type complete with oil reservoir, pumps with motors, filter pressure vessels, pressure regulators, heat exchangers, oil heater, temperature controllers etc., flow switches, level switches, pressure gauges, pressure switches, temperature gauges, oil flow indicators, etc. The oil tanks shall have adequate capacity so as the return oil de-aerates, gives away heat picked up from lubricating points before again being pumped.

Wherever there is chance of water ingress into the oil lubrication system, the provision for water detection/removal shall be provided.

The selection/design and construction shall be suitable in every way for the service intended and shall be oriented towards maximising interchange- ability of components and minimising maintenance.

#### 04.07 Optimisation of Indian supplies & services

The Bidder shall make all efforts to optimise the supplies and services from Indian sources and shall, however, ensure that the performance of the plant and equipment are achieved as envisaged in the Technical Specification.

#### 04.08 Pumps

Centrifugal pumps shall be provided unless technical or strong economic reasons dictate that a positive displacement, either rotary or reciprocating is more appropriate.

#### 04.09 Valves

#### a. General

All valves shall be suitable for the service conditions under which they are required to operate. The design, construction and choice of material shall take into account all operational requirements.



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Complete valve schedule for each pipe work system shall be provided during the detailed engineering stage.

Parallel slide, butterfly or gate valves may be used for air, water services, and sluice valves for low head applications.

Any valve which is designed for uni-directional flow shall have an arrow embossed or cast on the valve body clearly indicating the required flow direction. All the valves provided with hand wheel/lever shall be clearly marked with "OPEN" and "CLOSED" positions and an arrow to indicate the direction of opening/closing.

Gate, globe, butterfly and non-return valves shall be provided with bypass arrangement as per applicable standards. Bypass arrangement may be integral with the valve or connected between pipes.

All valves, unless otherwise approved or specified, shall be of the external rising spindle type. Where desirable to protect the spindle against ingress of dirt, or where the position of the valve may create a hazard to operators when the spindle is extended, suitable spindle covers shall be provided. The spindles and operating gear of all valves for use outdoors shall have weather and dust proof protection.

Special attention shall be given to the operating mechanism and correct lubrication of all valves to ensure a minimum of maintenance and ease of operation.

All valves shall be positioned so as to be readily accessible for operation and maintenance from permanent floors, galleries or access platforms.

Eye bolts or similar facilities shall be provided, where necessary, to facilitate the handling of heavy values or components.

When valves are required to be locked in position for operation they shall be provided with a chain, padlock with three keys or other secure locking device.

All valves shall be provided with labels or name plates.

Materials of gate valve : Gate Valve shall be Body : for size 50 NB shall be stainless steel /Gun metal and above shall be cast carbon steel."

Within two (2) months of award of Contract, a valve numbering scheme to cover the complete Contract Works will be agreed. After approval of the numbering scheme, the bidder will draw up a valve schedule to cover the Contract Works. The scheduled details of



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each valve will include the valve number, its title as it appears on the valve label, the nominal size of the valve, its design pressure and temperature, the Manufacturer's name and model number and a brief description of the valve material. The valve schedule will be subject to the Purchaser/Consultant's approval.

## b. Butterfly Valves for Auxiliaries.

Constructional features, materials of construction of various components and testing of butterfly valves shall conform to IS13095: 1984 (1990) or reputed International Standards like BS EN 593: 1998 or ANSI/AWWA C504.

Butterfly valves to be installed on delivery lines of pumps and on headers shall be tight shut-off valves and regulating valves respectively as per BS EN 593: 1998.

The valve must be capable of positive shut-off in both directions against full system pressure. Unless an alternative type is proposed by the Bidder and approved by the Purchaser/Consultant as being fully suitable for the particular duty, the seating of the disc will be positive (that is, the disc must not be capable of passing through the shut position); a stop fitted on the actuator/ operating lever is not adequate for this purpose.

Internal shaft bearings must be capable of opening dry, that is, not dependent on the presence fluid.

Each valves body will be of best quality cast steel conforming to approved standards with a closure seating of bronze or stainless steel, or resilient seal material. The valve disc will be of high quality cast steel with seat facing or bronze or stainless steel which may also include the resilient seal material. Shaft bearings will preferably be of self-lubricating type, with "0"ring seals.

The actual position of the valve disc will be clearly shown by an external indicator.

The shaft shall be of stainless steel to AISI 410 and shall consist of a one-piece unit extending completely through the valve disc.

Valve seats shall be designed to provide tight shut-off in both directions. Valve seats shall be of nitrile rubber.

Valves shall be fitted with sleeve type bearings contained in the hubs of the valve body. Valves shall be equipped with thrust bearings which shall hold the valve disc securely in the centre of the valve seat. Sleeve and other bearings fitted into the valve body shall be of self-lubricated materials that do not have a harmful effect on water or rubber.



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The valve must be capable of positive shut-off in both directions against full system pressure. Shaft bearings shall preferably be of self-lubricating type, with "0" ring seals. The actual position of the valve disc shall be clearly shown by an external indicator. Beside mechanical operation tests, each valve shall be subjected to a body pressure/leakage test and disc strength test.

## c. Globe Valves

Globe valves shall generally be used for regulating purposes. An arrow indicating the direction of flow through the valve shall be clearly cast or embossed on the body of each valve.

Generally the values are to be operated with hand wheel. Gear operation shall be provided for gate values of nominal size DN 125 and above unless otherwise specified. Stem shall be of stainless steel and forged or machined from forged/rolled bar. No casting is permitted.

Gear arrangement shall be totally enclosed bevel gear having grease case with grease nipples/plugs and position indicator for open/ closed position. Gear operators shall be designed to operate effectively with the pressure across the closed valve equal to the cold non-shock pressure rating.

Globe valves shall comply with IS:778-1984, R'90 or IS 2906 or equivalent as might be applicable to the particular installation requirement.

## d. Gate and Sluice Valves

Gate and sluice valve shall conform to IS : 780 - 1984, R'90 or IS: 2906

Constructional features, materials of construction of various components and testing of CS gate valves shall conform to IS or equivalent reputed International Standards like BS, DIN, ANSI/AWWA, API and ISO. For the cooling circuits, process water, make-up water cast steel gate valves shall be provided.

Bodies of valves shall be double-flanged ends and shall be fitted with seat rings securely fixed in machined recesses.

Stem shall be of stainless steel and forged or machined from forged/rolled bar. No casting is permitted.

The wedge-to-stem connection shall be designed in a way that their connection shall be



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stronger than the weakest stem section in order to avoid detachment of the wedge from the stem while operating the valve.

The guides and lugs shall be provided to guide the wedge through its full travel. The guides and lugs shall be lined with brass or bronze and the liners shall be secured by countersunk screws or rivets of non-ferrous metals.

Hand wheels shall be fixed to stem by a washer and a nut screwed on to the stem. The collar on the stem shall be integral with the stem by forging and shall not be welded on to it. Hand wheels shall be arranged to turn in a clockwise direction to close the valve.

Generally the values are to be operated with hand wheel. Gear operation shall be provided for gate values of nominal size DN 125 and above unless otherwise specified. Gear arrangement shall be totally enclosed bevel gear having grease case with grease nipples/plugs and position indicator for open/ closed position. Gear operators shall be designed to operate effectively with the pressure across the closed value equal to the cold non-shock pressure rating.

## e. Safety Relief Valves

Safety relief valves shall be of the spring-loaded type unless otherwise specified, or unless the Purchaser/Consultant has given written permission for the use of a different type of valve actuation.

## f. Float Valves

Float valves should be of the equilibrium ball float type. Floats for cold water duty shall be plastic, of a grade that does not deteriorate in sunlight, and for hot water duty be same shall be copper. All operating rods, guides, brackets and covers shall be of non-ferrous material.

Float valves operating in liquids other than fresh water shall be of materials to the Purchaser/Consultant's approval. The float valves shall comply with international standards. Float valves shall be complete with float rods and guides together with covers and brackets where required.



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## g. Non Return Valves

Non-Return Valves shall conform to IS : 5312

All non-return valves shall be provided with means of draining the space between the valve and its adjacent isolating valve. The design shall preclude the possibility of the valve jamming in the open position; the effect of solid particles settling- out in dead spaces within the valve should be recognized in this respect. Where screw-down non- return valves are supplied, they shall provide a demonstrable leak-tight joint.

Constructional features, materials of construction of various components and testing of double-flanged C I non-return/check valves shall conform to IS 5312 : 1984 (1990), Part 1 or IS 5312 : 1986 (1991), Part 2 or BS 5153 : 1974 (1991) or equivalent reputed International Standards like DIN, ANSI/AWWA, API and ISO.

The body end ports shall be circular. The disk shall be either integral with or separate from the hinge and flat seating face. Where the disk is separate from the hinge, means shall be provided to prevent the disk, hinge pin and retainers becoming detached in service.

Any parts of the valve which can become detached in service, such as hinge pin and disk, hinge pin plugs, hinge pin stuffing boxes and two-piece disks, shall be locked. Hinge pin design shall ensure accurate alignment of the disk and the valve seat.

where applicable, check and non-return valves shall have an arrow cast or embossed on the side of the valve body to indicate the direction of flow.

#### h. Motorised Valves

Valves, dampers and similar devices requiring abnormal physical effort to operate or high speed operation, shall be provided with powered actuation. Hand operating equipment shall also be fitted for closing and opening, which is effectively decoupled during power operation.

The following criteria are preferred in the selection of the power source for the servo mechanism

- All motor operated valves shall have de-clutchable manual override along with the position indicators. The motorised valve shall be designed in such a way that it is possible to remove the actuator from the valve without requiring shutdown.
- Isolation and other duties not subject to operation more than once in 10 minutes electrical, compressed air.



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- Continuous or intermittent modulation compressed air, or hydraulic fluid. Modulating Electrical Actuators shall be to the Purchaser/Consultant's approval.
- Continuous or intermittent modulation involving heavy control forces likely to produce fluttering or hunting-hydraulic fluid, electrical.
- Emergency control or isolating duties compressed air, spring loaded, or hydraulic fluid with sufficient reservoir capacity to complete the operation without an external source.

Electric actuators for on/off duties shall be fitted with travel limiting devices capable of accurate and positive adjustment. Torque limiting or other devices shall be provided to prevent damage to the mechanism in the event of jamming of the driven device. All powered valve or damper mechanisms shall be provided with accurate indication of the position of the driven device.

#### i. Hand Operation Requirements

Where required, valve spindle shall be lengthened so that the hand wheel shall be at a height approximately one meter above the level of the floor or platform from which the valve is to be operated and where necessary they shall be provided with pedestals of rigid construction. All thrusts when opening or closing the valve shall be taken directly on the valve body. Pedestal hand wheels or valve tables shall be provided at a convenient operating floor or intermediate floor level. Such pedestals and valve tables shall be mounted direct on floors or steel members and not on floor grills or plating.

All valve hand operating mechanisms shall be easily operable by one person. Special attention shall be given to the operating mechanism for large size valves with a view to ensuring that a minimum of maintenance is required and to obtaining quick and easy operation.

All valves shall be closed by rotating the hand wheels in a clockwise direction when looking at the face of the hand wheel. In cases where the hand wheel is not directly attached to the valve spindle suitable gearing shall be introduced to ensure clockwise closing. The face of each hand wheel shall be clearly marked "open" or "closed" with arrows indicating the direction of rotation to which they refer.

Plastic valve hand wheels will not be acceptable, All valve spindles shall be fitted with



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indicators so that the valve opening can be readily determined. In the case of valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.

#### 04.10 Pipe work

During detailed engineering stage bidder should submit schedules of the pipe work to be provided under this Contract for approval of Purchaser/Consultant. These schedules shall state, for each pipe work system or parts of a pipe work system, the design and operating pressures and temperatures, the fluid transmitted, the piping and valve materials, the types of valves, any corrosion allowances, the pipe work design code, insulation proposals, pipe supports and any other data relevant to the mechanical design of the pipe work system or part of a pipe work system.

All piping shall be routed to provide a neat and economical layout and requiring the minimum number of fittings. Piping shall be arranged so that full access is provided for the operation and maintenance of equipment and that removal or replacement of equipment can be achieved with the minimum dismantling of piping.

In specification the term "high pressure" refers to where the design pressure exceeds 20 bars.

Mild steel / Carbon steel pipelines shall be used in general for water supply facilities and SS pipes for soft / DM water. Material of pipes selected shall be indicated by bidder in the offer and the same will be subject to Purchaser's /Consultant's approval. The steels shall be suitable to withstand the temperature and pressure conditions involved in the operation of the plant under all circumstances.

No piping less than 20 mm nominal bore shall be used except for instrument services or services specifically approved by the Purchaser/Consultant.

In any one system or pipe service all pipe work and fittings shall be of the same material or similar analysis unless specified or agreed to by the Purchaser/Consultant.

The number of joints shall be kept to a minimum necessary for efficient maintenance of the plant. Tees and bends shall be to standard dimensions. Bends shall be of the pulled type



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or forged. Hot bending with packing may be used for larger sizes according to facilities available, but hot bends in alloy or stainless steels may only be made after permission has been given by the Purchaser/Consultant. Where pipelines are to be mechanically cleaned (pigged) the bend radius shall not be less than five pipe diameters unless approved by the Purchaser/Consultant.

Adequate provision for expansion of the pipe work shall be made. Expansion joints or bellows shall be used only where they can be justified technically and economically. The pipe network shall be provided with air release valves at high points and drain valves at the lower points.

All drain and vent valves shall be located in easily accessible positions. All drains and vents shall discharge to safe locations. Drains and vent pipe work shall be neatly run and shall not interfere with maintenance or operating access requirements.

## PIPE SPECIFICATION

## A) Black Pipes DN 15 to DN 50:

- 1. End condition : Bevel Ends
- 2. Material : ASTM.A.53 Gr:B/IS:1239 (Part-I)/ASTM A106Gr.B
- 3. Manufacturing : Seamless
- 4. Thickness : As per Schedule 80. (DN15: 3.7 mm, DN20: 3.9 mm, DN25: 4.5 mm, DN32:4.9mm, DN40: 5.1 mm, DN50:5.5mm)

## B) Carbon Steel Pipes DN 65 to DN150 as per IS:1239-1990(R.A.-2004) :

- 1. End condition : Bevel Ends
- 2. Class : Heavy
- 3. Material : As per IS: 1387 / IS 1239 (Part-I)/ASTM A106 Gr.B
- 4. Thickness : As per Schedule 40. (DN65: 5.2 mm, DN80: 5.5 mm, DN100: 6 mm, DN125:6.6mm, DN150: 7.1 mm)

## C) Pipes above DN 150 as per IS:3589-2001/ASTM A106Gr B:

- 1. End condition : Beveled ends for butt welding
- 2. Material : Carbon steel, Gr. Fe 410



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3. Thickness : DN200-DN350: 9.52 mm, DN400 & above: 12 mm Pipes of size more than DN300 will be spirally welded.

## D) Carbon Steel G.I (Galvanised Iron)

Pipes DN 15 to DN 150 as per IS: 1239-2004:

- End condition : Screwed up to DN 50, Beveled ends for all the sizes above DN 50.
- 2. Grade : Heavy
- 3. Material : Carbon steel, Gr. Fe 410

## E) S S Pipe & Pipe Fittings

- 1. As per ASTM A 312 Pipe, seamless ANSI B36.10, Schedule 40 (size 6mm-200mm)
- As per ASTM A 358 Pipe, welded, ANSI B16.9, Class 3000,Schedule 40, Sizes more than DN250
- 3. SS butt welding fittings: ASTM A403 WP304, ANSI16.9
- 4. SS socket welding fittings: ASTM A182 WP304, ANSI16.11
- MS pipes (without inside surface protection) handling DM/ soft water: upto DN300: seam less { IS 1239, P-1 heavy grade, IS3589,t=9.52 mm) DN300- DN700: 12 mm, more than DN700: 16 mm.

## 04.10.01 Pipe Supports and Anchors

Pipe work shall be supported and anchored in an appropriate manner.

The Bidder shall take all necessary precautions to ensure that the piping shall be free from vibration by the installation of vibration dampers or other acceptable means. The Bidder shall prepare and include in the plant operating and maintenance manuals, pipe work layout and other similar drawings marked to show the position of every pipe support.



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## Table for maximum span of supports

Nominal pipe size (mm)	Maximum span for liquid services (m)
25	2.1
40	2.7
50	3.0
65	3.4
80	4.0
100	4.3
150	5.2
200	5.8
250	6.7
300	7.0
350	7.6
400	8.2
450	8.5
500	9.2
600	9.8
900	12.0
1000	15.0

**Note:** Vertical pipe work shall be clamped at intervals of 3.5m (approx.) and at the base of each riser. Maximum span at the place of turning shall be 0.7 times of normal span.

## 04.10.02 Pipe Terminations and Connections

All pipe connections shall be fusion welded except where flange connections are required or specified to facilitate erection or maintenance or where pipe materials used preclude welding.



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Pipe work flanges shall comply with the requirements of the code to which the pipe work is designed.

Jointing material, bolts, nuts and washers shall be provided where necessary for flanged pipes, valves and fittings supplied under this Contract.

## 04.10.03 Internal Cleaning of Pipes

Bidder is responsible for ensuring that the internal surface of all pipelines is thoroughly clean before the pipelines are placed in commission.

The procedure adopted is to include the following:

- a) Thorough cleaning of all internal surfaces prior to erection to remove accumulations of dirt, rust, scale, and welding slag due to site welding before erection.
- b) Prior to, and during erection, all parts shall be inspected to make sure that they are clean and adequate steps shall be taken to prevent entry of foreign matter both during and after erection. Each section erected shall be cleaned out before being connected into the previous section. All headers shall be cleaned before closing up.
- c) Thorough cleaning of all pipe work after erection by flushing with water.
- d) Already embedded pipes shall be cleaned with wire brush/ pickling to bring back original / required ID.
- e) For lub oil line pipe line to be cleaned by pickling process or other standard process accepted by manufacturer.

Bidder shall provide all necessary facilities in the pipe system for carrying out the requirements of item (b) including and temporary pipe work, valves and supports.

#### 04.10.04 Traps, Drains and Vents

Bidder shall provide all traps, drains and vents which are called for in this Specification or which are necessary for plant operation, line or plant filling.

Drains and vents from different systems, or parts of systems operating at widely differing pressures, shall not be interconnected. At highest point vent and lowest point drain should be provided to avoid the water hammering.



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## 04.11 Welding General Requirements

#### a. General

All welding shall conform to the relevant National or International Standard Specification as agreed by the Purchaser/Consultant.

## b. Welding Equipment

Any welding equipment which in the opinion of the Purchaser/Consultant, is unsuitable or unsatisfactory for the service for which it is being used, shall be replaced by Bidder. The absence of comment by the Purchaser/Consultant shall not be taken as approval for any equipment.

## c. Weld Procedure Documents

Complete and full detailed weld procedure documents shall be kept and these shall be made available to the Purchaser/Consultant on request. Prior to the commencement of the welding the Bidder shall submit to the Purchaser/Consultant for approval the welding procedures to be used in the fabrication of the relevant sections of work.

## d. Welders Qualification Tests

All welders shall be qualified for the work and shall hold current welders' qualification certificates in accordance with National Standards.

Records showing the date and result of the qualification tests performed by each welder and weld operator together with the identification number assigned to him shall be available for scrutiny by the Purchaser/Consultant.

## e. Welding Inspection

i. Quality Requirements for Welds

All welds subjected to non-destructive tests shall be entirely free from cracks or crack like defects, lack of root fusion, lack of sidewall fusion, root burn through or tailed pores. The standard for porosity and slag inclusions will be as indicated in the agreed standards for design and welding.





#### ii. Visual Weld Inspection

Each weld shall be subjected to a stringent visual inspection and shall be free from undercut, cracks, porosity and other surface imperfections.

Fillet welds shall be checked for dimensional tolerance and from using a fillet weld gauge. Fillet welds should be slightly concave in form and each leg of the weld shall have equal length.

#### iii. Non-Destructive Examination

All non-destructive examinations shall be supervised by a fully qualified and experienced specialist appointed by the Bidder. Individual operators in each of the respective techniques shall be qualified and trained in the respective subject.

Dye Penetrant Test, Ultra Sonic Examination, Radiography; Magnetic crack detection shall be carried out in accordance with National Standards.

#### iv Weld Repairs

The Purchaser/Consultant's approval shall be obtained prior to commencement of any repair or rectification work.

Weld repairs shall be made to the same procedure as for the original weld. All tests shall be repeated after the repair has been completed.

#### v. Mandatory Inspections

All transmission welds between dissimilar materials, such as high alloy steel to carbon steel, or non-ferrous materials to steels, shall be subjected to 100% ultrasonic examination or crack detection wherever practicable. In addition, all butt welds between dissimilar materials shall be subjected to 100% radiographic examination.

Alternatively, Ultrasonic test is permitted in lieu of Radiographic test per ASME Sec VIII Div2 para 7.5.5.

All welds in ferritic alloy steels, e.g., having a carbon equivalent value in excess of 0.40%, and high yield-strength steels, e.g. having yield strength greater than 300 MPa, shall be



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subjected to 100% ultrasonic examination and crack detection wherever possible. In addition, all butt welds in these materials shall be subjected to 100% radiographic examination.

#### 04.12 Noise and Vibration

#### a. Noise

Maximum noise level tolerable in work areas shall be within the applicable limit as per applicable code & standard. The equipment and the services shall be designed such that limits are not exceeded. Bidder shall indicate the maximum noise level guaranteed for each equipment/system with detailed description of noise control measures adopted, if any.

#### b. Vibration and Balance

Plant shall be designed and constructed to operate without vibration in so far as the nature of the works will permit. Where vibration must be expected this shall be reduced to the minimum which can be achieved by good design and careful balancing in the case of rotating plant.

The amplitude of vibration of rotating plant when measured on the bearing housings under steady state conditions at the designed operating speeds shall conform to IEC 34-14 (1982) or equivalent International Codes.

## 04.13 Scaffolding, Stairway and Ladders

Where safe and easy plant operation and maintenance cannot be arranged from provided floor levels, Bidder shall supply and erect all platform galleries, stairways, access ways and ladders necessary for providing the required safe and easy access to the plant items. Bidder shall ensure that the whole of the access ways are of uniform design and pattern throughout the Works. Where access is required for operation then standard design stairways must be provided, but if infrequent access for maintenance only is required then vertical ladders will be considered.


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#### 04.14 Safety Guards

All moving parts, shafts, couplings, flywheels, bare conductors and hot or cold surfaces shall be adequately and securely guarded in accordance with the prescribed legislation and to the Engineer's approval so as to afford complete safety to all personnel.

#### 04.15 Commissioning Spares

All the spares and consumables as may be required during erection & commissioning of the instrumentation system shall be included the scope of work and supply of bidder.

#### 04.16 Special Tools and Tackles

The following tools and appliance shall be supplied under this tender for use by the Purchaser.

a) One set of all special tools and tackles including testing, calibrating and measuring instruments required for assembly, disassembly and maintenance of all equipments/ systems covered under the scope of the contractor shall be supplied by the Contractor. In case of any damages of any tool & tackles, same shall be replaced by new one by the bidder. These shall not be used for erection/ commissioning purposes and shall be in an unused and new condition, when they are handed over to the purchaser/owner. A list of such special tools and tackles shall be submitted along with the offer.

Supply of all instrumentation measuring devices etc. (both test grades as well as standard) needed for conductance of demonstration / commissioning/ performance guarantee test. The instrumentation specifically brought by the contractor for the purpose of various PG testing alone, can be taken by the contractor after conductance of the PG tests.

b) One set of special lifting and handling appliances required for the normal maintenance of unit # 1 & 3.(only one set need to be provided)

Each tool or appliance is to be clearly marked with its size and/or purpose. The tools and appliance supplied shall not be used for erection purposes by Bidder and shall be handed over in new condition.

The exception to this is the special lifting and stud tensioning equipment which may be used provided that when it is handed over to the Purchaser it has not been subjected to





more than normal wear and is still fully suitable for its intended use. In case of doubt, the Purchaser will require the bidder to replace the worn appliances. Copies of certified test certificates for lifting appliance must be handed over at the Taking over Date.

Each set of tools and appliance under category (a) shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the plant and equipment in question. If the weight of any box and its contents should be such that it cannot conveniently be carried. It shall be supported on steerable rubber-tyred wheels.

Each cabinet and box shall be painted, fitted with lock and clearly marked in white letters with the name of the item of equipment for which the tolls and appliance contained are intended.

Suitable storage racks shall be provided for all portable lifting tackle in this contract. Suitable lifting lugs, ears or eye bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

All lifting tackle shall be stamped with unique identification number and safe working load. A test certificate from an approved Authority shall be supplied for each item of lifting tackle.

The bidder shall provide a schedule of all lifting tackle and tools and appliance being supplied for the approval of the owner engineer/consultant.

The bidder shall provide all runway beams, trolley, chain blocks, special slings etc. necessary for the safe and efficient handling and maintenance of the works. The supply of Mandatory spares and tools & tackles shall be delivered with the last consignment of the respective equipment of first unit. Tools and appliance with the appropriate storage racks, cabinet and boxes shall be handed over the Purchaser at the time of taking over. Where the bidder includes site erection any special tools or appliance required solely for erection (but not for maintenance) shall be provided by the bidder for own use and shall remain the property of the bidder.



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#### 04.17 Painting

#### a. **General**

The primers & finishing paints will conform to latest Indian Standard or equivalent international standards. There shall be of approved quality and shade.

General precautions for painting such as preparation of surfaces, application of paints, inspection and testing etc. will be as per relevant clause of IS:1477 (Part I & II) and shall be followed, wherever possible.

General compatibility between primer and finishing paints recommended by the paint manufacturer, supplying these paints shall be followed.

General compatibility between successive coats must be ensured.

Unless otherwise specified, the general colour scheme for finishing coats for different types of equipment and pipelines as per requirement of the Purchaser/Consultant are to be followed. Colour schemes, however, may be changed, if necessary, by the Purchaser/Consultant at any stage before the start of the painting of the equipment.

#### b. Painting instructions

In general, unless otherwise specified, all plant and equipment & pipelines will be given one coat of antirust primer, lacquers, etc. at the supplier's works after completing surface preparation to remove grease, rust, scales and other foreign materials. The second coat of antirust primer will be applied immediately after erection after completing requisite surface preparation) followed by two coats of finishing paint of approved quality & shade.

Technological structures, crane girders & other structures shall be given one coat of primer during manufacturer & one coat of primer after erection followed by two coats of finishing paint.

For equipment where original colour as per supplier's practice is desired, both primer & finishing coats will be applied at supplier's works before dispatch of equipment. Structures embedded in concrete shall have no shop painting applied. The portion of the column that is to be embedded in concrete shall be given a coat of portland cement slurry after thoroughly cleaning the surfaces from mill scale, grease & oil immediately after fabrication.



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The portion of the structures embedded underground shall be given two coats of red lead graphite primer at shop and finished with two coats of bituminous black paint of approved quality.

Machined/plained surfaces shall be coated with while lead and tallow before dispatch or before being put into open air & covered with gunny cloth.

Surfaces to be site welded shall have no shop paint applied within 100mm of welding zone. After site welding normal painting application will be followed.

Areas which become in-accessible after assembly shall be painted before assembly. Cables & other electrical accessories shall have adequate antirust protection. Chequered plates shall be given primer coats only.

The phosphate coated surface shall have one coat of baking based and two coats of finished paint of amino alkyd resin stone enamel.

External surface of pipe fittings shall be thoroughly cleaned by wire brushing and given two coats of red oxide zinc chromate primer at supplier's works & two coats of final synthetic enamel paint after erection.

The equipment which is to be dispatched in knocked down condition and require assembling at site shall be given two coats of rust and corrosion preventive primer and one coat of synthetic enamel paint of approved quality and shade. After assembly at site, such equipment shall be given one final coat of synthetic enamel paint.

The equipment which can be sent as a single block unit duly shop assembled, shall be given full application of paint i.e. two primer coats of rust and corrosion preventive primer and two finish coats of paint of approved quality and shade as per relevant Indian Standards/equivalent international standards.

All painting shall be carried out by brushing or roller application with prior permission of the Purchaser/Consultant.

All metal parts not accessible for painting shall be made of rust and corrosion resisting materials. Interiors of equipment will be suitably quoted with anti-rust compounds.

The fasteners shall not be painted. These will be dispatched with application of anti-rust compound.





Any special painting requirement indicated on Bidder's drawings by the Purchaser/Consultant during approval stage shall be binding.

#### c. Surface preparation and environmental conditions

All surfaces to be painted shall be thoroughly cleaned of dirt, grease, rust & mill scale. Removal of rust & scale shall be by hand brushing, power driven wire brushes or by sand blasting, as the surface condition/service condition warrants.

The paint shall be applied on the metallic cleaned surface after it is perfectly dry but not later than 3 hours after cleaning of the surfaces. Reasonable time gap should be allowed between any two consecutive coats of primer or finishing coats.

Surfaces coming in contact with acid & acidic fumes alkalis, soda, detergents etc shall be cleaned thoroughly to get complete metallic surface as per IS;1477 Part I & II or BS 4232-1967. After sand blasting the surface shall be cleaned with cotton rags, soaked in benzene, to remove fine rust, grease, etc. No sand blasted surface shall be exposed to weather for more than 3 hours.

The choice of primer & finishing paint will depend on the environmental condition to which the plant & equipment and pipelines are exposed to.

Paints are to be applied on dry surface only under agreeable weather conditions. Painting in damp & foggy weather conditions will not be permitted.

For a selected primer the method of surface treatment best suited for that primer & suggestion of paint manufacturer shall be obtained and followed.

Zinc rich primer paints which have been exposed for a long time before the finishing coat is applied shall be washed down thoroughly to remove soluble zinc salt deposit.

The recommendation of paint manufacturer shall be forwarded to the Purchaser/Consultant for approval.

#### d. Primer paint

In general, two coats of primer paints conforming to relevant Indian Standard or equivalent international standards shall be applied on all unmachined surfaces, except noted otherwise.



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Where equipment is to be finish painted for dispatch, both coats will be applied before finishing coats at supplier's works.

Where equipment warrants finishing coat after erection, one coat will be applied just after manufacture at supplier's works and the second coat just after erection at site after surface cleaning.

Equipment on which primer coat has been damaged due to prolonged exposition at site, final erection or transport, shall be given two coats of primer at site before applying finishing coats. Before applying paint the surface will be thoroughly cleaned by sand paper. The primer applied should be compatible in quality and colour schemes with the subsequent finishing coats.

Unless stated otherwise, the following primer paints shall be used depending upon the exposition and environmental condition to which the plant & equipment, structures & pipelines are exposed to :

- Aluminium zinc oxide conforming to IS;2931
- Red oxide zinc chromate conforming to IS:2074
- Heat resistant aluminium conforming to IS:161
  - primer paint Air drying chemical resistant paint
- Epoxy resin paint (cold cured) -
- Poly urethene paint
- Chlorinated rubber based conforming to DEF-1402, Ministry of Defence

#### e. Finishing paint

Two coats of finishing paint compatible with the primer and conforming to relevant Indian Standard or equivalent international standards shall be applied on all unmachined surfaces unless mentioned otherwise.

Unless noted otherwise, the following finishing paints will be applied on plant & equipment, structure & pipelines depending upon the exposition and environmental conditions to which the plant & equipment, structures & pipelines are on subjected to:

- Synthetic enamel conforming to IS;2932 exterior type
- Epoxy based finishing paint -



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- Heat resistant silicon based Aluminium paint IS:161

The finishing paint shall be of approved colour. The undercoat shall have different tinge to distinguish from the finishing paint.

The surfaces of the equipment on which finishing coats of paint has been damaged due to prolonged exposition at Bidder's work, erection site, during transport, storage or final erection shall be thoroughly cleaned & touched up with the same paint as applied previously.

#### f. Thickness of coat of paint

A single coat of paint when dry should have a thickness of 25 to 30 microns (0.025 to 0.030 mm) or 1 mil to 1.25 mils.

Total thickness of 4 coats (2 primer coats + 2 finishing coats) should have thickness of 100 to 125 microns (0.100 to 0.125 mm) or 4 to 5 mils.

In case of bituminous aluminium gilsonite based paint 3 coats are to be applied. The total thickness of 3 coats will be not less than 100 microns (0.100 mm) or 4 mils.

Immediately following the award of the Contract, the Bidder shall submit the names of the proposed paint supplier and applicator together with a quality assurance program for approval. All paints for one section shall be provided by one manufacturer and preferably shall be manufactured in one country to ensure compatibility.

#### 04.18 Coding Scheme

A coding scheme for identifying the drawings, plant and equipment, structures, spares and shipping documents shall be adopted by Bidder.

#### a. Coding scheme for drawings

Ten (10) digit drawing numbering scheme is proposed for all the plant and equipment/spares to be supplied. The scheme will be cleared by the Purchaser/Consultant.

# b. Coding scheme for plant and equipment/ spares (Equipment identification number)

Eight (8) digit coding scheme is proposed for all such items of supply. The first three (3)





digits conform to the shop complex, next 3 represent the equipment number. Suffixes of two (2) digits may be used at the end of six digits, wherever necessary. (Identification number presently used by plant people shall also be given for easy identification number).

#### c. Shipping code for plant and equipment/spares

The various items of plant units which arrive at site in packages have to be stored at proper areas/stores so that they can be retrieved easily and also to ensure the completeness of supply proper storing of the packages have to be done without opening the packages. As such, the boxes/packages have to be marked so that the contents may be easily identified for proper storage and easy retrieval.

Shipping code will comprise:

- Code number assigned to Bidder
- Code number of equipment
- Package SN/total number of packages

#### d. Colour scheme for plant & equipment

Purchaser/Consultant will indicate the colour scheme to be followed during painting of the plant and equipment. This as well as the equipment identification number will be indicated by the Purchaser/Consultant soon after the Bidder submits the list of plant and equipment along with GA drawings.

#### 04.19 Erection, testing & commissioning of plant and equipment and pipelines

#### a. General

Bidder, amongst other things, shall be responsible for renovation of the plant equipment to be reused and erection of plant and equipment, fluid system, electrics, auxiliaries, etc. as per the scope of supply within the design limit as given in the Technical Specification. Bidder shall delivery of the equipment and transport the same to his store/erection site, maintain his own stores for the storage of equipment and all related documents and records and finally transport the equipment to site for erection. Bidder shall take an erection - cum - storage insurance policy covering all the risks including third party liabilities for equipment as well as human life. All security arrangements also shall be made by Bidder.





Bidder shall unpack the cases and do visual checking against physical damages of equipment and do cleaning of the equipment before start of erection.

Bidder shall be responsible for proper and neat storage and also undertake conservation of all consignments including damaged boxes. During storage of equipment, Bidder shall take into account deterioration and carry out the re-conservation of the complete equipment/parts/supplies as may be necessary as per the Storage Instructions of the Manufacturer of equipment/components. Bidder shall also supply the consumables required for such re-conservation/conservation work and repair/replace parts required thereof for the proper functioning of the equipment after erection and commissioning.

Damage/shortage of the equipment/component during transit / transfer / storage, shall be made good by Bidder without loss of time so as not to upset the agreed erection and commissioning schedule and at no extra cost to the Purchaser/Consultant. Delay on account of settlement of insurance claims by Bidder shall not be taken into cognizance by the Purchaser/Consultant.

Bidder shall be liable to make good any damage to existing equipment and/or facilities caused by Bidder's personnel. In case any existing equipment or facility is required to be dismantled for erection of the new equipment, the same shall be restored at no extra cost to the Purchaser/Consultant.

Equipment will be installed on the existing civil foundation provided by the Purchaser. However, if any deficiency is noticed in the quality of concreting, dimensions, center-lines, levels, locations, etc of the foundation or anchors bolts or other embedments, the same will be rectified by Bidder at no extra cost. Chipping/ rectification of the equipment for proper erection, alignment, etc. shall be done by Bidder. Chipping/dressing of the foundation with air or air and water jet prior to placing the equipment will also be carried out by Bidder.

Bidder shall lay and maintain properly all the temporary supply lines at the erection site for temporary power, water, and air connections required for erection purposes, from the points earmarked by the Purchaser/Consultant for this purpose.

Bidder shall provide all necessary construction tools, compressors, small hand tools, instruments, all commissioning instruments, welding equipment, service bolts, nuts, jigs and fixtures, winches, alignment tools, precision levels etc. and other equipment which may





be required for carrying out the erection work efficiently within the time schedule. Unless otherwise specified, the above construction materials shall be the property of the Bidder after the erection work is over. Special tools & tackles obtained by the Purchaser/Consultant with the equipment will, however, be the property of the Purchaser/Consultant.

Bidder shall provide all temporary ladders, scaffolding materials, platforms, supports and other necessary facilities required for handling, erection and visual inspection of supplies at the point of installation and shall also provide necessary packing plates, wedges, shims, leveling screws, etc. required for erection of plant and equipment.

Bidder shall provide erection consumables like oxygen and acetylene gas, welding rods, solder lugs, oil, grease, kerosene, cotton waste, etc. required for erection of plant and equipment.

Bidder shall erect and maintain his own site offices, main stores and site temporary stores as required for the work and arrange for maintaining in neat manner the area placed at his disposal.

Bidder shall provide sufficient fencing, notice boards and lights to protect and warn others as may be considered necessary by the Purchaser/Consultant.

On placement of order, the Bidder shall provide his scheme for mobilisation with bar chart indicating clearly the resources, of erection machinery man-power and machinery proposed to be deployed to ensure timely completion of work and quality of workmanship.

The plant and equipment will be erected as per the instructions of the manufacturers/suppliers and under the supervision of the supervisory personnel, to be deputed by the Bidder at site. Bidder shall also undertake rectification work on account of manufacturing defects, required for proper erection and assembly which can be done at site only according to site condition.

Bidder shall align, level, couple and securely fix all equipment, steel structures and accessories in accordance with drawings and/or instructions.

All precision survey instruments including leveling instruments shall be arranged by the Bidder.



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Bidder shall supply materials and carry out flushing and first filling of oil and lubricants, grease, chemicals and as required till successful commissioning.

Laying and termination of cables, bus bars, bus ducts and earthing shall be done by Bidder.

Installation and connection of all pipings and fittings from the headers termination points to the equipment and inter-connection of all service lines within the design limit after the main headers/termination points shall be Bidder's responsibility.

Bidder shall check electrical connections to individual items.

Bidder shall be responsible for calibration of all the instruments used at site.

Bidder shall be responsible for checking the correctness of erection of mechanical equipment, auxiliary systems, electrical equipment, other equipment, etc. as per the specification and relevant drawings.

Bidder shall arrange all facilities at site to undertake radiographic testing and stress relieving of butt welded pipe joints, as required.

Bidder shall be responsible for the management of erection work with proper and adequate supervision for ensuring progress of erection work and quality of workmanship.

Bidder shall deploy required number of supervisory, skilled, unskilled and auxiliary labor as required, for the erection work and comply with such reasonable instructions of the Purchaser/Consultant in the interest of satisfactory progress and completion of the work according to the schedule.

Bidder shall be responsible for total commissioning of the Plant including mechanical run, commissioning and demonstration of Performance Guarantee Parameters.

Bidder shall organise the work in a manner that other work at site is not impeded and the workmen therein not endangered. He shall arrange temporary access at site, if required, for the erection work.

Bidder shall intimate the Purchaser/Consultant/ concerned Plant authorities in writing well in advance about the requirement of shut down of any of the existing units/facilities for



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inter-connection/ incorporation of additional facilities. The shut down period shall be mutually discussed and finalised. The work to be undertaken during the shut down period shall be planned meticulously by the Bidder to reduce the shut down period to the minimum.

Bidder shall make temporary arrangement for maintaining the continuity of the services/ facilities before commencement of the diversion of existing service lines wherever shut down is not possible, without any extra cost to the Purchaser/Consultant.

Bidder shall return to the Purchaser/Consultant all crates, packing cases and packing materials and all returnable supplies belonging to the Purchaser/Consultant at a place designated by the Purchaser/Consultant at the erection site in the conditions these exist during and after erection work is completed.

The tests/checks to be conducted during erection by the Bidder shall be as per the manufacturer's instructions. The Bidder shall attend to the rectification of erection defects, if any, expeditiously. The Bidder shall arrange all testing instruments for such testing at site.

Bidder shall carry out final painting including supply of paint of the plant & equipment and pipelines, etc. erected as per the instructions of the Purchaser/Consultant. Grouting of the equipment on the foundations with shrinkkomp / ferro grout shall be the responsibility of the Bidder.

Bidder shall indicate to the Purchaser/Consultant well in advance the requirement of services such as electric power, water, EOT crane, etc. required during construction/erection period.

Bidder will arrange for the staying facilities of his working personnel.

All safety, health and pollution control measures, as required to be adopted as per the Statutory Regulations and the Safety Codes for projects issued along with the tender documents otherwise required or implied by statutory regulations or practices, shall be strictly followed by the Bidder during the execution of the Contract. The Bidder shall set up a suitable safety organisation of his own at site in this regard.



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The Bidder shall comply with all Statutory Rules & Regulations with respect to the employment of labour at site including payment of minimum wages as per Govt. rules, deduction of employees's contribution to Provident Funds, depositing the same along with Bidder's contribution to the Provident Fund Commissioner, Employees State Insurance and other statutory deductions/obligations.

At the end of the work the Bidder shall remove all such temporary structures put up by him and hand over the site to the Purchaser/Consultant in neat and tidy manner.

#### 04.20 Supervision of erection, testing, commissioning and performance guarantee tests

Bidder shall depute at site engineer/ specialists from various disciplines for the supervision of entire renovation works, erection, testing trial run, commissioning and performance guarantee tests of the plant and equipment under his scope of work engineers/specialists from various disciplines. The above mentioned engineers/specialists shall supervise the erection, testing, commissioning and conducting of performance guarantee tests of the plant and equipment with their auxiliaries so as to establish to the Purchaser/Consultant that the guarantees as stipulated by the Purchaser/Consultant and agreed by Bidder are fully met.

The Purchaser/Consultant may place his engineers of respective disciplines to witness successive steps adopted in successful erection, testing, commissioning and performance guarantee tests.

For mechanical completion, erection, testing, commissioning and performance guarantee tests refer other section of this tender specification.

#### 04.21 Contract Terminal Points

Bidder's responsibility for making connections shall be as follows unless otherwise stated in the Specification:

- a) Where pipe work and ducting supplied under this Contract connects the equipment already existing or supplied by the Purchaser, the connection shall be made under this contract.
- b) This contract includes the terminating and connecting up all cables, which are supplied under this Contract except where noted.
- c) All associated existing cabling not included in the Contract will be checked and tested under the supervision of the Purchaser/Consultant but it will be the



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responsibility of the Bidder under this Contract to assist the Purchaser/Consultant in re-checking all final connections and to ensure the subsequent satisfactory operation of the equipment.

Bidder shall be deemed not to have fulfilled his obligation insofar as the commissioning of the plant in concerned until complete end-to-end tests have been carried out to the satisfaction of the Purchaser/Consultant.



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#### 04.22 ELECTRICAL FACILITIES.

#### SPECIAL INSTRUCTIONS TO BIDDERS

#### **Compliance with Specification**

All equipment and accessories covered under this specification shall conform to Technical Specifications' given in this specification (Vol-II & Vol-III).

All equipment shall be suitable for voltage/freq. variations and other data given in Electrical System Design in (Vol-II & Vol-III).

#### **Standards and Regulations**

The design, manufacture, performance, testing and installation (including safety, earthing and other essential provisions) of equipment and accessories covered under this specification shall, in general, comply with the latest issue of:

- Applicable Standards and Codes of Practices published by Bureau of Indian Standards.
- Central Board of Irrigation and Power
- Indian Electricity Act.
- Central Electricity Authority
- Indian Electricity Rules.

Equipment complying with other recognised Standards such as IEC, BS, VDE, DIN etc. will also be considered if it ensures performance equivalent to or superior to Indian Standards.

Equipment and accessories for which Indian Standards are not available, shall be designed, manufactured and tested in accordance with the latest issues of recognised Standards such as IEC, BS, VDE, DIN etc.

In case of conflict between applicable Standards referred to in this part and the Technical Specifications given in vol-II, the latter shall govern to the extent of such difference.



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#### Safety

All equipment shall be complete with approved safety devices wherever a potential hazard exists and with provision for safe access of personnel to and around equipment for operational and maintenance functions. The design shall include not only those usually furnished with elements of machinery but also the additional covers, stairways , ladders, steel structural platforms for operator's control panels , handrails, partitions etc. which are necessary for safe operation of the plant.

All danger and caution notice boards' shall be in English, Hindi & local languages.

The Contractor must take sufficient care in moving his construction plants and equipment from one place to another so that those may not cause any damage to the property of the Purchaser particularly to the overhead and underground cables and other service lines. When the work is carried out at night or in the obscure day light, adequate arrangements for flood lighting in the working area shall be made by Contractor at his own cost and got approved by the Purchaser / consultant.



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The safety posters/regulation for prevention of accidents shall be displayed by the Contractor at appropriate places. Notices and warning signs shall be displayed for all sources of dangers.

All electrical drives and equipment must be equipped with safety devices. The safety provisions shall conform to the recognized standards, safety codes and statutory regulations.

All safety measures as required to be adopted as per the statutory regulations and the safety rules of the plant shall be strictly followed by the Contractor during the execution of the Contract.

Adequate number of first aid boxes as defined in the State Factory Rules shall be provided and maintained at all work sites.

#### Coding/Numbering Scheme

A coding scheme for identifying the drawings, plant and equipment, structures, spares and shipping documents shall be adopted by the contractor in a sequential manner. The objective shall be to provide the following :

- Streamlined archives management
- Effective control with respect to identification of equipment and drawings to be supplied by different contractors/sub-contractors.
- Identification of the spare parts for easier inventory control.

#### Compliance with rules, regulations, and obtaining statutory approval

All equipment/materials shall be installed in accordance with the requirements of relevant standards, Indian electricity Rules and Acts and also the Factories Act. It is the responsibility of the bidder to see that the electrical installation supplied and erected by him shall be to the entire satisfaction of Chief Electrical Inspector, Central Electricity Authority or any other statutory body having jurisdiction in the area and also to the owner/ consultant.

The responsibility for obtaining the Electrical Inspectorate's approval for the installation and modifications to be carried out rests entirely with the contractor. It shall be the



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responsibility of the contractor to prepare and submit all necessary drawings, calculations, test certificates and relevant details (other than those given by the owner/consultant) to the Electrical Inspector and obtain prior approval for commencing the work and for the complete installation work done.

#### **Instruction Manuals**

Instruction manual shall give step by step procedure for :

- 1 Erection, testing and commissioning
- 2 Operation
- 3 Maintenance and Repair.

Maintenance instruction shall include:

- 1 Diagnostic trouble shooting / fault location charts
- 2 Tests for checking of proper functioning.
- 3 Periodic Maintenance schedule.

Instruction manual shall also contain:

- 1 Manufacturer's catalogues with ordering specification for all items.
- 2 List of consumables with specifications, brand names and annual consumption figures.
- 3 Drawings relevant for erection, operation, maintenance and repair of the equipment.
- 4 Procedure for ordering spares.

## DESCRIPTION OF EXISTING PLANT & SYSTEM

CHAPTER NO - 05





#### 5.00 DESCRIPTION OF EXISTING PLANT & SYSTEM

#### 5.01 Description of Maithon Power house.

Maithon Hydel Station (MHS) is located below the water level and access to the power house is through a house-shoe shaped tunnel about 700feet long. The size of the tunnel and the gradient permit transportation of the heavy equipment in to the power station. Entrance of the tunnel will be fitted with rolling steel doors with small door for personnel entrance. The turbines are placed in niches each of which measures 43ft long 17.7 wide 17 ft high. The generators are placed in the machine hall measuring 62.48m (205ft) long 13.71m (45ft) wide 19.81m (65 ft) high. The roof is arch shaped with proper reinforcement and lining wherever necessary. The access to each turbine is through a vault from the machine hall. The main power Transformers are also located underground in vaults located alongside the access tunnel. The L.T AC and DC equipment are located on the switch gear floor of the power house. An emergency shaft 3.66m (12 ft) in diameter and 56m (184 ft) deep with a spiral staircase provides exists to the roadway on the top of the dam.

For handling of equipment within power station a 115 T travelling crane having two trolley each equipment with 57.5 T capacity hoist is provided. The crane is also equipped with monorail hoist and dismantling track running on rails has been provided.

An emergency shaft 3.65m (12 ft) in diameter and 56m (184ft) height with spiral stair case provided exists to the roadways on the top of dam.

Layout drawings of Maithon power house, inlet tunnel, emergency exits and other available drawings are provided in Volume-IV of this technical specification.

SI no.	Details	Description
1.	Name of the Project	Maithon Hydel Station
2.	Type of Hydro Plant	Storage Reservoir type Hydro power plant with horizontal shaft Francis turbine.
3.	Location of Hydro Plant	Maithon Hydel Station is a underground Power house is located on the river Barakar, Near the border of Dhanbad (Jharkhand) & West

The details of Maithon Hydel Station are as given in the table below:-



MAITHON HYDEL STATION

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SI no.	Details	Description
		Burdwan (West Bengal) districts of the states
		of Jharkhand & West Bengal respectively
4.	No of Unit	Three (3)
5.	Name of the supplier	Unit 1&3: NEYRPIC, France/ SIMENES
		Unit # 2 : ALSTOM & BHEL consortium
6.	Installed capacity	Rated Rating : 63.2 MW
		Unit # 1 : 20 MW Unit # 2 : 23 2 MW (up-rated rating)
		Unit # 3 : 20 MW
7.	Year of Commissioning	
	Unit No. 1	October 1957
	Unit No. 2	May 1958 (Up rated on -2005-06)
	Unit No. 3	December 1958
8.	Type of turbine	Horizontal Francis Turbine
9.	Rated Head	Maximum Net head: 38.71m (127 ft)
		Rated net head : 34.4m (113ft)
		Minimum net head : 24.08m (79ft)
10.	Rated Discharge	Unit # 1 & 3: 64.5 m3/sec (2275 cusec) at
		rated head
		Unit # 2. : 72.64 m3/s
11.	Water Source	Maithon Reservoir on river Barakar
12.	Reservoir's details	Top of Flood level: EL 500 ft/ 152.4m
		Maximum Power Pool: EL480ft/146.3m
		Normal Power pool: EL460ft /140.2m
		Minimum power pool: EL435ft /132.5m.
13.	Generator	25000 KVA, 11 KV



MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

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SI no.	Details	Description
14.	Location	At & Post: Kalyaneshwari
		District : West Bardhanman
		State : West Bengal
13.	Approach to site:	24 km from Asansol, 45 km from Dhanbad
	By Road	Nearest Railway stations are at Kumardhubi,
	By Rail	Barakar (small station) Asansol and Dhanbad
	By Air	Nearest Air Port is Kazi Nazrul Air port,
		Durgapur

#### Details of the floor levels of the Power House Building are as under:

SI no.	Description	Floor levels
1.	Depth of the power house from Road ways	184 ft (56.083m)
2.	Road level (entry to power house)	401 ft.(122.225m)
3.	Generator floor level (machine hall)	328 ft.(99.974m)
4.	Turbine floor level	324 ft.(98.755m)
5.	Draft tube handling/ Surge chamber level	358 ft.(109.118m)
6.	Switch gear (Basement) floor level	310.5 ft.(94.64m)
7.	Center line of Turbine	332 ft.(101.194m)

#### Maithon Reservoir Details

SI no	Description	Elevation
1.	Top of flood control pool	152.4m (500ft)
2.	Maximum flood level	150.876m (495ft)
3.	Maximum Power Pool	146.304m (480ft)
4.	Normal Power pool	140.208m (460ft)
5.	Minimum Power Pool	132.588m (435ft)
6.	Drainage area	2430 sq miles (6293 sq km)
7.	Type & no of gate	Redial , 12 nos
8.	Design Discharge	13,592 Cumes (480000Cusec)





#### 5.02 TURBINE AND ASSOCIATED EQUIPMENT

#### a. Turbine

The turbine is horizontal shaft, Francis type, with plate steel spiral case, straight conical type draft tube, and actuator type oil pressure governor system. The rotation of the turbines shall be clockwise when looking from the generator toward the turbine. The turbine is designed to develop an output of 27,750 BHP each, under the maximum net head of 38.71m (127 ft).

Particulars	Description
Name of Supplier	NEYRPIC, France (unit # 1 & 3)
Type of Turbine	Horizontal Francis type
Installed Rated Capacity	20 MW
Maximum Net head	38.71m (127 ft)
Rated net head	34.4m (113ft)
Average head	31.69m (104 ft)
Minimum net head	24.08m (79ft)
Rated Full Load Discharge	2275 cusec (64.5 m3/sec) at rated net head
Normal Speed	176.5 rpm
Runaway Speed	350rpm

#### b. Runner

The runner of the Francis turbine is of annealed cast steel in one piece. A runner cone is attached to the hub of the runner to guide the water as it leaves the runner. Ample numbers of vent holes through the runner hub is provided to relieve pressure under the head cover. Bolted connection has been provided for attaching the runner with shaft.

Particulars	Description
Diameter	3000 mm
Material of hub	Annealed cast steel
No. of Blades	15
Weight of turbine rotor	12 ton





#### c. Wicket Gate (Guide Vanes)

The wicket gates are made of annealed cast steel with integrally cast stems ground to a smooth contour and machined on top and bottom and along the line of contact at full closure. All gates are interchangeable. Each gate stem are provided with three bronze bushed, grease lubricated guide bearings, one located in the bottom ring and the other two in the head cover. Each gate stem is also provided with a suitable bronze thrust bearing arranged to resist thrust in either direction. The gate stems are provided with holes through their entire length carrying pipes for grease lubrication of the inner stem bearings and the inner ends shall have rounded or tapered edges to facilitate entering the bushings. Grease connections were provided for pressure lubricating of each gate stem bearing but the same is not working condition.

Shear pin are provided between each gate lever and the operating ring, designed to be the weakest element which will break in case one or more gates become blocked.

Particulars	Description
Number of wicket gates	24 nos.
Type of Lubrication	Grease lubricated

#### d. Stay vane

Twelve nos. (12) Stay vane has been has been provided in the scroll case to guide the water and strength. Both sides are welded with scroll case. The stay ring is made from annealed cast steel. The stay ring is designed to withstand hydraulic thrust to maximum static head 198 ft, plus a possible pressure head of 48 feet in the draft tube due to tail water rise during extreme flood.

#### e. Wicket Gate Servomotors

Two nos. vertical type, servomotors were installed in the machine hall for movement of the wicket gates of each turbine. Double-acting, hydraulic operated servomotors are installed for operation of the wicket gates. The maximum operating oil pressure is 300 psi. The operation of the servomotors is controlled by a governor actuator. Mechanical locking device is provided on one of the servomotors for holding the turbine gates securely in open of closed position. Stopper is being provided right side of the servo motor to prevent collision.





#### f. Head Cover

The head cover is made of cast steel properly stress-relieved and split in circumferentially to form outer and inner head cover sections. Marshall Type carbon seal renders water tight in the passage through the head cover which takes that shaft. It is supported by a ring in two pieces fixed to the head cover and bears on the shaft though a stainless steel wear plate. Provision is made for supplying grease under pressure to the gate stem bushings but the same is not working condition. Drains are provided for any leakage water from the packing boxes.

#### g. Turbine Shaft, intermediate shaft & Coupling bolts

The turbine shaft is made of forged open hearth steel properly heat treated. Turbine shaft is in two sections. Main and extension turbine shafts are coupled through integrally forged flanged couplings. The shafts is connected to the extension shaft (intermediate shaft) and the extension shaft is connected to generator via forged flanged male half coupling for connection to a similar female half coupling on the generator shaft. The turbine shaft has an integrally forged flanged male half coupling for connection to the runner.

Particulars	Description
Diameter of the turbine shaft	600-640mm (approx)
Outside diameter of intermediate shaft	640 mm (approx)
Thickness of the intermediate shaft	230 mm (approx)
Length of intermediate shaft	7400 mm (approx)
Weight of the turbine shaft	Ten (10) Ton

Turbine coupling is integrally forged flange type Metal guard shall be provided to cover the bolts and nuts on the couplings between the generator and extension shaft and between the extension and main turbine shafts.

Particulars	Description
Outside dia of the flanged	1065 mm (approx)
PCD of coupling bolt	900 mm (approx)
Number of coupling bolt between turbine and generator	Fourteen (14) nos.



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Bolt diameter	75 mm.
Bolt head diameter (major)	137 mm.
Bolt head diameter (minor)	120 mm.
Length of Bolt	485 mm.
Length of Nut	85 mm.

#### h. Turbine Bearing & Thrust Bearing

The turbine bearing is Babbitt-lined, oil lubricated type located near the runner. The thrust bearing is capable of withstanding the maximum hydraulic thrust from the runner in both directions. The turbine bearing is split in two parts horizontally and fit into a cast iron housing mounted in the head cover and supported on a pedestal. Same is self aligning type with a spherical seat. The Babbitt lining is peened, grooved for lubricant circulation, bored, scraped and polished to proper fit on the shaft. Shims, dowel pins and hold-down pins and hold-down bolts is provided.

The thrust bearing consists of a number of flexible pads lined with white metal. Two collars of the thrust bearing will be machined from the turbine shaft itself and carefully polished. The bearing permits axial movement of the shaft necessary for adjusting the thrust bearing and for clearing the male and female portions of the coupling.

Lubrication is self contained. To facilitate starting, a high pressure pump has been provided for supplying oil under pressure to the underside of the bearing journal vide high pressure pump. The pump motor is 400 volt, 3 phases, 50 cycles. Most of the oil piping was of seamless copper tubing with brass solder joint fittings. Automatic operation of pump for starting and stopping is not working and presently it is operated manually. The guide bearing is self lubricating by means of lubricating rings. The two thrust blocks are also self lubricating type.

The hot lubricating oil from combined thrust and guide bearing is cooled by circulation of water through passages formed in the lower half of the bearing barrel as well as by two heat exchangers. Presently the cooling system (heat exchangers) is not sufficient to maintain the bearing at normal working temperature and hence one no additional heat exchanger (outside) has been installed to maintain the lube oil temperature.





#### i. Spiral Case:

The spiral case and extension is of welded plate steel construction and designed for the maximum static head of 198 feet without exceeding a unit tensile stress of 12,000 psi on any section. The inlet diameter of spiral case is 13'-0" and made of plate steel 3/8" thick. The necessary butt strap is provided for making the circumferential riveted joint to the penstock and the rivets for joining the butt straps to the spiral case extension and penstock. The spiral case and stay ring in close contact by bolts and rivets.

Specification of the Spiral casing is as follows:

Description	Particulars
Inlet diameter	13 ft
Position	vertical
Material	Welded steel plate
Plate Thickness	3/8" thick inch

There is a connection of six (6) inch pipe size for draining the water from spiral case to sump is located at the lowest point of the spiral case. A vent pipe is connected to the highest point of the spiral case (adjacent spiral inlet section), for disposal of trapped air.

Two man doors has been provided and equipped with a hinged cover and with backing out screws has been provided. The manhole doors were located approximately in a vertical plane through the unit on the turbine vault side of the spiral, one above and one below the shaft centre line.

#### j. Trash Rack:-

Trash Rack prevents water-borne debris (such as logs, boats, animals, masses of cut waterweed, etc.) from entering the intake of a hydel turbine.

Details of the trash rack are:

Description	Particulars
Height	13.75 ft.
Width	13.23 ft.
Weight	3.415 T
No of Trash rack	Six (6) nos. for each Unit.





#### k. Intake Emergency gate:

One number emergency gate is common for all three units. Emergency gate usually lowered during the maintenance of the intake gate. Vertical lift type measuring 14'-0" wide x 27'-4" height has been provided up-steam of the gate. Emergency gate is handled by means of a lifting beam attached to the intake gantry crane operating along a runway traversing the length of the intake depth. The gantry also service for installing and dismantling the intake gates and hoists. Emergency gates are rusted and rubber seals are in damaged condition.

Description	Particulars
Height	8.473m (27.8 ft.)
Width	4.45m (14.6 ft.)
Weight	23.3 T
Number of gate	One (1) no. [common for all the three units]

#### I. Intake Service Gate:

The intake structure located beside the reservoir and has separate intakes for three units. Details of the Intake Gate:-

Description	Particulars
Height	24.3 ft
Width	14.6 ft.
Weight	23.3 T
Number of gate	3 nos. [1 no. for each unit]

The emergency gate is handled by means of a lifting beam attached to the intake gantry crane operating along a runway traversing the length of the intake depth It is closed by a single leaf vertical lift type service gate operated by individual electrical hoist. To permit repairs after probable operational failure of the service gate or hoist an emergency gate of the single leaf.

#### m. Penstock:

Shape of Intake conduit: Rectangular at mouth gradually transferred to round section of 14ft dia in a concrete length of 60 ft.





Details of the penstock are:

Particulars	Description
Inlet diameter (reservoir end) of the penstock	4.27m (14.00ft)
Outlet diameter (spiral case end)	3.96m (13.00 ft)
Steel plate thickness	9.5mm
Length of penstock	45.70m (150.00ft) steel lined length
	66.75m (219 ft approx) total length
	(varies)
Thickness	9.52mm (3/8 inch)

Available drawings of penstock are enclosed in volume- IV.

#### n. Draft tube gate handling area (Surge chamber as designated by DVC personnel):

Draft tube gate handling area (Surge chamber as indicated by DVC personnel) is located downstream of the power station and directly above the draft tube outlets. The chamber is common to all three units. The surge chamber is designed to dissipate a surge which might occur from sudden rejection of full load from three units simultaneously with a tail water elevation corresponding to the normal flood discharge of 7000 Acft. Surge chamber also serves as the operating space of the draft tube gates. Suitable access of the surge chamber is also provided.

#### o. Draft Tube:

The Draft tube is of straight conical type with diameter increases from 3m to 6m. It consists of a liner of welded steel plate construction heavily ribbed all around for anchorage. The approx length of draft tube is 16.31m. Length of the steel lined plate is 15.24m and rest of the draft tube is made of concrete extending up to the tailrace. Corrosion is observed at few areas on the draft tube, metal loss also observed in the welding area.

For dewatering of the draft tube, pipe connection with valves has been provided. Presently water equalization system is not working. Water equalization valve has been installed in the surge chamber. However same is not in working condition since long and remain in open condition.

Available drawings of draft tube are enclosed in volume- IV.





#### p. Draft tube gate :

One nos. draft tube gate has been provided for one nos. unit. Height of the gate is 20'6'' and width of the date is 20' 2(3/8)''. Available drawings of the draft tube gate are enclosed in Vol –IV.

#### q. Tunnel & Channel:

Short separate tail tunnel is provided for each unit at the downstream of the surge chamber. These tunnels merge into common tunnel which ultimately joints the open channel. Cross section of the tunnel is horse shoe type. Length of the open channel is approx 300m and ultimately joins to Barakar river.

#### r. EOT Crane :

For handling equipment within the power house a 115 ton travelling crane, having two trolleys each of 57.5 ton capacity hoist, is provided. The crane is also equipped with a monorail hoists and a dismantling truck running on rails have been provided. An equipment hutch in the erection bay permits, lowering of the equipment to the basement for installation.

Particulars	Description
Make	TERNI ETALY
Capacity	115Ton (57.50T X2)

#### s. Monorail.

For dismantling of the turbine cover, etc. one no monorail has been provided in the each turbine vault. Two no lifting tackles of 10 ton capacity with travel by hand with electrical lift operation has been provided. At present only two nos. lifting tackles are available for three nos. units.

Available details are indicated as under:

Particulars	Description
Capacity	10 Ton
Maximum lift	32 ft.
Lifting speed of monorail	12fpm hoist hook





#### t. Compressors :

Two nos. reciprocating air cooled compressor is installed to meet the air requirement of breaking system as well as governor. The compressor is tank mounted "V" type machine. Compressors including pipe, valves and fittings are quite old.

Details of the compressor as follows:

Particulars	Description
Make	ELGI
Model no.	THPC -300
Discharge Pressure	30kg/cm2
Capacity	13m <sup>3</sup> /hr.
RPM	950
Tank capacity	0.250m <sup>3</sup>
Installation date	August 81

#### u. Dewatering system

Four (4) nos. dewatering pump have been installed for the power house. All the four (04) pumps are working in alternate manner. Apart that two nos.. diesel driven pump used for dewatering system when electric power is not available.

Details of the pumps are as follows.

Particulars	Description
Make	KIRLOSKAR
Rated head	25.49 m
Rated flow	226.90 m <sup>3</sup> /hr
Rated RPM	1490
Motor capacity	30kW

Details of Diesel pump set are as follows:



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Particulars	Description
Make	KIRLOSKAR
Туре	B4 Series- II
BHP	40
RPM	1500
Engine No.	20/140273





#### 3.02 GENERATOR & ELECTRICS

#### a. Generator:

Generator is horizontal shaft, hydraulic turbine driven type with rated capacity of 25000KVA (20MW) at 0.8 power factor 11KV, 176.5 rpm, 50Hz, 3 phases. The generator is equipped with direct connected main exciter and geared pilot exciter, rapidyne permanent magnet generator, voltage regulator and excitation and supervisory cubicles.

The generators are designed for unearthed operation. Earthing will be effected on the 11KV side by means of a five limbed three phase three winding potential transformer. The insulation of the stator, rotor and exciting machines is class B.

The rotor comprises two pole wheels pressed on to generator shaft. The pole pieces are of the solid pole beam type with welded pole shoe laminations and are fastened to the rotor rim by means of screwed bolts. A pneumatic brake acts on the break ring and is design to bring the machine to rest from a speed of 40-45 rpm in 5 minutes.

Particulars	Description
Туре	PFL 670/47-34
Serial no	Generator #1 D 73 443
	Generator #3 D 73 445
Rated output	25000 kVA
Voltage	11000 <u>+</u> 5% V
No of generator magnetic poles	34 nos.
Current	1310A
Power factor	0.8 lag
Speed	176.5 rpm
Runaway speed	350 rpm
Excitation voltage	335V

#### **Details of Generator**

The machines are capable of delivering 29000kVA continuously at 11000 + 5 % V and 0.8 p.f.

**Ventilation** is of the closed circuit system. Eight (8) coolers are provided in the generator pit. The coolers are designed for a 35<sup>o</sup>C. Flow alarms are provided in the cooling water line for the air coolers and for the bearing and in the bearing oil lines.

The generators has temperature detector embedded in the stator winding, in the bearings





and in the cooling air. In addition to the usual brushes on the slip rings, an extra set of collector ring brushed, brush holder and terminals are provided for operating a rotor temperature detector.

**Bearing** are located on either side of generator. Two oil rings are provided on the on the shaft in the each bearing. One AC and one DC standby oil pump rated at 4kW,415V,3 phases,50 cycle and 220V DC respectively are provided for the purpose of lubrication. Two nos. bearing oil surface cooler are provided to cool the lubricating oil. The bearings are designed to operate at a temperature of 60 degree. Two jacking pumps each rated at 1.5kW, 220 volts DC are provided on each bearing to lift the rotor during starting and shutdown. All bearing are insulated to prevent flow of shaft currents.

#### Main Exciter

Particulars	Description
Make	Simens- Germany
DC	Generator
Туре	GV 441/36
RPM	176.5
Exciter	V-148, A-14

#### Repidine (Automatic voltage regulator)

Particulars	Description
Make	Simens- Germany
DC	Generator
Туре	RGA-1900-2
RPM	1485
kW	5.2

#### **Pilot Exciter**

Particulars	Description
Make	HANS STIL AG HAMBURG
DC Generator no.	533357
Туре	GV 150EK
Volt	230



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Amp	15.6
kW	3.6
RPM	1490

#### a. Generator Termination Cubicle (11 kV Cubicle)

Generator termination cubicle is divided into four compartments and it consists of current transformers, potential transformers, copper strips of each phase from generator, outgoing cables connection for generator transformer, tapping for unit auxiliary transformer.

#### b. Neutral Grounding Cubicle

The generator neutral is grounded through an inductor just outside generator barrel but inside the generator cubicle. 3 nos. of line side CTs are also located here.

#### c. Governor:

The governing system for each turbine to control the speed comprises of actuator, servo motor return motion mechanism, oil pressure tank, two AC motor-driven oil pumps & one stand-by DC motor driven pump, manual & electrical control devices etc. All of these, expecting servo meters are mounted inside a steel cabinet located in the machine hall.

All the controls for starting, regulating the speed & stopping of the turbine are mounted on the actuator cabinet. The gate limiting & speed adjusting devices are electrical motor driven to enable remote control.

Normal operating oil pressure is 260psi-290psi. The servo motor for operating the turbine wicket gates are operated by the oil pressure.

#### d. Generator Transformers:

Three (3) Phase generator transformer for each unit is located in separate vault adjacent to access tunnel. Brief specification of existing Unit # 1 & 3 generator transformer is as follows:

Particulars	Description
Make	ASEA





## MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



Rated kVA	25 MVA
Rated Voltage Ratio	11kV/33kV
Frequency	50Hz.
Type of Cooling	OFW
Vector Group	Yd1
Impedance	10%

Generator transformer is connected to generator through 11kV Bus duct and evacuation of power is through 33kV cables.

Oil water cooled transformers are equipped with two coolers. The oil pump motors are rated at 2.2HP.415V 3 phase, 50Hz AC. The coolers are design for cooling water temperature of 35°C and pressure of 6 PSI. Cooling water is tapped from the turbine scroll case and hence reduced in pressure from header pressure of 61/34 psi. The water flow from the cooler drains under gravity to sump and from there to the tailrace by the sump pumps. The quantity of water required per cooler is 80 g.p.m.

The transformer is provided with offload ratio adjusted rated KVA output and a voltage variation of (-7.5% +5% at the step of 2.5%).

Signalling and tripping contacts for failure of oil and water flow, mal operation of tap changer, excessive winding temperature gas production, oil turbulence and other usual devices are provided.

Each transformer is located in separate vault adjacent to access tunnel. The vault opening is provided with fire doors (steel) which is being kept normally open. Ventilation of vault is aided by an exhaust fan provided at the top of the 11kV bus duct which exhausts the air in to power house basement. Fire protection is being done by carbon dioxide. In the event of the fire, the exhaust fan will shut down and steel doors will close under pressure and fusible link tripping.

Bus bar connection between generator and transformers primary windings are designed for 1500amps capacity, and will consist of aluminium flats. Bus bars are layout in a single tier formation and are suspended from the roof in the cable gallery.




### e. Auxiliary power supply: 415 V AC supply

Auxiliary power supply in underground is at 415V, 3-phase, 50Hz AC .All auxiliary AC power derived from grid or generators. Each Unit Auxiliary transformer is fed either through generator in operation or from reverses feeding through grid.

Specification of UAT # 1	
Make	Raychem RPG (YOM-2013)
Туре	Dry type transformer
Rating	400KVA.
Ratio	11kV/0.433KV, Dyn 11
Phase	Зф
Frequency	50 Hz.

Specification of UAT # 2 & 3	
Make	Kirloskar Power Equipment ltd.
Туре	Dry type transformer
Rating	400KVA.
Ratio	11kV/0.433KV
Connection/ Vector Group	Dyn11
Phase	Зф
Frequency	50 Hz.

The 415V AC main service board is divided in to two sections. One section is feed by UAT#1 and other section is feed by UAT # 2 & UAT # 3. The two sections are connected by means of a bus coupler. The AC auxiliary power in underground power house is controlled from control panels located in operation floor. This panel control all the three transformer incoming 415V breakers.

The power requirement of the switchyard and dam auxiliary are obtained from Earthing transformer # 1 or 2.





### DC system

There are two sets of DC system. One set at Power House (under ground) and other set at Control Room (over ground). Each DC System consists of Battery bank, corresponding battery charger and DC Distribution Board. DC system has also 3 nos. MG sets (3 phase, 50c/s, 15kW, 970rpm motor and 220 – 300V Generator). The existing system details are as below:

Battery Bank, Battery Charger inside Power House & Control Room:

(a) Charger

SI. No. 3076/1 & 3076/2,

Type: Automatic Float Cum Boost Charger,

AC Input : 415V±10%, 4Wire, 50Hz±3%

Output Volt : 252V DC (at Float mode)

Upto 2.75V/Cell (at Boost mode)

Output Current: 150A (at Float mode)

Starting rate: 28A, Finishing rate: 14A (at Boost mode)

Make: Chloride Power Systems & Solutions Ltd.

- (b) Battery
  - Type: Plante Capacity: 200AH No of Cells: 112, Nominal Voltage:2.2V Make: EXIDE Location: Inside Power House & Control Room

### 3.03 132/33 kV SWITCHYARD

#### 33kV SYSTEM

33kV outdoor switchyard consists of two bus (Main and Transfer bus) and following bays :

- 3 nos. generator transformer (GT) bay each consists of isolators, circuit breakers, current transformers. GT Bay #1 & GT Bay # 3 also consists of 33kV/415V, 250 kVA earthing transformer.
- 7 nos. feeder bays namely
  - MHS-Right bank(R/B#1)
  - MHS-Right bank(R/B#2)



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- > MHS-Kulti (K#1)
- MHS-Kulti (K#2)
- > MHS-Chitranjan Locomotive Works (CLW#1)
- > MHS-Chitranjan Locomotive Works (CLW#2)
- MHS-Chitranjan Locomotive Works (CLW#3)

Each bay consists of isolators, current transformers and circuit breaker

- 2 nos. bus coupler bays consists of isolators, circuit breakers
- 2 nos. bays for two nos. 33/132 kV, 50MVA Transformer consists of isolators, current transformers and circuit breaker.
- Each bus (Main & transfer) has one set of Potential Transformer.

#### 132 kV SYSTEM

132 kV outdoor switchyard consists of two bus (Main and Transfer bus) and following bays :

- 2 nos. 33/132 kV, 50 MVA Transformer bays
- 1 no. Bus Coupler bay
- 7 nos. 132kV feeder bays namely
  - MHS-Patherdih (L#66)
  - MHS-Patherdih (L#67)
  - MHS-Kumardhubi(L#16)
  - MHS-PHS(L#17)
  - MHS-Jamtara(L#34)
  - MHS-Kalyaneshwari(L#68)
  - MHS-Kalyaneshwari(L#69)

The main components of 132 kV switchyard are 132 kV Circuit breaker, current transformer, Potential Transformer, Wave Trap, Capacitor Voltage Transformer, Isolator and Lightning arrestor etc.

### 4.0 CO<sub>2</sub> Based fire fighting system.

Presently Intelligent addressable microprocessor based FDA and  $CO_2$  gas fire fighting system already installed for the Turbine Generators & Generator Transformers in the Maithon Hydel Station.  $CO_2$  cylinder banks along with auxiliaries have been placed in switchgear floor (310.50ft) of the TG building.  $CO_2$  nozzles has been provided in different level of the



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generator transformers room and turbine generators for dissipation of  $CO_2$  in case of fire and same is connected with  $CO_2$  banks with piping.

SI no.	CO <sub>2</sub> system for Turbine Generator.(three nos)	Numbers
i.	CO <sub>2</sub> cylinder 68 liter (45.4kg)	18 nos
ii.	Slave cylinder valve	14 nos
iii.	Master cylinder valve with Elect. actuator	4 nos
iv.	Operating pressure	60kg/cm2
V.	Smoke detector	6 nos
vi.	Heat detector	6 nos

SI no	CO <sub>2</sub> system for Generator transformer.(three nos)	Numbers
i.	CO <sub>2</sub> cylinder 68 liter (45.4kg)	16 nos
ii.	Slave cylinder valve	14 nos
iii.	Master cylinder valve with Elect. actuator	2 nos
iv.	Operating pressure	60kg/cm2
٧.	Smoke detector	6 nos
vi.	Heat detector	6 nos

#### 5.0 Water Based fire fighting system

Fire water hydrant system has been installed in the electrical switch gear floor. Presently fire water connection is tapped from reservoir by gravity. Hose box with fire hose are installed in the switchgear floor and connection are provided near to for Unit # 1 & 3. During inspection, all the valves were inspected and found in acceptable condition. However, leakage water visible from some of the valves. Overhauling of valves is required during shutdown condition.

#### 6.0 Ventilation System

In Maithon Power house, Ventilation system comprises three exhaust fans of the axial flow type, each rated for 40,000 cfm of air under a static water head of 2 inch. The fans are located inside a structure on the top of the emergency exit shaft. The air is drawn in through the main access tunnel and to counter against occasional dust storm the air is fed through mechanical self-cleaning filter. Control louvers of the fixed and adjustable type are provided at key points inside the power house in order to maintain uniform distribution and temperature of the incoming air throughout the power house.



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SI no	Description	Numbers
а.	Main Exhaust Fan complete with the following :	
i.	Vertical type 48" dia. "Air Screw"	3 nos.
	Axial Flow Exhaust Fan complete with fan blades,	
	Fan housing of mild sheet steel stream – lined inlet,	
	Outlet diffuser cone 21" long tapering to 54" Outside dia & accessories –each fan of following	
	Specifications:-	
	Static Pressure - 2.75" Ins. water gauge	
	Speed - 1310 r.p.m.	
ii.	Motor : "Brook" Vertical Drip proof squirrel Gage	3 nos.
	Induction	
	Motors of following specifications :	
	Supply : 400 volts, 3 phase, 50 cycles	
	Rating : 35 H.P.; Full load speed ; 1450 rpm Rotor Current : 320 Amps ; P.L. Current : 45Amps	
b.	Main Exhaust Louvres	
i.	Each louvre in 2 sections and each section Measuring 3' high by 6' wide and having a	6 nos
	Capacity of 10,000 C.ft. of free air per Minute per section and furnished with insect Protection screen.	
С.	Battery Room Exhaust Fan	
i.	Horizontal shaft propeller type, SF type, PMA – 30,	1 nos.
	arrangement – 1, having a capacity Of 160 C.F. /	
	Speed of 14,00 r.p.m consisting of a 12" inch dia	
	Runner mounted on the extended shaft off a squirrel cage	
	Induction motor suitable for operation 400 volts, 3	
d	phase,50 cycles A.C. Supply Mechanical Air Filter	
<u>u.</u>		
i	Mechanical Air Filter of M/S American Air Filter Co.	1 nos.
	Capacity: 82,000 cfm	
	Resistance & Efficiency : 90%, Max_air velocity : 500 F P M_complete with	
	Mechanical drive, capacitor Type motor , automatic	
	control. 0.45 water gauge	

# SCOPE OF WORK, EXISTING FACILITIES & BATTERY LIMIT

CHAPTER NO - 06



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



### 06.0 SCOPE OF WORK, EXISTING FACILITIES & BATTERY LIMIT

### 06.01 Scope of work

The broad scope of work for Unit # 1 & 3 are as follows. The descriptions, type & information indicated are typical in nature and indicated as per single unit. Bidder shall utilized data/ information for unit # 1 & 3 as per scope of work.

- a) Isolation of both Units # 1 & 3 from upstream (reservoir end) and downstream side (draft tube end) and dewatering the system before start of R&M activities. Existing facilities like intake gates (both service gate & emergency gate), draft tube gate, handling & hoisting facilities and dewatering system shall be utilized. Engagement of divers and material required for sealing & isolation are included in bidder's scope of work. Isolation of Unit # 1 & 3, (both ends) dewatering and making the system ready and safe in all respect before starting of R&M activities is included in bidder's scope of work.
- b) Dismantling of existing Turbine Generators (TGs), transformers set including auxiliaries and accessories like electrical system, cooling water system, ventilation system (partly as per requirement) etc and shifting to these at a suitable storage space. Location of storage space for vendor's site store will be indicated by DVC. However, development of site store under the scope of vendor including developing of roof shed (as per requirement of the project), access road to the site store (if required for transportation) and other needful for proper preservation of supplied materials till erection will be under the scope of vendor.

Vendor's site for storage newly supplied equipment will be approx. 1.5 ~ 2 Km from MHS. Storage space for old dismantled equipment will be about approx. 2~2.5 KM.

- c) Renovate and reuse the Fixed/embedded components: penstock, spiral case, stay Vane, foundation ring, draft tube, draft tube liner, pit liner, and foundation plates and anchorages as detailed in specification.
- d) Assess the condition of various existing civil foundations, strengthen and reuse the foundations.
- e) Collect all the information/dimension, take all measurement, if any, requires carrying out for Computerized Simulation Study (CFD modeling) before manufacturing.
- f) Reverse Engineering shall be done by bidder where the drawings are not available.
- g) Carrying out Design, Computerized Simulation Study (CFD modeling)., manufacturing, inspection and testing, supply, packing for dispatch/shipment, freight and insurance, port handling including custom clearance (if any), loading, transportation to site, store at



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site, complete erection of all the components testing, start up, commissioning, performance testing and handing over of Unit # 1 and Unit # 3 (two nos.), each of capacity 20 MW of horizontal Francis type Hydro turbine-generator set (TG set) to DVC. The TG set includes Francis turbine & Synchronous Generator along with associated auxiliaries; Plant electrics including Step-up transformer and associated equipment; Control & Instrumentation system, associated civil works. Bidder shall ensure that the TG set shall be completed with all materials and equipment whether specifically mentioned herein or not but required for satisfactory operation of the Unit # 1 & 3. The design criteria and detailed scope are described in this chapter and for Transformer & electrical, control & instrumentation & CCVM; please refer - Vol-III of the technical specification.

### Access to Site:

- This site is well connected with NH-02 (between Kolkata and New Delhi) via state Govt. road (PWD road). There are two entry points

   via Kalyaneshwari Temple Road.(West Bengal end)
  - ii. via BSK Collage Road (Jharkhand end via Maithon dam)

Maximum transportation limit via Maithon dam: The spillway bridge of the dam has been designed to carry IRC Class 'A' loading. The clear width of roadway provided is 22 ft". For transportation of generator parts or any other heavy equipment/broad equipment bidder may conduct "Route Survey" during detailed engineering stage.

 The access to the underground power house is through a horse-shoe shaped tunnel about 700 ft long. The size of the tunnel and the gradient permit transportation of heavy equipment into the power house.

Approximate L X W X H of tunnel is as follows: -

Length of the access tunnel = 700 ft. Width of the access tunnel (at bottom) = 14 ft. Height of the access tunnel = 13.5 ft.

#### 06.01.01 Existing Facilities to be Dismantled

The following existing facilities shall be dismantled

• Unit # 1 & 3 Turbine Generator (TG) set including the associated equipment up to 33kV switchyard, electrics and C&I. The broad details of the existing major equipment have been given in **Chapter-05.** 



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- (MECHANICAL & CIVIL)
- All facilities associated with the above including cables, cable structures, maintenance platforms etc.
- Transport/shifting of the dismantled equipment to the store yard and place all the dismantled equipment to the storage yard marked for the purpose.

(Not all tools including special tools required for dismantling are available with Purchaser, however tools as available can be used by bidder, but responsibility of assessment of healthiness of tools will lie with bidder, other tools as required for dismantling to be arrange by bidder)

The broad facilities/equipment to be dismantled are (Typically indicated, applicable for both units # 1 & 3) given in Table below:

### Name of the equipment / facility (typically for two units.)

Turbine assembly and associated equipment including Turbine runner, cone, Turbine shaft, intermediate shaft, guide & thrust bearing, shaft seal, shaft sleeve, Guide vane, discharge ring, etc of two units.

Lubricating Oil system including oil pumps, coolers piping, valves, etc i.e entire system.

Entire wicket gate assembly including levers, linkages, shear pin arrangement, regulating ring, servo motor system including piping valves etc, self lubricating bushes etc.

Generator and associated equipment including stator, rotor, generator shaft, guide bearings, breaking system, Generator air Coolers.

Old Excitation System including Pilot Exciter, Main Exciter, Slip rings mounted above generator including Generator neutral grounding etc.

11 kV Bus-duct from generator to Generator Transformer.

All 11kV panels adjacent to Generator housing

Replacement of existing three phase,11/33 kV, 25000 kVA generator transformer of unit 1 & 3 including Protection and Metering System

33 kV GT Bay: Replacement of existing GT bay circuit breaker with new SF6 / Vacuum circuit breaker.



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### Name of the equipment / facility (typically for two units.)

Replacement isolators by motorized cum manual operating Isolator. Replacement of all Current transformer of GT bays of Unit #1 & 3

Existing 11/0.433 kV, 400 kVA, 3 phase dry type unit auxiliary transformer shall be retained.

220V, 200AH Battery Bank for Power House & Control Room, MG sets and associated panels, One (01) no DCDB for Common Control Room.

33kV cables, LT Power & Control cables etc within battery limit

Current Transformers and Isolators of 33 kV GT Bay # 1 & GT Bay# 3

Earthing System

Oil pit and oil handing system for Generator Transformer

Cooling water system including pumps & accessories, pipe lines, strainer, filters, valves, etc.

Dewatering system including replacement of DG driven dewatering pump, pipes, fitting, valves, pump-motor sets, water float valves with interlock system etc. Replacement of discharge pipe line for the exposed portion including delivery point at surge chamber.

Compressed air system for the units including compressors, air distribution line, pipe, valves and air receivers etc.

Control & Instrumentation system.(excluding governing system)

CCTV system

Complete dismantling in all respect of suction air filter installed at inlet of power house and other equipment for including three nos. ventilation fans ventilation as required system.

Miscellaneous items used in Unit # 1 & 3

#### 06.01.02 Existing facilities to be renovated and utilised.

Fixed/embedded components of Unit # 1 & 3 e.g. penstock, spiral case, stay ring, foundation, draft tube, draft tube liner, pit liner, and foundation plates and anchorages are to be renovated and reused.

RLA reports of both units including findings of NDTs are available with DVC/MECON. The successful bidder may have access the same after placement of order only. However, any NDT or any other test deemed necessary by the bidder for reuse of the component may be accomplished by the bidder prior to start of R&M job.

The detailed renovation scopes are given below:-



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SI. No	Name of the equipment	Details of Renovation activities
i.	Penstock and associated facilities	As detailed in this chapter
ii.	Spiral Case and associated facilities	As detailed in this chapter
iii.	Stay vanes	As detailed in this chapter
iv.	Draft tube and associated facilities	As detailed in this chapter and in civil portion Sec-B (Vol-II)
v.	Ventilation system (fans and ducts)	As describe in this chapter
vi.	Complete cleaning, including civil repairs of the area where damages occurs during R&M works (Unit-1, 2 & 3 area)	As detailed in this chapter

### i. Penstock and associated facilities (Refurbishment)

For improving the efficiency and life of the penstock, the inner surface shall be mechanically (high pressure water jet/ manually/ or other method as required by bidder- subject to approval of purchaser/consultant) & chemically (if required) cleaned. All cavities will be filled up by welding, smooth, finish to smooth curvature profile and painted with water resistant epoxy after suitable surface preparation. For detail painting scheme of pipelines refer Chapter - 04 of this volume. Bidder may propose superior alternative painting /coating scheme for penstock during detailed engineering stage subject to approval of consultant/ client. Penstock is provided with dewatering valve & piping to drain out water to draft tube during maintenance. Penstock dewatering pipeline along with all valves shall be replaced. Existing manual valve shall be replaced with new one (manual valve).

Thickness testing in the lower portion (below bend portion) of penstock has only been carried out and 1~1.25 mm (approx) thickness reduction has been observed in the bottom areas.

However, thickness testing in Upper portion of the penstock has not been carried out due to water leakages. Following scope of work has been included



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- (MECHANICAL & CIVIL)
- a. Thickness measurement of the entire length of the penstock using suitable method to be carried out by bidder. A joint inspection report shall be prepared mentioning the various thicknesses prevalent across the penstock. The bidder shall analyse whether the measured thickness is adequate to withstand the stresses due to design pressure, within the stress limits defined under IS-11639 part-2 or equivalent standard.
  - b. If measured thickness cannot be repaired by weld filling, the same shall be repaired with MS plate lining (if required).
  - c. For bidding purpose, weight of new MS lining plate to be considered by bidder is 8.50 Ton. However, the bidder should submit the unit rate of steel considering supply, fabrication and erection at site in his bid document.
  - d. Payment shall be on the basis of quantum of work actually carried out. Steel consumption of +/- 15% shall be within scope of bidder. If steel consumption during execution is more/ less than +/- 15% over specified quantity, Employer shall pay/ deduct to/ from bidder at already quoted rate of steel plate by bidders.

Note: Plate required for reinforcement of penstock shall be reimbursed by DVC actual basis by DVC as per prevailing DSR rate. Drawing of penstock is provided in Volume –IV. Broad specification of the existing penstock is given below:

Particulars	Description
Inlet diameter (reservoir end) of the penstock.	4.27m (14.00ft)
Outlet diameter (spiral case end)	3.96m (13.00 ft)
Steel plate thickness	9.5mm (3/8 inch)
Length of penstock	45.70m (150.00ft)-steel lined portion /
	66.75m/219ft- total length.
Length of horizontal limb	6.76m (55ft.)
Length of vertical limb	26.95 m (95 ft.)
Angle of bend	89°87'

### ii. Spiral Case and associated facilities (Refurbishment)

The spiral casing is of welded steel plate construction embedded in concrete. The inlet diameter is 3.96m (13 ft) and approx thickness is 10mm (3/8 inch) (varying thickness). The upstream side of the spiral case is welded to penstock.



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Cleaning of spiral case shall be done (high pressure water jet/ manually/ or other method as required by bidder- subject to approval of purchaser/consultant); All cavities will be filled up by weld filling, smooth, smooth curvature profile and painted with water resistant epoxy after suitable surface preparation. Damaged weld portion need to be re-weld after surface preparation. For detail painting scheme of pipelines refer Chapter - 04 of this volume. Bidder may propose superior alternative painting /coating scheme for spiral case during detailed engineering stage subject to approval of consultant/ client. Replacement of all gauges / instruments and manhole seal are included in scope of work. Initial filling line to draft tubes and cooling water lines are connected with spiral casing. Same need to be replaced. (Details indicated in the piping portion).

**Note:** During RLA studies thickness testing of the Spiral case has been carried out and 1~ 1.25mm (approx) reduction of thickness has been observed in bottom areas..

### iii. Stay Vane (Refurbishment)

Twelve nos. (12) Stay vane are available in the scroll case to guide the water to turbine runner. Eroded portion of stay vanes shall be examined by ultrasonic method. The surface of the stay vanes shall be cleaned of mud and rust, etc. (high pressure water jet/manually/alumina blasting or other method as required by bidder- subject to approval of purchaser/consultant). The eroded portion of the stay vanes shall be weld filled and machined smooth and painted with water resistant epoxy paint after surface preparation. Bidder may propose superior alternative painting /coating scheme for stay vane during detailed engineering stage subject to approval of consultant/ client.

### iv. Draft Tube (Refurbishment)

Draft tube is of straight conical type with diameter increases from 3m to 6m. It consists of a liner of welded steel plate construction. The approx length of draft tube is 16.31m. Length of the steel lined plate is 15.24m (approx) and the rest of the draft tube is made of concrete extending up to the tailrace. Corrosion is observed at few areas on the draft tube, metal loss is also observed in the welded area.

As per NDT test reports there are some defect was observed in draft tube concrete zone. Details of the civil repairing methods are indicated in civil portion (Sect-B) of tender specification.

During inspection high scaling, deposition of mud, and pitting, corrosion and erosion were





observed. Weld area also damaged condition.

Draft tube to be cleaned with high pressure water jet/ manually/ or other method as required by bidder- subject to approval of purchaser/consultant). All cavities shall be filled up by welding, machined to smooth curvatures and painted with water resistant epoxy paint after surface preparation. Damaged weld portion to be re-welded. Draft tube manholes to be refurbished. Bidder may propose superior alternative painting /coating scheme for Draft tube liner during detailed engineering stage subject to approval of consultant/ client.

Rung ladders both Unit # 1& 3 are in damaged condition. Same need to be replaced with new. For drawing of existing draft tube refer Vol –IV of the technical specification.

### v. Ventilation System (Refurbishment & Modification)

Ventilation room is located at top of the emergency exit to meet the total ventilation air requirement of the power house. The air is drawn in through the main access tunnel and to counter against occasional dust storm the air is fed through mechanical self-cleaning suction filter. Details of the ventilation system indicated in the Chapter -05.

Intake filter installed at main access tunnel need to be replaced along with control system and instrumentation facilities. All three (3) nos. ventilation fans along with motors are recommended for replacement with control & power panel with remote ON/OFF including cabling. In case of tripping of running ventilation fan, stand by ventilation shall be started automatically. Existing ventilation duct shall be replaced with new one with Colour coated sheet/GI sheet (minimum 6mm thk.). Control Louvers installed at power house, ventilation room and ventilation duct also require to be replaced. Ventilation system should be interlocked with the fire protection system i.e. in the event of fire in any area fire sensor will give signal for tripping the ventilation fan of that area. Specification of existing self cleaning filter is indicated in at the end of this chapter. For Drawing of ventilation system refer Vol –IV of the technical specification.

#### vi. Complete Unit-1, 2 & 3 area

Cleaning of the area (Unit # 1, 2 & 3 and GT area) including civil repairs of the area where damages occurs during R&M works.



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### 06.01.03 Supply/ Erection of Plant & Equipment (Typical):

The broad scopes of supply of new equipment /facilities are as follows.

SI. No	Name of Equipment / facility	Unit	Qty
Α	Turbine, Generator & Associated Equipment		
i.	Horizontal Francis turbine suitable for generating 20 MW		
	at Generator terminals at rated head and discharge	Set	2
	complete with all associated equipment (except embedded	001	2
	parts) and auxiliaries.		
ii	Generator, its auxiliaries and its associated equipment	Set	2
iii	Excitation system & Voltage regulator	Set	2
iv	Cooling water system	lot	1
V	Diesel driven dewatering pumping system	lot	1
vi	Compressed air system (compressors, air piping,	lot	1
	valves, fittings and valves including all auxiliaries.)		1
vii	Ventilation fan motor along with refurbishment of the	lot	1
	system		1
vii	Refurbishment & Re-installation Common CO <sub>2</sub> based	set	2
	fire fighting system for Generator # 1 & 3.		2
В	Electrical Equipment		
i.	11/33kV, 25MVA, 3 Phase, 50Hz Generator	Set	2
	Transformer		
ii	33kV Circuit Breaker	Set	2
iii	33kV motorized cum manual operating isolator,	Set	8
iv	33 kV Current Transformer	Set	6
V.	Gantry structure, conductors, insulators, clamps,	lot	1
	switchyard.		
vi	11kV motorized UAT#1 isolator with CTs and cubicle	No	1
vii	11kV Panels consists of PTs, CTs, Surge protection	Set	2
	equipment etc		
viii	Generator Neutral Grounding Cubicle	Set	2
ix	Metering & Protection panels	Set	2
x	HT Bus duct	Set	2



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SI. No	Name of Equipment / facility	Unit	Qty
xi	Generator Disconnecting Switch	Set	2
xii	Change over panel for chargers	Set	2
xiii	DC Distribution Board (DCDB) for Control Room	lot	1
xiv	Local Control Station / Local push button system	Set	2
xv	Float-1 & 2 cum Boost Battery Charger	Set	2
xvi	Power and Control Cable	Set	2
xvii	Cable tray & its supporting Structure	Set	2
xviii	Illumination system	lot	1
xix	Earthing materials	lot	1
xx	Fire detection & alarm system (FDA)	lot	1
ххі	Fire Fighting system	lot	1
C	Control & Instrumentation		
i	Control & Instrumentation system as per scope	Set	2
ii	IP Based closed circuit video monitoring (CCVM)	lot	1
	system including all auxiliaries.		-
D	Civil Works		
i	Civil works as per scope	1.5	
	(As detailed in specification and as per requirement)	20	1
Е	Spares, Tools & Tackles		
i	Mandatory spares as per list	Lot	1
ii	Commissioning spares	Set.	1
iv	Special Tool & tackles	Set.	1
v	List of Operation & Maintenance spare parts, tools for		
	two years (only list along with price list)		
G	Miscellaneous items, if any	Lot	2



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#### 06.01.04 Battery Limits:

The scope of Renovation and modernization of Unit # 1 & 3 of Maithon Hydel Station shall start from Penstock up to draft tube end. Complete electrics and C&I up to drives and civil works in open channel portion are included. Power evacuation up to 33kV switch yard shall also include in bidder's scope.

### 06.01.05 Facilities Already Installed For the Proposed Unit

- Penstocks, Scroll cases, Stay vanes, Draft tubes, Power House, EOT Crane, intake gates (emergency & service gate) & hoist and the Draft tube gates & hoists and Tailrace tunnel & channel are already constructed/installed and to be utilized for the proposed Unit # 1 & 3. Details of equipment indicated in chapter-05 and available drawings provided in Vol-IV.
- For Space available inside power house, refer layout details of the power house enclosed with TS.

#### 06.01.06 Design Criteria and Detailed Scope Of Work

#### A) Reference documents

IEC 60041:1992, Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines

IEC 60193:2019, International code for model acceptance tests of hydraulic turbines

IEC 60308:1970, International code for testing of speed governing systems for hydraulic turbines

IEC 60545:1976, Guide for commissioning, operation and maintenance of hydraulic turbines

IEC 60609:1978, Cavitations pitting evaluation in hydraulic turbines, storage pumps and pump turbines

IEC 60994:1991, Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump-turbines)

ISO 20816 (latest)-5: Mechanical vibrations of non-reciprocating machinesmeasurements on rotating shafts and evaluation criteria of machines set in hydraulic power generating and pumping plants.





IEC 61362,34 Guide to specification of hydro-turbine control systems

ISO 3740:1980, Acoustics – Determination of sound power levels of noise sources – Guidelines for the use of basic standards and for the preparation of noise test codes.

### B) Design criteria

Bidder shall assess and confirm the possibilities of accommodation of new Turbine Generator (TG) system in the provided existing space before putting up the bids. Necessary modification if required shall also be included in the scope of bidder. Bidder may carry out overall inspection of the units as may be considered necessary over and above the data/information provided herein, so as to achieve the desired outputs. Bidder shall be solely responsible for arriving at the desired performance and should not make any plea of non availability/incorrectness of data etc. as the criteria for not achieving the output on later. Bidder shall visit the site, study the existing machines in detail satisfy himself/ herself with plant details before putting up the offer. The Bidder shall try to supply the equipment and spare from the Indian market to the maximum extent possible.

The project location is under Seismic Zone-III as per IS:1893 Part-3. Seismic forces shall be calculated as per latest IS:1893.

The details of existing plant are already described in the **Chapter 05** of **Volume II** and available drawings provided in **Volume-IV** of the technical specification.

#### The scope of work shall include but not limited to the following:

The manufacturers / suppliers shall make in-depth study on various aspects before offering the equipment guaranteeing to meet requirements of cavitations free performance for entire range of head and discharges at the available turbine setting and with the available water.

Bidder shall specify the minimum head and maximum head at which the unit can be safely operated without any cavitations and vibration.

New turbine shall be designed as per site condition and meet the requirement as specified in the Technical Specification.

Unit shall be designed to four (4) times start up and four (4) times shut down in a day and 350 times in a year (approx data, typical value applicable for one unit only).



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The turbine and/or generating unit shall be designed to withstand the additional stresses resulting from the operation of unit with one or more guide vane passages in blocked condition. Bidder shall provide calculation to substantiate this provision in design for this aspect during detailed engineering.

Turbine shaft and guide bearing including support shall be designed to withstand any unbalanced conditions due to blockage of passages as specified above. The weight of the turbine rotating parts and any unbalanced vertical hydraulic thrust shall be supported by the generator thrust bearing.

New discharge ring shall be provided. The turbine guide bearing lubricating oil and governor oil shall be of the same specification as the generator bearing oil.

The new turbine shall be manufactured only after carrying out computer simulation studies (CFD) by the successful bidder and approval by consultant/purchaser.

### C) Computerized Simulation Studies

To ensure the output and efficiency of the machine, new runner will be designed and manufactured after based on computerized simulation studies by the Bidder. Same may be carried out bidder own laboratory or in an independent laboratory. The laboratory must be accredited as per NABL or APLAC or ILAC accredited independent third party International standard IEC/ISO 17025:2017. In respect of efficiency, output, smooth operation, Cavitations performance of the turbine will also be carried out. Bidder also furnishes the results of the study to Purchaser/Consultant for review/approval. Report of CFD analysis shall be made available to the Purchaser by the Bidder before going ahead with the manufacturing of the turbine.

**Design criteria for Turbine –** Basic data for design of turbine are as follows.

- The turbine- generator set is to be accommodated in the existing foundation and space available in the Power House.
- Trash rack, intake, penstock, scroll case, stay vane and draft tube is already there and the same are to be utilized for the installation of the proposed unit.





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### i. The new turbine will be designed based on the following parameters:

SI. No.	Description	Parameters in m (ft)
1.	Design head	35.3m (115.81 ft)
2.	Max. head	43.8m (143.83)
3.	Minimum head	23.1m (75.98 ft)
4.	Head variation with respect to design head	124.19 % to 65.6 %
5.	CL line of turbine	C <sub>L</sub> 101.149m

#### ii. Tail water level.

Tail water level (TWL) of the Maithon Hydel Station during months of October 2020 is as follows

SI no.	Condition	Cumulative generation (MW)	TWL in m (ft)
1	When All units are in stopped condition	0	105.64 (346.6)
2	When one unit operating at no load condition	0	105.76 (347.0)
3.	When U # 2 is operating @ 23.2MW	23.2	107.10 (351.4)
4.	When U # 2 is operating @ 23.2MW and Unit # 3 @ 20MW	43.2	107.80 (353.7)
5.	When U # 2 is operating @ 23.2MW, Unit # 3 @ 20MW & Unit # 1 @ 20MW	63.2	108.81 (357.0)





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### iii. Chemical analysis of water sample

Chemical analysis of water sample collected from Maithon Dam test on dated 30/08/2019 are indicated below.

SI.No	Parameter	Result
1.0	РН	6.9
2.0	Condutivity	125
3.0	Turbidity NTU	100
4.0	P- Alkalinity (ppm)	BDL
5.0	M O - Alkalinity (ppm)	60
6.0	Total Hardnes (ppm)	47
7.0	Calcium Hardnes(ppm)	37
8.0	Magnesium (ppm)	10
9.0	Total Disolve Solide (ppm)	83
10.0	Chloride (ppm)	13
11.0	Sulphate (ppm)	16

#### Reservoir water temperature

- i. Winter = 15 to 20 degree centigrade
- ii. Summer = 30 to 35 degree centigrade

If any further details regarding raw water are required then necessary water analysis shall be carried out by bidder.



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### DETAILED SCOPE OF WORK

### 06.02 TURBINE AND ASSOCIATED EQUIPMENT

#### Turbine:

The turbine shall be of the horizontal Francis type suitable for coupling through horizontal shaft synchronous generator.

The turbine shall be complete and consist of Runner & Runner cone assembly, shaft sleeve, sealing arrangement, Turbine thrust and guide Bearings with lubricating and cooling arrangement, distributor, Inlet pipe, casing, regulating ring (operating ring) etc.

The turbine shall be designed to deliver rated output of 20 MW (at generator terminals) at rated head with weighted average efficiency of the turbine within 90% (max) guide vane opening.

The turbine shall be able to deliver output higher (minimum 10%) than the rated output continuously when operating at heads higher than the rated head. The bidder may offer his nearest standard design. The maximum output both at minimum and maximum heads shall also be stated in the offer.

The details of the hydraulic system and basic data for design of turbines and water analysis details are already indicated above.

The already constructed power house plan and section (enclosed with this specification) shows space availability, turbine setting (Centre line of turbine and Minimum tail water level), Penstock, Transformer & turbine oil tanks and draft tube gate details, turbine and generator foundation and tentative layout of equipment. The turbine should fit in the existing facilities.

Bidder shall critically examine the silt data and chemical analysis of water and take the same into account while designing the turbine and auxiliary equipment susceptible to abrasive effect of silt, making all such specific provisions and measure including selection of materials, coatings and paintings which will help to resist silt abrasion and enable easy and quick maintenance / replacement of worn out components

The hydraulic turbine shall comply with latest versions of relevant IEC/IS standards. Turbine shall have smooth and quiet operation. The vibrations, pressure pulsations and power fluctuations shall be within the limits specified in relevant standards. The amplitude of vibrations at the shaft shall not exceed the limits specified in relevant ISO standards.



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The peak efficiency of turbine shall be higher than 94% and weighted average efficiency shall not be less than 93%.

- Weighted average efficiency ( w) will be calculated as follows:
- Weighted average efficiency ( w) =  $0.8 \text{ x}_{100} + 0.1 \text{ x}_{80} + 0.1 \text{ x}_{60}$
- (  $_{100}$ ,  $_{80}$ ,  $_{60}$  mean the efficiency of the turbine at rated head and when it delivers 100%,80% & 60% of rated output respectively)

The values of critical sigma as per IEC 193A shall be furnished in form of curves for different guide vane openings and different heads of operation. Plant sigma curves as recommended by the manufacturer shall also be plotted on it clearly to show the safety margin available. Cavitations test report shall also be submitted along with the offer.

The moment of inertia of the unit shall be maintained at the existing level and the normal guide vane closing time shall be so adjusted that the maximum momentary speed rise as per IS 12837) of the unit shall not exceed 45 % of the rated speed and the maximum pressure rise shall be limited to 30% of maximum head. (The turbine manufacturer shall coordinate with the generator manufacturer for limiting the speed and pressure rise values).

Maximum noise level resulting from any of the operating conditions as per IEC 34-9 shall not exceed 90 db (A) at any place 1.0 m away from any operating equipment.

The turbine shall be designed to withstand runaway speed for 15 minutes without causing any residual detrimental effect on future operation of the machine. However, critical speed of the machine shall be 25% higher than maximum runaway speed.

The turbine shall be capable of delivering a guaranteed rated output of not less than 20 MW at generator terminals when operated at a rated net head of 35.30 m and at rated speed of 176.5 rpm. This output shall be generated within 90% guide vane opening and shall be called rated output of the turbine.

The capacity curve at net heads of 43.84 m to 23.16 m at different guide vane openings up to full guide vane opening shall be submitted.

The turbine shall be designed for continuous operation over the range of net heads of 43.84 m to 23.16 m.





### i. Material selection and standards

The material specification and their standards for major components Turbine shall be as shown below. The material grade and classification wherever specified are obligatory and proposed equivalent national/international standards for the same shall also be considered if their chemical composition, mechanical properties, manufacturing method are similar/ superior and are proposed use. The Contractor shall establish the equivalence/ superiority for acceptance by the DVC/authorized consultant.

SI. No	Item	Material	Material Standard
1.	Runner	Stainless Steel, 13Cr-4Ni	ASTM A 743 Grade CA6NM or ASTM A240 UNS S41500
2.	Runner Cone	Stainless Steel, 13Cr-4Ni	ASTM A 743 Grade CA6NM or ASTM A240 UNS S41500
3.	Rotating labyrinth (Upper & Lower)	Stainless Steel, 13Cr-4Ni	ASTM A 743 Grade CA6NM or ASTM A240 UNS S41500
4.	Fixed labyrinth (Upper & Lower)	Stainless Steel, 13Cr -4Ni	ASTM A 743 Grade CA6NM or ASTM A240 UNS S41500
5.	Shaft seal sleeve/liner	Stainless Steel, 13Cr-4Ni	ASTM A 743 Grade CA6NM or ASTM A240 UNS S41500
6.	Guide vanes	Stainless Steel, 13Cr-4Ni	ASTM A 743 Grade CA6NM
7.	Facing plates	Stainless Steel, 13Cr	ASTM A240 UNS S41500
8.	Discharge ring	Stainless Steel, 13Cr	ASTM A240 UNS S41500
9.	Bottom Ring	Carbon Steel	ASTM A537 Class II
10.	Head cover	Carbon Steel	ASTM A537 Class II
11.	Draft tube cone	Carbon Steel	ASTM A537 Class II
12.	Spiral case	Carbon Steel	ASTM A537 Class II
13.	Stay ring & stay vane	Carbon Steel	ASTM A537 Class II
14.	Draft tube	Carbon Steel	ASTM A516 Gr. 60 or IS 2002 Gr. 3
15.	Turbine shaft	Alloy Steel	ASTM A668 Class G,H or J to N
16.	Turbine guide bearing housing	Carbon Steel	ASTM A537 Class II



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#### ii. Cooling water failure duration withstand capacity

The turbine guide bearing shall be designed and guaranteed to withstand operation at maximum continuous rating without any damage or deterioration for a period of at least 15 (Fifteen) minutes without cooling water supply.

#### iii. General Arrangement and Construction

The General arrangement shall be same as of existing Unit. The turbine shall be so constructed as to allow all the removable parts to be dismantled conveniently. The design shall permit removal of rotating parts without disturbing the guide apparatus. The design shall also permit horizontal movement of runner shaft by an amount sufficient for adjustment of bearings and for clearing the joint at the coupling of the turbine and the generator.

All equipment shall be neatly arranged and shall be readily and easily accessible for operation and maintenance. The necessary walkways, handrails, ladders, chequered plates, platforms, etc., required shall be provided by the Bidder.

#### iii. Head cover

The head cover shall be fabricated from carbon steel plate of pressure vessel quality. It shall be of heavy construction, adequately ribbed and shaped split in circumferentially to form outer and inner head cover sections.

All major stress carrying welds shall be fully penetrated and stress relieved in oven. Radial ribs of the head cover may be fillet welded. Balancing pipes with valves shall be provided for releasing the pressure in the annular space between the runner and head cover. These pipes shall be adequately sized so that the pressure remains within acceptable limits even with worn out labyrinths after long operations.

The head cover shall be designed to withstand, safely and without detrimental deflection, the maximum water pressure, and all other forces acting up on it. Split type head cover with bolt joints shall also be acceptable.

The head cover assembly shall have machined seat for regulating ring, shaft seal, guide vanes and any other auxiliary equipment such as air vent, pipe connections etc. A retaining ring or pads shall be furnished to prevent any lifting tendency of the regulating ring.





Renewable carbon seal facing plates shall be provided in the head cover adjacent to the wicket gates. Carbon seal wearing ring shall be provided in the head cover adjacent to the runner periphery.

The guide seat for the regulating ring shall be provided with replaceable bronze or self lubricating liners accurately machined so as to ensure minimum lost motion and friction in the operation of the regulating ring.

Self lubricating bush bearings and water cup seal arrangements for each guide vane stem as described in clause "Guide vanes and operating mechanism" shall be provided in the head cover. Suitable drains shall be provided for any leakage water from the seals so that water cannot accumulate in the spaces between the ribs. Water contracting surface of the head cover shall be accurately machined to provide a smooth surface to the water passage at the entrance to the runner.

Replaceable 13Cr-4Ni stainless steel facing plates of adequate thickness in suitable sections shall be provided on the inner surface of the head cover coming in contact with water. Fixing arrangement of liner shall be susceptible to silt erosion/damage and shall be easily accessible for maintenance.

The arrangement defined shall be as accepted by the purchaser at the time of award of contract/detailed engineering.

A minimum of three piezometers connections shall be provided on the head cover piped to a common manifold equipped with suitable valves and a pressure gauge. These connections shall be arranged so that radial variations of water pressure below & above the runner can be measured. The pressure gauge will be mounted on the turbine gauge panel on the pit wall. Walk ways around the regulating ring and turbine bearing shall be provided with gratings or suitable openings to facilitate inspection.

#### iv. Discharge ring

The discharge ring shall be fabricated from carbon steel plate of pressure vessel quality, sectionalized as necessary to facilitate shipment and handling. The welds shall be fully penetrated and stress relieved before final machining. It shall be of heavy section and adequately ribbed externally to prevent distortion.





Replaceable anti corrosive and wear resistant 13Cr-4Ni stainless steel facing plates of adequate thickness in suitable sections shall be provided on the inner surface of the discharge ring coming in contact with water. Fixing arrangement of liner shall not be susceptible to silt erosion/damage and shall be easily accessible for maintenance.

The arrangement defined shall be as accepted by the purchaser at the time of award of contract/detailed engineering.

### v. Guide vanes and Guide vane regulating mechanism

New sets of guide vane shall be provided as per requirement of new design of turbine. The tips and contact surfaces shall be machined in such a fashion as to provide uniform contact when in the closed position. All guide vanes shall be interchangeable. The final surface finish of the guide vane shall be in accordance with the latest relevant standards.

The number of guide vanes and the number of runner vanes shall be coordinated in a manner to ensure that the turbine will operate without objectionable vibrations.

Self lubricated bush bearings for guide vane with proven and established performance in high silt content water shall be provided. Each guide vane stem shall be provided with a thrust bearing or collar.

Guide vanes stems, links and regulating rings shall be designed to produce a minimum of lost motion and friction. The guide vanes shall be connected through couplings, links and levers to the regulating ring. The link pins shall be of the eccentric type to facilitate adjustment. During assembly and before dowelling of the guide vane items, the eccentric pins shall be set in such a way that eccentricity is available for future adjustments. The design shall be such that repairs and replacements can be carried out easily and quickly with minimum dismantling of the turbine. Bidder may propose any other proven design. However, such design will merit consideration only if its technical adaptability and benefits are established and shall be subjected to approval of the Purchaser.

The guide vanes shall be accurately machined and ground to a smooth finish and even surface. The tips and contact surfaces shall be machined in such a fashion as to provide uniform contact when in the closed position. All guide vanes shall be interchangeable. The final surface finish of the guide vane shall be in accordance with the latest relevant standards.





Guide vane regulating ring shall be made of cast carbon steel or welded carbon steel plate, with all welds fully penetrated and stress relieved. The regulating ring and guide vane operating mechanism shall be so designed as to remain undisturbed when dismantling and replacing the main guide bearing and accessories.

The guide vane operating mechanism shall be of ample strength to withstand the maximum load likely to be imposed on it in the most severe operating conditions.

Suitable shear pin shall be provided between each guide vane stem and the regulating ring shall be strong enough to withstand the maximum operating forces, but which will break in the event of excessive forces acting in either the opening or closing direction and will protect the rest of the mechanism from damage in case one or more of the gates become blocked.

For detection of shear pin failure, a suitable detection system should be provided to actuate in the event of the breakage of a shear pin.

Stoppers shall be provided in front of individual guide vane lever to limit the angle of movement of the guide vane stem levers in case of the breakage of the shear pin or link so that interference of the loose guide vane with operation of other guide vanes or runner will be prevented. These stops shall have manual adjustment provisions with which the motion of the turbine guide vanes at the opening and closing extremities can be positively limited.

As a precaution against damage when a guide vane is free to rotate due to breakage of a shear pin or link, the guide vane levers shall be restrained from excessive movement by means of a friction device located on the guide vane stems which provides a restraining force between the guide vane coupling and lever. The friction device shall be designed to resist independent movement of the guide vane for the maximum hydraulic torque at any guide position. The friction device mechanism on each guide vane shall be tested during erection to ensure performance as designed.

Alternatively, bidder may propose bearings shall be of self lubricating engineered thermoplastic bearing for the above application. The OEM must be confident with this design and submit detailed credential regarding application and successful operation during detailed engineering stage for the approval of consultant/Purchaser before any procurement.





#### vi. Servomotors

Turbine shall be provided with oil pressure operated two nos. double acting hydraulic servomotors having each capacity sufficient to supply the maximum force necessary to open/close the guide vanes under maximum operating head, at the minimum oil pressure.

The servomotor shall be rigidly supported from base and shall be capable of moving the guide vanes from a completely closed position to a fully open position in one stroke, and vice versa.

The servomotor cylinders may be made of cast steel or welded steel plate. The servomotor piston rod shall be of forged steel and provided with bronze bushings. Lubrication shall be arranged to ensure that lubricant is admitted to high pressure areas regardless of guide vane position. The piston rod shall be arranged for adjustment of stroke. The connecting rod pins shall be hardened and ground.

The inner surface of the cylinder shall be bored to uniform diameter, and shall have a surface finish to allow the piston to traverse freely and smoothly with minimum oil leakage past through the piston and seals. Suitable packing shall be used to prevent oil leakage from the cylinder past the piston rod. The piston connecting rod shall be of forged steel of uniform diameter. Each piston shall be fitted with not less than three piston rings, suitably shaped to give close contact and uniform pressure on the cylinder walls.

Servomotor cylinders shall be provided with flanges for connecting oil piping. Connections for pressure gauges shall be provided at each end of each cylinder. An air vent and a drain cock shall be provided on each servomotor for bleeding/draining purposes.

Provision shall be made for field alignment of the servomotors, using leveling plates supplied by the bidder. The servomotor flange shall be dowelled in field to its mounting flange.

Manual locking device of simple construction shall be provided on both the servomotors to permit locking of guide vanes in fully open and fully closed positions and capable of withstanding safely the full operating force of the servomotors. The device shall be such that it can be easily engaged and disengaged by one man. Electrical contact switches suitable for indication for D.C. systems shall be provided to indicate guide vanes locked in fully open and fully closed positions. An additional contact for unit start interlock shall be provided. All contacts shall be wired to terminal blocks in the turbine terminal box.





Bypass connections equipped with orifices and/or at the adjustable needle valves shall be provided on the servomotors to retard the rate of closure of the guide vanes from slightly below speed-no load position to the fully closed position. Bypass connections shall be fitted with check valves to prevent sluggish movement on opening the guide vanes from the fully closed position to provide damping effect. A suitable pointer and scale, graduated in tenths with subdivisions, shall be provided to indicate the percent stroke of the servomotor and guide vanes angle in degrees from the closed position. The scale shall be calibrated in the field and marked "closed" at one end of the scale and "opened" at the other end.

The servomotor stroke must be capable of manual adjustment. Means for positively locking the adjustment must be provided. Servomotors shall be shop tested under a hydrostatic pressure equal to 150% of the maximum design pressure of the governor oil system.

### vii. Rotating parts, guide bearings and seals

#### a. Runner

The runner shall be a forged fabricated construction of 13Cr-4Ni stainless steel with HVOF coating. Proposed list of material is given in sl (i). The runner shall be coupled to the turbine shaft with nuts, bolts and locking keys in accordance with ANSI/IEEE Std 810 "IEEE Standard Hydraulic Turbine and Generator-integrally forged shaft coupling and shaft run out tolerances" or applicable standards. The connection shall be designed for tightening and holding from above as required for incremental assembly. A forged/fabricated cone shall be bolted to it. labyrinth rings, shall be provided the runner shall be matched all over and accurately ground in the water passage homologous with corresponding runner.

The runner shall be coupled with the turbine shaft as per manufacture practice. A runner cone shall be attached to runner and shall guide the water as it leaves the runner.

The coupling bolts shall be designed for tightening using hydraulic torque tightening system. Rotating labrynth ring shall be provided upper part of runner to accommodate the stationary labrynth fitted below the head cover. Fixed labrynth shall be provided at the upper end of Draft tube.





### b. Turbine shaft & intermediate shaft

General arrangement of Turbine shaft & intermediate shaft shall be as per existing design. Turbine shaft & intermediate shaft shall be supplied by the bidder to couple with generator rotor. The shaft shall be forged & properly heat treated. Turbine shall be provided with coupling flanges in between turbine shaft and & intermediate shaft and intermediate shaft in between intermediate shaft & generator shaft for connecting to the generator shaft and to the runner respectively.

Shaft shall be hollow and shall have a finish of approximately 3.2 micrometers Ra (roughness average). Suitable oil baffles and water deflectors shall be provided between the main guide bearing and the shaft seal.

The magnitude of shaft run out shall be checked by rotating the finished shaft in a lathe or aligning device in the shop or any other machine able to check the trueness. The magnitude of run out shall not exceed the approved tolerances in Indian/international standards. Two bands shall be machined and marked on the shaft for use for verticality and alignment purposes.

Additionally, one band immediately above the turbine guide bearing housing location, of at least 100 mm width, shall be machined on the shaft for use of non contact type vibration pick up. The band shall be concentric with the shaft and polished to a finish of 0.4 micrometer Ra. Shaft shall be designed for eccentric loading caused by unbalanced operation in addition to torsional loading. Shaft coupling shall be designed as per provision of ANSI/IEEE Std 810 or applicable standard for fabricated shaft. The coupling bolts shall be designed for tightening using hydraulic tensioner/tightening device. The turbine shaft diameter shall be coordinated with the generator shaft diameter. The critical speed of the combined turbine and generator and generator rotating part shall be calculated by the bidder and first critical speed shall be at least 25% above the maximum runaway speed. Calculations satisfying the compliance with these requirements shall be submitted to Purchaser prior to manufacturing. The shaft shall be painted all over except mating surfaces of coupling bearing journal, vibration pickup band and shaft sleeve, which shall be adequately protected during shipment.





### c. Turbine Guide bearing & Thrust Bearing

Existing turbine guide bearing is split in two parts and fit into a cast iron housing mounted in the head cover and supported on a pedestal. The turbine bearing shall be babbit lined oil lubricated type located near the runner in main shaft packing box.

The thrust bearing is capable of withstanding the maximum hydraulic thrust from the runner in both directions; i.e bearing arrangement shall permit axial movement of the shaft necessary for adjusting the thrust bearing and for uncoupling. The bearing shall prevent foreign matter from entering the bearing running surfaces. The bearing shall permit sufficient vertical movement of runner and shaft to allow for adjustment of the generator thrust bearing

The thrust bearing consists of a number of flexible pads lined with white metal. Two collars of the thrust bearing will be machined from the turbine shaft itself and carefully polished.

The bearing permits axial movement of the shaft necessary for adjusting the thrust bearing and for clearing the male and female portions of the coupling.

Turbine bearing arrangement shall be as per existing one i.e split horizontally and fit into housing and supported on a pedestal. Same is self aligning type with a spherical seat. The Babbitt lining is peened, grooved for lubricant circulation, bored, scraped and polished to proper fit on the shaft. Shims, dowel pins and hold-down pins and hold-down bolts to be provided. Lubrication shall be self contained.

Two nos, Pump-motor set shall be provided for the system. One motor shall be sourced through AC supply system and another motor shall be connected with DC system. In case of failure of any one pump-motor set, other motor shall start through auto start facility. System shall be designed accordingly.

The hot lubricating oil from combined thrust and guide bearing is proposed to be cooled by circulation of water through passages formed in the lower half of the bearing barrel as well as by heat exchangers oils one of which situated in the thrust bearing chamber and the other in the reservoir.

To facilitate starting, a high pressure pump (jacking oil pump) to be provided for supplying oil under pressure to the underside of the bearing journal vide high pressure pump. The oil piping was shall be "SS" tube. Jacking oil pump for starting and stopping facility is required, automatic





operation of same shall be provided. Configuration of the jacking pump shall be one (1) working and one (1) stand by (1W+1S).

Alternatively, bidder may also propose external cooling system (water cooled heat exchangers) as an alternative arrangement. Minimum two nos. heat exchangers need to be provided. The capacity of each exchanger shall be 2x60% and must have 20% plug margin.

If external heat exchanger has been envisaged then suitable capacity of lub oil pump along with auxiliaries need to be provided. Turbine bearing oil pump shall be screw type and able to developed adequate lubrication for guide and thrust bearing. Configuration of the pump shall be one (1) working and one (1) stand by (1W+1S) electrical driven. One Motor shall be sourced through AC supply system and another motor shall be connected with DC system. In case of failure of any one pump-motor set, other motor shall start through auto start facility. System shall be designed accordingly.

Bidder shall submit design calculation for lubrication system during detailed engineering stage.

The bearing shall be capable of being operated continuously, without damage, at any speed up to 110% of rated speed. Further, it shall be capable of continuous operation for half an hour from 110% of rated speed to runaway speed without damage. Starting at normal operating condition, bearings shall be designed to operate for at least 15 min without cooling water without any additional stresses resulting from operation of unit with one or more guide vane passages being in blocked condition or in case of breakage of shear pin of one or more guide vane resulting in freeness of the guide vane at any location/angle.

The lubricating oil system shall be designed so that the temperature of the bearing metal and bearing oil shall not exceed 70° C and 65 ° C respectively under continuous operation in any operating conditions.

The bearing housing shall be made of cast steel, or welded plate steel of heavy construction.. Irrespective of the material used, the bearing shall be stress relieved before final machining operation. For ease in maintenance guide bearing housing shall be designed in two halves.

The design of the bearing and oil reservoir shall permit their inspection and adjustment or removal without disturbing or major dismantling of the other parts of the turbine. The bearing design shall be such that no water shall enter the lubricating system via the shaft seal, and there shall be no appreciable loss of oil by leakage past the lower oil shedder or by overflow





from any part of the oil system under any condition of normal operation, within the range of headwater and tail water elevation from speed no-load to full-load.

The babbitt lining on the guide bearing shell/segments shall be according to a grade suitable for the bearing and anchored tightly to the shell. The babbitt lining shall be accurately bored and shall be suitable for oil circulation. Suitable lifting eye bolts and backing-out studs shall be provided for use in removing and installing the bearing segments.

Bidder shall supply and install the following indicating and protection devices for the guide bearing. All electrical contacts shall be wired to terminal blocks in the turbine terminal box.

- i) Adequate numbers of temperature sensing devices, liquid expansion type thermometer, one in each segment/ pad for bearing metal and one in bearing oil for bearing oil temperature. The devices shall have two sets of separately adjustable contacts suitable for operating alarm and tripping circuits. The device shall have a third contact to indicate loss of thermometer bulb pressure or loss of power supply.
- ii) Four or more resistance temperature detectors (RTD's)- Two or more equally spaced in the bearing metal and two in the bearing oil for bearing and oil temperature indication and recording at a remote location (The lead extension cable to the terminal box and 3-wire twisted cable shall be suitably shielded. Separate terminals shall be provided in the terminal box for terminating the shields of individual RTD lead extension cables.)
- iii) One direct reading flow-meter with electrically separate low-flow alarm contacts for the bearing cooling water supply, if cooling water is required.
- iv) One direct visual indicator of the bearing oil level marked in liters and high and low level adjustable alarm contacts.
- v) One oil-water contamination detector, if water cooled bearing arrangement is used.
- vi) A flow meter with two electrically separated alarm contacts to indicate low water flow to the bearing cooling system. (The piping shall be provided with a sufficient number of unions to permit ease of removal).
- vii) Two no. Pump-motor set shall be provided for HPOP system. Both Motor shall be sourced through AC supply system. In case of failure of any one pump-motor set, other motor shall start through auto start facility. System shall be designed accordingly.



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### d. Shaft seals

Bidder shall provide two (2) shaft seals, one as main working seal and another as maintenance seal. The arrangement and design of these seals shall be such that they remain fail proof even while the turbine is operating in water having high silt concentration and maximum leakage shall be guaranteed by the bidder. The arrangement defined shall be as accepted by the Purchaser at the time of award of contract/detailed engineering.

Main working seal shall be provided before the bearing which shall prevent the leakage of water along the shaft. The shaft seal shall be arranged for water lubrication. Two or more connections for water shall be provided evenly spaced on the periphery to admit a supply of clean water at a pressure to exclude foreign matter from the seal. Any leakage water from the seal shall be removed by drains. The seal shall be so arranged that it may be serviced without disturbing the bearing or dewatering the draft tube.

Maintenance seal shall be provided along the main working seal to allow the main seal segments to be serviced without dewatering the spiral casing. This maintenance seal shall prevent leakage along the shaft when the turbine is stationary.

Water for shaft sealing shall be drawn from cooling water header and suitably cleaned and filtered before supplying to the seal at a suitable pressure. Suitable lifting eye bolts and backing out studs shall be provided for use in removing and installing the shaft seal parts.

The successful Bidder shall provide necessary piping and valves for the required necessary connection water flow meter of suitable make with adjustable alarm contacts suitable for operation at 220 volt DC shall be provided in the water supply piping to the seal. These contacts shall be wired to terminal blocks in the turbine terminal box. One additional contact shall be provided to operate an indication light in the gauge panel to indicate that shaft seal water is "ON". A duplex pressure gauge shall be provided to indicate the pressure beneath the seal and in the supply line.

All bolts, nuts, screws and hard ware used in connection with the shaft water seal shall be of stainless steel.

Alternatively, bidder may propose shaft seal shall be of a material suitable for water lubrication using forced water flow for cooling and lubrication. The bearings shall be of tough Synthetic Elastomeric Polymer Alloy, for the above application. The OEM must be confident with this





design and submit detailed credential regarding application and successful operation during detailed engineering stage for the approval of consultant/Purchaser before design/procurement activities.

### e. Regulating ring

The regulating ring shall be ample strength to withstand the maximum load likely to be imposed on it in the most severe operating conditions. All working points with relative motion shall be provided with self-lubricated bushes. Each guide vane shall be individually connected to the regulating ring through suitable levers and links. Shear pins / breaking link or some other suitable arrangements shall be provided on each guide vane to protect the guide vane and to provide alarm on foreign body getting wedged between guide vanes. The regulating ring shall be fabricated from welded steel plates. Self-lubricating buses to be provided in place of conventional bushes.

### f. Levers and Linkages

All the working joints with relative motion shall be self-lubricated bushes. All the linkages and levers are designed in such a way that it can transmit the necessary torque to give the rotary motion to the guide vanes without failure.

### 06.02.02 Turbine Governor

Purchaser already procured new turbine governors for all three units. As such, supply of turbine governor is excluded from scope of work. However, all connection to governor inlet points and all interfacing work is to make the system complete in all respect included in the scope of work. Details of the facilities are indicated in the C&I chapter (Volume-III) of this tender specification. Connection of servo motors including nipple, piping, valves and all fittings with governor along with all interfacing with turbine governor is included in the scope of work of the bidder. Bidder shall design and procure equipment like servomotors and all the auxiliary piping and valves compatible with as per the existing governor model. Replacement of Pressure accumulator is included in the scope of work. Material of the accumulator shall be IS2002 or equivalent.

Some drawings are enclosed in Volume IV of this specification. Available drawing shall be provided to the successful bidder after placement of order.




### 06.02.03 Oil Purifier

An AC motor driven portable type centrifugal type oil purifier shall be provided for water and sludge removal from the oil in oil tank. The purifier shall be provided with an hourly capacity of not less than 20% of the total oil quantity in the oil system and shall be connected in bypass to the oil system in such a manner that it can be continuously operated when the turbine generator is either running or shut down. Required connection to be provided in each turbine generator to connect portable oil centrifuge.

The purifier shall be fully self-contained on an oil tight base plate and shall be provided with all necessary pipe connections. The material for the rotating parts of the centrifuge shall be high grade stainless steel AISI 316 or equivalent. Other parts in contact with the oil shall be of stainless steel. The casing shall be of cast iron or carbon steel construction. The construction shall be vapour tight.

The arrangement of the assembly shall enable easy removal of the collected solid particles within a short time. The rotating parts shall be statically and dynamically balanced.

Suitable interlocks shall be provided to prevent operation of purifier unless necessary pumps are in service. Safety devices shall be provided to alarm and trip the centrifuge in the event of centrifuge sealing failure. Pumps required for purifying unit shall be of positive displacement type with at least 110% of the normal purifier capacity. Each pump shall be provided with adequate relief bypass valve to prevent damage from excess pressure. Necessary indirect heating system shall be provided



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### 06.03 GENERATOR AND ASSOCIATED EQUIPMENT

### General:

Generator shall comply with the latest versions of IS/IEC standards. The weighted average efficiency of generator shall be not less than 98.5 % at rated load.

Insulation shall be thermal class "F" for the stator and the rotor windings with temperature rise limited to that of thermal class "B" as per relevant IEC standards.

RTDs or thermocouples shall be provided at suitable locations for monitoring temperature of stator core, stator winding and bearings.

The generator shall be capable of safely withstanding the maximum stress during normal operation, runaway speed conditions, two phase and three phase short circuit conditions, single phase earth fault, 180 degree and 120 degree out of phase synchronization, magnetic imbalance with 50 % of the poles short circuited within the speed range of 1.3 times the rated speed, brake application etc.

### **General Arrangement and Construction**

The General arrangement shall be same as of existing Unit, i.e horizontal orientation. The Generator shall be so constructed as to allow all the removable parts to be dismantled conveniently.

All equipment shall be neatly arranged and shall be readily and easily accessible for operation and maintenance. The necessary walkways, handrails, ladders, chequered plates, platforms, etc., required shall be provided by bidder.

### III Generator

The new generators (two nos) shall comprise the following:

Synchronous generator, direct driven, horizontal shaft with 10% continuous overload to match the turbines as given in Clause 06.02 of this chapter, complete with air cooled stator, rotor, shaft, thrust safety devices etc., for measuring flow, vibrations, temperatures, etc with provision of extra contacts / ports for integration with plant SCADA. (Typically indicated applicable for both units)

- One (1) set of fire protection systems for generator complete in all respects.
- One (1) set of brake systems complete with compressed air piping, valves etc. for braking etc. of the generator rotor.
- One (1) set of jacking oil system including pumps, piping valve etc.



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- One (1) set of brake dust collection systems.
- One (1) set of carbon dust collection system.
- One (1) set of anti-condensation heaters.
- One (1) set of air coolers.
- One (1) set of oil coolers for guide bearings.
- One (1) set of all required oil, air and water pipes, fittings, valves, pressure gauges and flow relays.
- One (1) set of interconnecting cables, termination, etc. between various parts.
- One (1) set of moisture detector system.
- One (1) set of sole plates, foundation bolts, sleeves and anchor plates etc. required for proper erection, leveling and alignment of the generators and their components.
- All special tools and devices for handling, assembly, installation, erection, dismantling and testing of the generators and auxiliaries.
- Oil for the first filling of bearings and jacking system, etc. including 10% extra.
- Erection, testing and commissioning of generator.
- Field acceptance and performance tests, including submission of report on generator.
- Any other item not specified above but necessary to complete the assembly or mentioned hereunder, erection, testing, commissioning including field acceptance testing of generator and associated auxiliaries.
  - Special tools.
  - Set of spares.

(Note: One set is defined as the total number required for one unit. Applicable for both units)

### IV Special Design and Layout Conditions

The Generator shall be horizontal shaft synchronous Generator with guide bearing located both sides of the rotor. The design and construction of turbine and generator shafts shall be adequately coordinated between the generator and turbine manufacturers.

### V Basic Dimensions and Rating

The dimensions of generator shall be such that, it is accommodated in the existing slot and generator barrel



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### a. Rating:-

Description	Details		
No. of phases	Three (3)		
Construction type	Conventional		
Rated continuous output, (MVA)	23.53		
Continuous overload output (110% of rated	25.8		
output) (MVA)			
Rated generator voltage, (kV)	11 ± 10%		
Rated frequency (Hz)	50 ± 5%		
Combined voltage and frequency variation	±10%		
Power factor (cos )	0.85 lagging		
Rated speed (rpm)	Matching turbine speed		
Direction of rotation (when viewed from top)	Matching the direction		
	of rotation of turbine		
Insulation class of stator and rotor windings	Epoxy based "F"		
SCR	Shall be around 1.1		

Temperature rise of stator and rotor windings shall be limited to that of thermal Class B as per relevant IS/IEC Standards.

### VI. Capacity and Temperature Rise

The generator shall be capable of delivering a guaranteed rated continuous output of 23.53 MVA and maximum continuous overload output of 25.8 MVA at rated p.f., rated voltage and rated frequency at the terminals without exceeding the limit of temperature rise as follows. For rated Condition

- Stator winding :85<sup>0</sup> C(ETD)
- Rotor winding :90<sup>0</sup> C(Resistance)

For overload condition the temperature limits will be 10<sup>°</sup>C more than above temperature rise limits.

# Short Circuit Withstand Capability

The generator shall be capable of withstanding a three phase short circuit at the generator terminals when operating at rated continuous power output i.e. 23.53 MVA and at rated power factor for a period not less than 3 sec.



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### Occasional Excess Current

The generator shall be capable of withstanding occasional excess current equal to 1.5 times the rated current for not less than 30 seconds each time.

### VII. Wave Form and Poly-Phase Symmetry

The waveform of the e.m.f. between terminals of the generator on open circuit shall be practically sinusoidal. The waveform shall be accepted as practically sinusoidal if none of its instantaneous values varies from instantaneous value of the same phase of the fundamental wave (50Hz) by more than 5 percent of the peak value of the fundamental. The poly-phase voltage system of generator shall be practically symmetrical. Poly-phase voltage system is considered as practically symmetrical if neither the negative sequence nor the zero sequence components exceeds 5 percent of the positive sequence component. The calculated no-load harmonics in the voltage waveform shall be furnished.

### VIII. Stability and Performance

Generators shall operate satisfactorily in parallel with each other and with other machines connected to the grid. The generator shall be able to operate on sudden application / or loss of maximum load and during momentary short circuits and sustained ground faults without causing any abnormal vibration or resonant conditions. The generator shall be capable of operating continuously on an unbalanced system such that with none of the phase currents exceeding the rated current, the ratio of negative sequence component of current ( $I_2$ ) to the rated current (In) does not exceed 0.08, and under fault conditions shall be capable of operation with the product of (I2/In)2 and time in seconds (t) not exceeding 20.

### IX Runaway Speed Withstand Capability

The generator shall be designed and constructed to be capable of safely withstanding maximum runaway speed for a period of 15 minutes (with cooling water flow intact) without incurring damage from stresses under such conditions.

### X Speed, Runaway Speed

Units shall be designed for a nominal speed of 176.5 rpm. The runaway speed has to be determined by the turbine manufacturer and to be coordinated by the Contractor.

### XI Direction of Rotation

The direction of rotation shall match the direction of rotation of the turbine.



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# XII Efficiency

The guaranteed weighted average efficiency, at rated voltage and frequency as determined from the following formula, shall be 98.5 percent or more.

w	=	$0.8 \times _{100} + 0.1 \times _{80} + 0.1 \times _{60}$		
		where		
w	=	Weighted average efficiency		
100	=	Efficiency at 100 percent rated MVA and 0.85 p.f		
80	= Efficiency at 80 percent rated MVA and 0.85p.f			
60	=	Efficiency at 60 percent rated MVA and 0.85p.f		

To formulate uniform basis of losses to arrive at generator efficiency; following losses shall also be considered and included:

- Bearing friction losses (total bearing losses of generator )
- Windage / ventilation losses.
- Iron losses.
- Stator copper losses.
- Stray load losses.
- Field winding copper losses
- Excitation system losses.

### XIII Performance Criteria & Guarantee

The equipment covered under this contract shall be capable of performing all intended duties and it is the responsibility of Bidder to supply the equipment as per guaranteed technical particulars.

### XIV Design and Construction

### a. General

Generators shall be of horizontal type and shall be capable of safely withstanding maximum stresses during normal operation, runaway-speed conditions, two phase and three phase short-circuit conditions or single phase earth fault at the maximum output for which generators are capable of, 180 deg and 120 deg out-of-phase synchronization, magnetic unbalance at runaway speed with 50% of the poles short circuited and brake application etc. Seismic forces shall also be taken into consideration for design of the generators.





Construction of the generators shall be such that the rotor poles, stator bar and generator air coolers can be easily maintained/ replaced without disturbing the bracket.

Core stacking to the extent shall be carried out at manufacturer's work. In case for sufficient reasons such as transport limits, the work of core stacking for stator shall be carried out at site, it shall be so mentioned by bidder in their tenders, giving reasons.

Similarly, the rotor construction shall be such that rotor poles are easily removable and replaceable. The poles shall be interchangeable. The interchangeability of poles shall be such that odd pole can be replaced by odd pole and even pole can be replaced by even pole. However spare poles will be of universal type and they are interchangeable

The rotor shall also be supplied in the maximum possible assembled condition within the transport limits given. To meet the transport limits rotor rim of lamination sheets is required to be built up at site the rotor construction shall be designed accordingly to suit the assembly at site (stacking, pressing, curing of lamination insulation, installation and mounting of rotor poles).

All parts of the generating unit shall be designed mechanically to withstand all electrical, mechanical, and other stresses which may be experienced during the operation of the unit, including short circuit, faulty synchronization, over speed and runaway conditions.

All equipment shall be designed and manufactured under due consideration of the prevailing transport limitations.

The design of the unit, including the relative locations of the rotor, generator thrust and guide bearings shall be such as to cause no abnormal vibration or resonant conditions. The unit shall be physically stable under worst short circuit conditions..

The supporting brackets will be steel fabricated and shall be rigid enough to support and transmit the load to the concrete structure /foundation under worst conditions. The bracket supporting the brake assemblies shall, however, be designed to withstand the braking of the rotor even at 50% speed (though normal braking speed shall be lower).

Rotor field poles shall be arranged in a manner to permit easy removal with the unit rotor left in place. Field pole electrical connections shall be located in a position to facilitate ease of



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inspection, separation and reconnection. The field poles shall be provided with adequate damper windings to reduce voltage distortion etc.

### b. Main Shaft and Coupling

Generator shaft shall be forged & properly heat-treated. The design and construction of turbine and generator shafts shall be adequately coordinated by the generator and turbine manufacturers.

The critical speed and vibration strength of all rotating parts shall be checked with the turbine manufacturer and shall be verified by calculations.

The first critical speed of the combined rotating parts of the turbine and the generator shall be at least 25% above the maximum runaway speed.

### c. Bearings

The generator shall be provided with guide bearings either ends of generator for rotor. Bearing shall be with babbit lined split type pads of ample sized to be capable of safely coping with all operational conditions including runaway speed and start-up /shut-down.

The arrangement, design and construction of the bearings shall be duly coordinated with the turbine manufacturer and should take into account weights of the rotating parts of turbine, with unbalanced hydraulic thrust under all conditions of operation. Type and quality of the oil shall be the same for turbine and generator bearings.

The bearings shall be capable of operating at the following, guaranteed Conditions:

- Continuously at 50 % to 110% rated speed.
- 30 minutes at any speed between 110% rated and runaway speed with cooling water supply.
- 15 minutes at rated speed and full load without cooling water supply.
- 2 minutes at runaway speed without cooling water supply.

While designing the withstand capacity of bearing, weight of all rotating parts including shaft and runner, hydraulic tonnage at over load or more for which turbine is capable of under worst hydraulic conditions and severest faults or run away speed shall be taken in to account.

A high pressure lubrication system shall be provided for lubrication for bearing during start-up





and shut-down. The system shall operate automatically at set speeds between 0 and 100%.

High Pressure jacking oil system (HS pumps) including pumps, piping, valves etc shall be provided to lift the generator during starting and stopping condition. The design of the jacking oil system shall be as per system design generator /heaviest part to be lifted. Suitable hole along with connection shall be provided in the guide bearing for this purpose. After attaining desired "RPM" the jacking oil pump and attaining proper lubrication pressure shall be stopped automatically.

High pressure jacking oil pump shall be two nos (1W+1S). Two nos Pump-motor set shall be provided for the system. One Motor shall be sourced through AC supply system. In case of failure of any one pump-motor set, other motor shall start through auto start facility. System shall be designed accordingly.

Generator bearing oil pump shall be screw type and able to developed adequate lubrication for guide bearings of generator. Configuration of the pump shall be 1 working and 1 stand by (1W+1S) and same shall be electrical driven. One pump shall be AC driven and another shall be DC driven. In case of failure of any one pump-motor set, other motor shall start through auto start facility. System shall be designed accordingly.

Bidder shall submit design calculation for lubrication system during detailed engineering stage.

Material of coolers shall be as follows:

Tubes : SS

Tube plates : Mild steel

Coolers shall have adequate extra capacity to allow for 10% plugging of cooler tubes.

Supply and return line flanges with shut-off valves shall be provided at generator floor level to allow connecting the oil circuits to the oil transfer and treatment system. An overflow with connection to the return line shall be included.

Special care shall be taken in the design of the bearing seals. No oil vapour shall enter the generator compartments. The system shall preferably be based on quenching air and ventpipes with filters.

Bearings shall be adequately insulated to prevent harmful flow of shaft currents induced by the generator field. Test points shall be arranged at an easily accessible location to allow regular checks on the existence of shaft voltage. Above arrangement can be combined with



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the auxiliary brush-holder provided for the rotor earth fault protection.

All provisions shall be included to permit loss measurement using the calorimetric method.

Bearing shall be equipped with all the necessary indicating and control devices. Some of them are indicated as under:

- One oil level indicator in the bearing oil reservoir with high and low level alarm contacts and tripping contacts for very low oil level.
- Provision for Dial type thermometers (DTT) and RTDs shall be kept in all pads
- RTD & DTTs to be supplied in alternate pads.
- One direct-reading water flow gauge along with low-flow alarm contacts.
- One oil-water contamination detector.

Guide bearing shall be equipped with the following:

- One oil level indicator in the bearing reservoir with high and low level alarm contacts and tripping contacts for very low oil level.
- Provision for DTT and RTDs will be kept in all pads
- RTD & DTTs to be supplied in alternate pads.
- Dial type thermometers (DTTs) will be supplied in diametrically opposite pads and one for the oil.
- One direct-reading water flow gauge, low-flow alarm.
- One oil-water contamination / moisture detector (will be finalized during detail engineering).
- Oil flow indicator with Limit switches (NO & NC) contact in each side bearing

# d. Brakes

The generator brakes shall consist of asbestos free brake liners mounted on Horizental piston cylinder moving horizontally and shall operate against a polished vertically mounted circular steel brake track. The brakes shall be pneumatically / hydraulically operated type. For pneumatic operation, required compressed air system shall provided from compressed air system. Limit switches shall be provided for each brake to prevent the unit from starting if the brake is applied. The brakes shall be mounted on the turbine end bracket of the generator.

Combined hand - operated and solenoid - operated air valve to control the operation of





the generator brakes shall be supplied and mounted in the actuator cabinet – brake control panel. Operation of the solenoid of the air valve shall be selected by means of a control switch with "manual", "off" and "automatic" positions. The control switch shall be provided with spring return to "off" from the "manual" position and shall maintain the "automatic" position when so placed. A manual locking device shall be provided to permit locking of the brake valve in the "on" position. When in the "on" position, the control switch shall operate the solenoid of the air brake valve directly. With the switch in "automatic" position, the solenoid of the air brake valve shall be controlled by means of a suitable electric circuit, the requirements of which are given below.

Gate position switches and speed switches as specified herein shall prevent the application of the brakes until the guide vanes are fully closed and the unit speed has decreased to required level. It shall be possible, to apply the brakes continuously after an adjustable period of time by means of the automatic control. The brakes shall be automatically released after the adjustable period of time sufficient to ensure that the unit has been brought to a complete stop.

When the control switch is in the "automatic" position a separate contact shall be closed for interlock in the auto-start circuit. A pressure switch shall be supplied in the air line to the brake cylinders with contacts to open as an, interlock to prevent start – up whenever the brakes are on. A second pressure switch shall be provided in air supply line to brake valve to energize an alarm circuit of low air pressure.

### e. Winding

### i. Stator and Stator Winding

The new stator shall consist of a frame, core and winding. The stator frame shall be in two or more sections as per transport limits. The stator frame section joining shall be as per manufacturers design practice. The stator frame shall be of robust design to withstand maximum forces acting on it under the worst condition of operation. The stator frame shall be designed for lifting the completely built stator and provided with suitable lifting lugs and devices for handling.

The core laminations shall be punched from high grade non-ageing cold rolled silicon steel coated with suitable insulating enamel to minimize eddy current losses and piled on





dovetail key ribs which are accurately and securely fastened to the stator frame. The core shall be ventilated by means of radial air ducts throughout the stack length. The ducts, formed by non-magnetic space blocks will direct the air uniformly with minimum obstruction.

The stator core shall be clamped by means of flange and finger assemblies at both ends of the core. The assemblies are constructed by welding the non-magnetic fingers to the flanges and together they bridge the core and stator frame. The required pressure is provided and maintained with through studs.

All necessary tests shall be conducted after piling and before winding at manufacturer's work for detection of hot spots. In the event stator winding is carried out at site, all the necessary tests shall be conducted at site by Bidder and all the required items for test shall be arranged by Bidder only. The stator winding shall be bar type, Y-connected with line and neutral leads brought out to the stator terminals. Each phase winding shall be distributed around the stator such as to minimize unbalanced magnetic pull. The stator winding and connections as well as connecting leads, main and neutral leads shall be of epoxy cast resin type, corresponding to class 'F' insulation. The maximum accepted temperature rise at maximum output will be limited to the temperature rise corresponding to class 'B' insulation.

Insulation shall be made of the best quality material and suitably impregnated insulation method employed shall give a homogeneous insulation without any voids, high thermal stability and insensibility against humidity, oil and other pollutions. All the strands shall be insulated suitably so that no short circuit between adjacent strands may occur. The stator winding shall be adequately supported and braced to withstand the full stresses due to electrical short-circuiting. End connections of stator bar shall be made at the top of the winding.

The winding to the extent possible shall be manufactured & assembled at manufacturer's work before shipping to site. In the event that part of the stator winding is required to be done at site, supply of all insulation materials and other items and performance of all work for completing the winding at site shall be done by Bidder. Adequate number of temperature detectors per parallel circuit per phase, shall be embedded in various parts of the stator winding. Resistance temperature detectors or thermocouples shall be





provided for temperature measurement of the core. All the temperature detectors in and around generator shall be wired by shielded cables.

The neutral leads shall be brought out in a suitable manner and shall terminate at the neutral grounding cubicle. Type and arrangement of the line terminals shall be suitable for termination of fully insulated, three single-phase isolated phase bus ducts.

### ii. Rotor

The design and construction of rotor shall be in accordance with most modern practices details of which shall be furnished by bidder.

The rotor shall be designed for assembly on the rotor assembly bay in the erection area of the powerhouse. Bidder shall provide all suitable rotor erection pedestals and sole plate adapters for the permanent use by the Purchaser.

"The brake track of the rotor shall be designed to withstand all loads/vibrations/ stresses etc. for the braking at 50% of the rated speed".

Damper windings shall be provided as necessary. Equipment to monitor residual voltage of the rotor shall be provided. The rotor winding and the rotor leads shall be epoxy cast resin type with Class "F" insulation but temperature rise shall be limited to class "B". For each assembly new brush gear and slip ring shall be provided. The design should be such that Rotor pole disassembly as when required is easy. The design of the rotor shall be such as to permit the removal and replacement of field poles without the removal of the rotor from the stator. The field coils shall be adequately braced to withstand the stresses due to worst condition of short circuit and also due to centrifugal forces. The connections from the field coils to the collector ring shall be braced against mechanical forces. If tapered keys are used to secure the field poles to the rotor rim, the drive key shall project above the rotor rim at a sufficient distance to facilitate removal of this key by means of a key puller and to permit checking for tightness. Suitable keeper's keys shall also be provided to ensure that the keys do not get loose in service. The brake ring on the rotor shall be supplied in segments, which may readily be replaced. Provisions shall also be made for rotor fans/ air guiding baffles at the top and bottom.

### iii. Collector Rings

The collector rings shall be in an accessible location and provision shall be made for



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reversing the polarity of the collector rings. The brushes and collector rings shall also be so positioned as to avoid contamination by oil vapours or oil leakage from the bearing.

### iv. Creep Detection

A creep detector shall be provided complete with all necessary wiring and controls. The detector shall operate if shaft rotation occurs after expiry of the normal stopping period. The total rotation required to operate the detector shall not exceed 10 degrees of shaft movement.

### v. Rotor Temperature Measurement

One shunt, to be mounted in the generator field leads, shall be furnished complete with calibrated shunt leads for connection to a field temperature recorder for measurement of rotor temperature.

### vi. Rotor Ground Fault Detection

A collector ring and brush assembly shall be mounted on the generator shaft for field winding ground detector relays.

# vii. Brake Dust Collector

Suitable exhausting arrangements for sucking and collection of brake dust shall be provided during braking operation of the machine, consisting of extraction unit, hoppers around brake assembly for trapping dust and flexible hoses for connecting hoppers to the extraction unit. The extraction unit shall have a motor driven exhaust fan to be fitted with an easily removable sheet steel bin for collecting heavy dust. The lighter particles of the dust shall be collected by suitable fabric based filter.

### viii. Carbon dust collector

Suitable exhausting arrangement for sucking and collection of carbon produced/emitted by the brushes shall be provided so as to avoid the conduction through carbon deposition resulting in earth faults.

### ix. Speed measurement

For measurement of speed of the unit for governor operation etc. a toothed wheel & necessary probes shall be provided and mounted on the generator shaft.



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### x. Generator Air Cooler & Cooling System

The unit shall be self-ventilating by its own circulation action. The generator shall be totally enclosed.

The air-water heat exchangers (stator air coolers) shall be mounted MS frame located in generator cooler room at basement, each provided with shut -off valves at inlet and outlet. Each cooler shall be readily removable without disturbing others when machine is not in operation.

The surface air coolers shall have sufficient capacity to maintain stator winding temperature rise within class "B" temperature limit when the unit is operating at overload output, under worst system parameters i.e. at the maximum stator current.

The air coolers tubes shall be made of finned type stainless steel.

The cooling system shall be complete with air coolers, oil coolers, cooling water pipes, fittings, flow indicating devices, flow relays and all other accessories. All internal piping shall be terminated in a flange on the generator barrel for connection with the plant cooling water system as specified in "Cooling Water System".

The number of coolers provided, the normal working pressure and pressure drop through the coolers shall be indicated and supported by calculations. Connections shall be provided at the bottom of the air coolers to facilitate complete drainage. The coolers shall be designed for at least 10-kg/cm<sup>2</sup> nominal pressure (Though working pressure shall be 2 kg/cm<sup>2</sup> to 5 kg/cm<sup>2</sup>). Automatic air vents with drain pipes shall be provided at the top to prevent air locks in the coolers. Lifting lugs shall be provided to facilitate the removal of any cooler. Each cooler shall be provided with a pocket for inserting thermometer on discharge end. The cooling water pipes inside the barrel shall be suitably coated with fine quality paint to prevent damage due to condensation on pipes. Various sensors and instrumentation shall be provided. The generator should be able to operate at rated load with clogging of 10% of cooler tubes of all Air coolers

The cooling system of generator shall be provided with the following supervisory equipment:

• RTDs will be installed to measure the temperature of incoming water line and outgoing water line as per standard practice.



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- Four RTD's to measure the temperature of the heated air leaving the stator core and entering the air coolers.
- Four RTD's to measure the temperature of the cooled air entering the generator rotor.
- Measurement of the hot air and cold air temperature will be as per standard practice.
- Water flow gauges at individual cooler outlet with low-flow alarm contacts and indicating dial mounted on the gauge panel.
- Pressure gauges at inlet and outlet of the heat exchangers as per standard practice. However, the same shall be decided during detail engineering.
- All coolers shall be pressure tested at site before erection.

The coolers should be designed to operate at water flow available corresponding to minimum water level in reservoir.

### xi. Generator Fire Protection

# Fire Detection and Protection system for Generators

The scope of work shall include system study of available  $CO_2$  flooding system, modification/refurbishment works as per latest NFPA (National Fire Protection Association)-12 to make the system complete. Supply of parts (if any), dismantling, Erection, Testing & Commissioning works for  $CO_2$  fire protection and detection system as per latest NFPA (National Fire Protection Association)-12 code for Maithon Hydel Station unit # 1 & 3 are included in the scope of bidder.

Existing CO<sub>2</sub> flooding system is already installed in generators no 1 & 3 including DCS system in the control room. Bidder to require reuses existing CO<sub>2</sub> flooding system in proposed generators as well as for generator transformers. As far as possible existing piping and control system shall be reused. Dismantling of the system and re-erection (as required for installation of the new generators and generator transformer) and commissioning is included in the scope of work. Modification required in the system in view of new generator including replacement of nozzle, pipe, fittings, valves shall be as per requirement to suit the new generator is included in scope of work of bidder. System interfacing including modification required for connection with existing DCS system in included in the scope of bidder.



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Details of the P&ID drawing of existing  $CO_2$  flooding system are enclosed in the Volume – IV of this specification. Modification required for safe system design as per latest norms is included in the scope of bidder-

### Detectors:

Detectors shall be intelligent analogue addressable type. Detectors shall be housed or mounted in suitable enclosures in such a way that their performance is in no way affected. The detectors shall be of multisensor type with a combination of photo-electric and heat sensing elements. The multi-criteria smoke detector provides photo-electric sensing and heat sensing combined in a single sensor/base assembly. The sensitivity of multi-criteria smoke detectors shall be selected depending upon the environmental condition.

The fire detection and alarm panel shall be based on intelligent addressable redundant microprocessor based technology.

Sound alarm buzzer shall be provided at local to allow personnel evacuation prior to  $CO_2$  discharge.

### Cables:

**MICC cable** shall be 750V grade, heavy duty with outer covering of LSF material equivalent to BICC Fire safe conforming to BS:6207. The cables shall be rated for 950°C for three hours and shall meet with requirement of CWZ class as per BS: 6387. In addition the cables shall have high degree of immunity from electromagnetic interference.

**FRLS cable**: 1.1KV grade with stranded Cu conductor, HRPVC insulation for power cable and Cu conductor, PVC insulation for control cable, extruded PVC inner sheath, round wire armour and extruded FRLS PVC overall sheath.

Instrument cable: Stranded ATC 1.1 KV grade armoured FRLS with individual and overall screening.

### Painting

The bidder's scope of work includes supply of paints and painting of all equipment as per the standard colour coding scheme. The quality and finish of paints shall be as per standards of BIS. Purchaser's Colour Coding scheme shall be furnished during detailed engineering stage.





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## Drawing & Documents

After award of contract, the successful bidder shall submit the following drawings & documents for owner's approval:

- i) Design basis report for the entire system.
- ii) P&IDs, Layouts & Isometric Drawings showing the complete fire protection and detection scheme for Generators.
- iii) GA Drawings, Datasheet, sizing calculation of various System/ Equipment/ Instrument required for the complete system.
- iv) Bill of Material (BOM) for various System/Equipment/Instruments.
- v) Schematic drawing, Wiring diagram & Layout of DCS, Control Panel, UPS etc.
- vi) Cable Schedule and Datasheet.
- vii) Typical Control Schematics for protection of both Generators.
- viii) Backup calculation for no. of detectors, nozzles for both Generator protection system.
- ix) Typical Annunciation Schematic Diagram, Wiring diagram for both the systems.
- x) Operation Manual (2 nos. of hardcopies & softcopy) of the entire fire detection and protection system for the subject Generators.
- xi) Any other drawings & documents to explain the work stated in the scope of supply

Approval from all statuary authority is in the scope of bidder.

# Safety / Monitoring Devices

### a. Anti-Condensation Heating

In order to avoid water condensation during long non-operative period of the machine, heating elements shall be installed inside the generator barrel. These elements shall be rated for three-phase 415 V A.C., 50 Hz; and their terminals shall be connected to an easily accessible terminal box. The heating shall be controlled automatically by adjustable hygrostat, setting range about 50-100% relative humidity. The anti-condensing heating shall also be provided with manual ON/OFF switch and corresponding indication lamps in the local control panel. Provision shall also be made for adjustable thermostat for automatic control of the heaters.

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### b. Miscellaneous Provisions

### Instrumentation for Field Assembly and Tests

Bidder shall make arrangements for bringing all types of electrical and mechanical instruments required for field assembly of the rotor, stator and all testing equipment for testing and commissioning including field acceptance tests. These shall remain the bidder's property after fulfillment of all field tests.

### xii. Terminal Boxes

The generator manufacturer shall supply terminal boxes to be located inside the generator pit, for connection of control and secondary leads from the generator equipment and auxiliaries located in the generator enclosure. All leads including control and indications shall be wired to this terminal box.

### xiii. Control Wiring and Conduits

All internal wiring and conduits for control, relaying, fire protection, internal illumination and other systems shall be brought out to terminal boxes, and shall be suitably labeled.

### xiii. Instrumentation, Control and Safety Devices

Necessary sensors/sensing elements, signal generators for sequential control and interlocks, measurement (indication, recording of quantities), monitoring of abnormal conditions of operation (for safety, alarm annunciation and shutdown) and related instrumentation which are embedded in and/or mounted on the generator or its adjacent (local) gauge panel should be included in the scope of supply of the generator as an integral part.

These items shall generally pertain to the following:

Temperatures	Stator, rotor, bearings.
Liquid Level	Oil in bearing oil baths
Pressure	Brake air, High pressure lubrication oil,
	cooling water
Flow	Cooling water for generator air coolers,
	bearing oil coolers
Shaft current/Over	Generator
speed/Creep/Vibration/Fire	

Bidder shall cover these items in the generator supply. They shall also include any



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additional item not indicated but which are necessary for smooth operation and safety of the equipment. A list of these additional items shall be decided during detailed engineering.

### Miscellaneous Piping, Tubing, Valves

All internal piping and valves for the following functions shall be included in the scope of the Bidder:

- Cooling water inlet, outlet and drain for generator air and oil coolers.
- Lubrication oil supply to guide bearing meant for lubrication during start-up and shut down of the unit.
- Oil filling and drain connections at the bearings.
- Piping for brakes
- Jacking system(HS lunrication system)
- Tubing for connections between temperature sensing elements (vapour bulbs) to dial type thermometers, pressure gauge tubing.
- Any other essential piping, tubing, etc.

### Cabling

The following control and auxiliary power cables and wiring shall form part of the generator supply:

- All wiring within the generator housing for the speed signal generator connections, thermometers, flow meters, RTDs /DTTs, all alarms and control and metering circuits associated with the generator.
- Capillary tubes/Cables between the generator and the gauge board.
- All 240 volts A.C. wiring, lighting fixtures and convenience outlets within the generator housing.
- All conduit and/or cable trays required for conductors and cables within the generator housing.
- A cable-marshalling box with approved disconnecting links to terminate all cables leading to the exterior of the generator.

### 06.03.02 Excitation system and digital voltage regulator

Static high initial response rectifier excitation system shall be provided. Static rectifier excitation system shall obtain the necessary electrical power directly from the terminals of the generator. The system shall consist of excitation transformer, thyristor control element,





electronic regulator and de-excitation unit.

The capacity of the excitation system shall be adequate to supply continuously 1.1 times the excitation current and voltage required by the generator at its maximum continuous output and 100% rated voltage and also for supplying twice the excitation current required by the machine at its maximum continuous output and 110% rated voltage for duration of one minute.

The excitation system while operating at its maximum output, terminal voltage, power factor and speed shall be capable of changing from rated field voltage to 90% of ceiling voltage within 25 milliseconds for a sustained drop in generator terminal voltage of 5%.

Automatic voltage regulation (AVR), power system stabilizer (PSS) shall be in accordance with Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 and Central Electricity Authority (Grid Standards) Regulations.

The number of bridges shall be such that one bridge is always available as redundant. With the failure of two bridges it shall be possible to continue operation at reduced load. The rectifier PIV (peak inverse voltage) rating shall not be less than four times the maximum RMS voltage of the input.

The rectifier bridge shall be natural air cooled and shall consist of fully controlled 3-phase full wave bridge SCR circuits comprising two (2) x100% sets with associated bus work. Forced cooling of thyristor convertor shall be provided with 100% reserve capacity, cubicle mounted fans. Number of bridges shall be provided in such a way that one bride can be taken for maintanence without any restrictions on loading of the unit. Indication of thyristor fuse failure shall be provided. Arrangement shall be provided to change thyristor during machine running.

Slip rings made of alloy steel forging shrunk fitted on the rotor shaft and insulated from it shall be provided to deliver current to the field windings.

Adequately rated field-flashing system suitable for working on both DC system and 415 V AC System shall be provided for initial buildup of voltage.

Rotor angle limiters shall be provided to control both over and under excitation conditions. The thyristor bridge shall be rated to act for 3 phase fault adjacent to HV terminals of generator transformer cleared in 5 cycles & one auto reclose on to above fault after 20 cycles followed by clearance in 5 cycles. The bridge ceiling voltage shall be 1.8 times the





normal field voltage.

D.C. field circuit breaker shall be provided to ensure positive disconnection of the field from the D.C. source and subsequent discharge of the field energy into a discharge resistor.

The automatic voltage regulator (DAVR) shall be microprocessor based. DAVR shall maintain the average 3-phase generator voltage within 0.5% without hunting for all operating conditions.

The DAVR shall have necessary devices and control circuitry to achieve equal reactive power sharing of generators. The DAVR shall operate in both Auto and Manual modes.

DAVR shall have reactive current compounding circuit to provide reactive load sharing during parallel operation. The compounding characteristic shall be adjustable. Low excitation or a MVAR limiter shall be included to prevent the regulator reducing the generator excitation below approved safe limits under leading power factor conditions. AVR shall operate to keep following conditions.

- Maintain generator voltage +/- 0.5%
- Maintain generator voltage under load rejection or 150 % over speed = +/- 5%
- To supply field forcing

All necessary field suppression equipment shall be provided to ensure safe operation of the plant under all modes of operation.

Neutral point of each generator will be earthed via a distribution transformer. Secondary of transformer will be connected with a suitable resistor.

### a. Detailed Scope of Supply

The excitation system and DVR shall consist of: -

- One (1) set of dry type excitation Transformer
- One (1) set of full wave fully controlled rectifier system with (n+n) layout thyristor bridge arrangement for 100% redundancy, complete with firing circuit, control system etc.
- One (1) sets of digital voltage regulators with all limiters & power system stabilizer.



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- One (1) set of power supply unit
- One (1) set of field flashing equipment, including transformers.
- One (1) set of DC field circuit breakers
- One (1) set of discharge resistors
- One (1) set of digital control and metering equipment
- One (1) set of excitation cable connecting the rotor to DC field breaker
- Any other items not specified above but are necessary to complete the system for satisfactory operation.
- Set of Spares

(Note: One set is defined as the total number required for one Unit. applicable for both units).

### b. Special Design and Layout Conditions

The excitation system shall be of the static, digital, constant-voltage type with controlled thyristors. It shall feature a very sensitive, quick acting control of the generator voltage and reactive power respectively. The system shall be of reliable design with an adequate record of satisfactorily working reference plants.

### c. Basic Dimensions and Ratings

Unless otherwise stated, rating, characteristics, test and test procedures, etc. of the equipments of excitation system and DVR shall comply with the provisions and requirements of the latest applicable International / Indian Standards.

### d. Performance Criteria & Guarantee

The equipment covered under this contract shall be capable of performing all intended duties and it is the responsibility of bidder to supply the equipments as per guaranteed technical particulars.

# e. Design and Construction

The equipment offered shall be capable of withstanding lightning and switching surges and dynamic over voltages to which they may be subjected to and shall meet all the performance requirements and tests as described in the specification. The equipment





shall conform to the latest issue of IEEE 421 or equivalent standard.

### f. Excitation Transformer

The excitation transformer shall be of the 3-phase, cast-resin dry type, class "H" insulated. The winding material of transformer shall be copper. The L.V. and H.V. windings shall be impregnated and vacuum cast into moulds of glass fiber reinforced epoxy resin. The windings shall be provided with temperature sensors (PT 100) and static alarm and tripping device. The transformer shall be naturally air cooled, installed in a cage, designed and constructed to match perfectly with the common switchgear assembly. The L.V. connections to the rectifier cubicle shall be of copper buses and/or cables respectively and shall be in the scope of bidder.

### g. Characteristics of Excitation transformer

Ratings of the excitation transformers shall be sufficient to meet the duties specified herein.

Primary rated voltage	:	11 kV	
Secondary rated voltage	: To be decided by generator and Excitation equipment		
	manufacture	er	
Class of insulation	:	н	
Type of cooling	:	AN	
BIL (High tension)	:	75 kV	
Power frequency withstand vo	ltage:	28 kV	

The manufacturer shall supply a metal box, which will enclose the transformer high voltage bushings and terminate the isolated phase bus feeding the transformer. The flexible connectors from the isolated phase bus to the transformer bushing shall be arranged by bus-duct manufacturer. The manufacturer shall provide a flange for bolting the phase bus enclosure to the metal box. To maintain the generator isolated phase bus arrangement, metallic barriers of suitable design to prevent short circuit between phases shall be installed between phases inside the transformer.

### h. Thyristor Equipment

This equipment shall essentially consist of silicon power thyristor bridges installed in adequate cubicles. Each thyristor with relevant fast acting semi-conducting fuses shall be



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mounted on draw-out modules facilitating inspection and replacement. The fuses shall be monitored individually or in groups providing alarms and trips as required.

The design shall provide 100% redundancy in (n+n) layout arrangement of bridges where n is no. of bridges in one circuit. The rectifier shall be rated for the following duty cycles:

- Continuous operation at its maximum rating.
- Three phase fault adjacent to HV terminals of the generator
- Short circuit on the high voltage side of the transformer with duration of 2 sec.

The static excitation equipment shall be of modular design in such a way that it can be readily removed for inspection or replacements of parts.

Two independent circuits shall be provided for the manual and automatic control respectively.

The following monitoring and protection features shall be included:

- Temperature monitoring of thyristors
- thyristor failure
- D.C. short circuits
- Thyristor and field circuit over voltage protection
- Transient over voltage originating from the A.C. system, lightning or switching surges.
- The system shall operate correctly with supply voltages up to 120% rated voltage or unbalanced supply voltages.

Calculation for the capacity of rectifier shall be submitted. While determining the capacity, effect of ageing shall also be considered .The rectifier PIV (Peak Inverse Voltage) rating shall not be less than 4 times the maximum RMS voltage of the inputs.

# i. Digital Voltage Regulator (DVR)

The DVR shall be a digital (numerical) type regulator. The digital voltage regulator shall respond continuously and practically instantaneously to correct any change in generator voltage. It shall maintain the generator voltage for steady- state load conditions, without hunting, with 0.5% accuracy for any excitation within the operating range of the generator. For steady-state conditions with the generator circuit breaker open, the regulator shall maintain the generator terminal voltage at or below 105% of its rated for speeds ranging from rated speed up to an over speed of 120% rated speed. An exciter limiting control



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shall be provided to limit the generator voltage to max. 125% of rated voltage in the event that the digital voltage regulator is tripped coincidentally with 110% load rejection and the generator speed rising to runaway speed. The voltage regulator shall be provided with over- and under- excitation limiters. The intervention of the limiters shall not cause perceptible deviations or oscillations of the generated active and reactive power. The characteristics of the under-excitation-limiting curve shall match the static and dynamic stability curves of the generator. Such devices shall allow the regulator to reduce the exciter voltage to zero or to negative values in order to prevent over- voltages in case of operation under line reactive load conditions and over speeding of the unit.

The following features shall be included:

- stator current limiter
- field current limiter
- load angle limiter

The field current limiter shall act on DVR with a time delay so as not to disturb transient response of the system during voltage dips/faults. A slip stabilizer unit shall be provided to suppress the low frequency power oscillation during the operative conditions. The voltage regulator shall be equipped with a sensitivity-adjusting device and with an adjustable voltage droop compensation (compounding).

After the generator voltage attaining initial maximum value neglecting the instantaneous rises following any load rejection up to 110% of the rated load, DVR shall restore the generator terminal voltage to a value not more than 5% above or below the voltage being held before load rejection and shall maintain the voltage within these limits throughout the period of the generator over speed.

The excitation system shall be capable of operation on joint control maintaining even distribution of the reactive load between machines. Reactive power joint control function devices to ensure satisfactory load sharing during parallel operation of the generators shall be integrated in the station control computer. Paralleling of generators shall be achieved on 33kV side of Generator transformers. The voltage regulating system shall include device for improving the damping of active electromechanical oscillations. These devices shall operate to supplement the voltage regulating action by addition of an additional control signal into the excitation system input. This supplemental input signal





shall influence the excitation system as to cause a change in field current of the machine for stabilized operation. As an option, adaptive control function feature to the slip stabilizer shall be offered. The function of the control is to optimize the setting of the slip stabilizer to suit the different configuration system. The setting of device shall be determined by bidder.

The excitation system shall be designed for manual and automatic operation. The change-over from automatic to manual control shall be performed automatically following a failure of the regulator when operating on automatic control. The generator voltage shall be controlled within a range of +10% and -15% of rated voltage. A static follower shall be provided so that, in the case of change-over from automatic to manual control, it prevents the excitation current from deviating more than 5% of no-load excitation current under steady conditions. An alarm and visual indication shall be provided to indicate change from 'AUTO' to 'MANUAL'. The automatic and manual control circuits shall be fully independent. Local and remote control shall be possible.

The voltage setting device shall be of the solid-state digital type providing a range of +10% and -15% for local and remote control and indication. For testing purposes, settings of 0 to 115% shall be adjustable at the DVR cubicle.

# j. Initial Excitation System

In order to overcome the deficiency of remnant magnetism when starting the machine, initial excitation shall be applied to the field winding. The respective power shall be derived from the A.C. supply system via transformer and rectifier. All equipment for automatic field flashing, i.e. circuit-breakers, blocking diodes, control devices, protection, etc. shall be included. Provision shall also be made for field flashing through station batteries as stand-by arrangement. The field flashing circuits shall get disconnected when 70 % of the rated voltage is achieved at the generator terminals and normal excitation circuit takes over. This system shall also cope with the requirements of the excitation necessary for test runs.

### k. De-Excitation System

To achieve a quick suppression of the generator field and thus the voltage, the field winding shall be shunted by a discharge resistor (voltage dependent type). After tripping



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the generator circuit breaker the DC field breaker shall connect the discharge resistor and simultaneously the polarity of the excitation shall be reversed.

### I. Control Cubicle

The control cubicles shall comprise all control and supervisory devices required for the operation of the entire excitation system and DVR. The minimum requirements for instrumentation are the following:

- A.C. supply voltage
- D.C. supply current
- D.C. field current
- Set-point indicator for DVR control

### m. Interface with Unit and Station Control Equipment

A bus oriented control system will be provided. The digital voltage regulating and excitation control equipment shall be capable to communicate via serial interface and the field bus with the unit control boards. All signal interchange shall be realized through the bus.

### n. Cubicles

All the equipment of static excitation and DVR shall be suitably housed in sheet metal, dust proof cubicles. All these cubicles shall be located at one place in a row without any gap in between. The dimensions of the cubicles shall be identical to present a neat and functional line up.

### o. Protection of Static Excitation Equipment

The excitation equipment shall be protected against internal faults, failure of thyristor bridges, cooling fans etc. for which contacts shall be provided for alarm and shut down of the unit .The items of protection covered shall be the following but not limited to:

- Ñ Excitation equipment internal faults
- N Current asymmetry protection more than two stacks faulty
- Ñ Over current protection for overload and short circuit protection of the excitation transformer and rectifiers
- Ñ Cooling fan failure (main and reserve)
- N Loss of regulator DC power



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# RO ROT CONTRA

- (MECHANICAL & CIVIL)
- N Failure of thyristor firing circuit
- Ñ Failure of DVRs
- Ñ Individual cooling fan failure
- Ñ Rectifier cubicle exit air high temperature
- Ñ Current asymmetry, one thyristor stack faulty
- Ñ Operation at minimum excitation limit
- Ñ Operation at maximum excitation limit
- Ñ Excitation transformer winding temperature
- Ñ Operation of slip stabilizing unit
- Ñ Failure of field flashing circuit equipment
- Ñ Prevent over fluxing of the transformer

### p. Excitation Connections

Excitation power cable connections between the generator slip rings and the DC field breaker cubicles shall be provided. The power cables shall be of adequate copper cross-section to continuously carry the rated current of the excitation system and the maximum current for 10 seconds. They shall be made of highly flexible conductors and the cable insulation shall be of the heat-resistant type, taking into account the maximum temperature rise of 65°C at 40°C ambient temperature in the slip-ring compartment. The cables shall be adequately spaced and supported with consideration to the electromechanical forces involved and designed to prevent undue heating during continuous operation.

### q. Other items

Bus ducts for both units #1&3 - Generator CT, PT, LA & surge panel shall be provided as described in respective chapters (refer vol. III).





### 06.04 COOLING WATER SYSTEM

The scope of work covers design, engineering, manufacture/fabrication, shop testing, assembly, packing, supply, transportation to site, comprehensive insurance, unloading, unpacking, storage at site, site handling, fabrication, erection as per approved drawings, painting, commissioning, performance guarantee testing and handing over of complete cooling water system including fulfillment of guarantee of all the system and integrated system required for Maithon Hydel Station Unit # 1 & 3.

Presently cooling water is tapped from the spiral casing. There is a connection of six (6) inch pipe size for draining the water from spiral case to sump is located at the lowest point of the spiral case. A vent pipe is connected to the highest point of the spiral case (adjacent spiral inlet section), for disposal of trapped air. Each unit has separate cooling water intake system. Cooling water system consists of strainer, valves, NRV and piping. After the strainer there is a common header and from the common header, cooling water is distributed to the various consumers like Generator stator Air Cooler, Generator guide bearing oil cooler, carbon seal, gland cooling, Turbine bearing oil cooler and governor oil cooler.

### Further to above following works are included in the scope of work.

- a) The existing inlet valve including strainer including piping (including by pass system) of the cooling water line shall be changed along with a new motorised valve with provision for hand operation and controls from local panel and control panel. The motorised valve shall be in line with the specification given in chapter-4.
- b) All valves strainer and pipes shall be replaced with new set. All pipes of cooling water system shall be of carbon steel ERW as per IS 1239 and IS 3589.
- c) The new automatic cleaning type duplex filter shall be provided in place of the existing water filter.
- d) Replacement of Incoming and outgoing waterline including valves, etc from scroll case and draft tube of Unit # 1, 2 & 3.
- e) Replacement of Incoming and outgoing waterline including valves, etc of Generator cooling system of Unit # 1,2 & 3.



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# R) Ratio Comment

- (MECHANICAL & CIVIL)
- Replacement of Incoming and outgoing cooling lines including valve of generator bearing coolers, turbine bearing coolers, governor cooling system, generator air coolers.
- g) Initial filling lines for draft tube and spiral case including valves, etc.
- Supports for pipes, valves etc. wherever required shall be provided. Valve operating platform with necessary stair case, ladder, hand railing as required, to be provided.
- i) Common header pipe lines for units # 1, 2 & 3 required to be replaced
- j) It is proposed to install one nos. motorised valve in the bypass system across NRV for initial filling of draft tube and spiral case so that Water from one source can be diverted into another for all three units.
- A separate water filtration unit shall be provided with micro filters, cyclonic separators, etc for shaft seal cooling system.
- I) All required electrics and instrumentation including civil works for piping system included in the scope of work.
- m) New sets of instruments and gauges shall be provided in the cooling water system.
- n) Other balance works as required to complete the cooling water system.

For common header and unit # 2 same size of the pipe line to be maintained (minimum requirement).





### 06.05 COMPRESSED AIR SYSTEM

Two nos. reciprocating air cooled compressor is presently installed to meet the air requirement of breaking system as well as air requirement for governor. Compressors including pipe, valves and fittings are quite old. From compressed air receiver, there is a common header and from the common header compressed air is distributed to the various consumers like governor pressure tank, breaking system etc.

Details of existing compressed air system indicated in Chapter - 05 of this Volume.

As this system is very old, it is proposed to replace the entire compressed air system suit to the system requirement. Governor air required pressure 30~32.0 kg/cm<sup>2</sup> at governor terminal (each governor, total air to be considered for three nos. units simultaneously operating). Bidder shall design the compressor discharge pressure at maximum air requirement and also considering piping loss (system loss). Air requirement for breaking system shall be routed via suitable capacity pressure reducing valves (PRV). Required piping, fittings, valves for connection from compressor to air dryer, air receiver, PRV, and consumption points for all three units is included in the scope of work.

Approx 17~20 Nm3/hr Compressed air is required at governor terminal for operate the same. Apart that, bidder consider compressed air required for breaking system and other system requirement.

Two (2) nos high pressure reciprocating compressors (1W+1S) of required capacity (minimum 15% margin to be taken all and above system requirement- apart from leakage margin-5%) along with air dryers (1W+1S) and air receivers two (2) nos. {one nos(1) high pressure application and other one (1) air receivers for low pressure application} to be provided. The discharge pressure of the compressor shall be as per requirement of the system. The compressed air required for break and other system (for Low pressure application) as per requirement suitable capacity of PRV (1W+1S) to be provided.

Two nos. oil filters in series need to provide at the outlet of air compressor to restrict the oil content in the compressed air to 0.01 ppm.

Refrigerant type of air dryer shall be provided to meet the instrument quality compressed air. The entire pipe, fittings & valves from compressor discharge to air receiver; from air receiver to common header including distribution piping system from common header to various consumers for Unit # 1, 2 & 3 shall be replaced with new. Supports for pipes,



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valves etc. wherever required shall be provided. All pipes of compressed air system shall be of CS seamless as per IS1239 part-1/ ASTM A106 Gr B (heavy grade) & IS 3589.

All required electrics and instrumentation including civil works are included in the scope of work.

Suitable capacity monorail along with electric hoist required to be provided for air compressors. Capacity of electric hoist shall be based on heaviest component to be lifted during maintenance.

At the outlet of the compressor (each compressor) one no flow meter, pressure transmitter and isolation valves to be provided. One no dew point meter also needs to be provided at common header

### Broadly scope shall include the following: -

### A) Compressor

- Two (2) no .required capacity and matching discharge air pressure for operating equipment, reciprocating, horizontal/vertical, lubricated, Air cooled compressor.
  Bidder to submit capacity calculation to consultant/ client for approval.
- ii) Electric drive motor for air compressor. Compressor's Motor rating shall have be minimum 10% margin over and above BkW rating.
- iii) Two (2) nos. of horizontal/vertical air receiver of 0.3 m<sup>3</sup> water (minimum) holding capacity.
- All pipes, valves, fittings and supports for air from compressor air discharge flange to isolation valve of air receiver, drain and vents within the vicinity of equipment .Supply of all matching flanges, utility connections with necessary gaskets, bolts, nuts, washers in requisite nos.
- Dry type suction air filter cum silencer with filtering element of fiber glass felt sandwiched between wire mesh with supporting arrangement and fixing bolts, nuts etc. The suction filter design will be such that it will draw air from minimum four (4) sides.
- vi) Belt guard with fixing arrangement.
- vii) Intercooler/After cooler as applicable
- viii) Rotary gear oil pump with oil filter / strainer, oil level indicator and oil piping, pipe coupling / unions and oil cooler.
- ix) Teflon rings for piston and teflon gland packing.





- x) Non return valve and isolating valve at the discharge side of the compressor.
- xi) Two nos. oil filers in series need to provide at the outlet of air compressor to restrict the oil content in the compressed air to 0.01 ppm.
- xii) Companion flanges, reducers. tee, bends, nuts, bolts and gaskets for all types of flanged connections in pipes, valves and equipment.
- xiii) Pressure gauge at the outlet of compressed air discharge pipe line.

### B) Horizontal/Vertical Air Receiver (02 No.):

Horizontal/Vertical self supporting in cylindrical design with dished ends at both ends having water holding capacity of 0.3 m<sup>3</sup> (minimum capacity). Air receiver will be connected to compressor. Material of the air receiver shall be IS:2002/equivalent. The air receiver shall be designed for a working pressure of 120% discharge pressure of compressor and shall be supplied with following accessories.

- i) Skirt welded to the bottom portion of the shell.
- ii) Base plate welded to the skirt with holes for foundation bolts, foundation bolts / studs, nuts, washers as required.
- iii) Nozzles for inlet and outlet with weld neck flanges.
- iv) Isolation valve at the inlet & outlet of the air receiver.
- v) Manhole nozzle at an accessible height and cover having davit arrangement.
- vi) Safety valves
- vii) Pressure gauge
- viii) Pressure switch for loading & unloading operation

### C) Air Dryer (02 nos)

i)	Туре	:	Refrigerant type
ii)	Quantity	:	Two (2) Nos. (1W + 1S)
iii)	Air volume flow	:	As per system requirement.
iv)	Inlet air pressure	:	As per discharge pressure of compressor
v)	Service duty	:	Continuous
vi)	Inlet air temperature	:	As per max discharge temperature of
			compressor



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vii)	Ambient temperature (Design)	:	35 <sup>0</sup> C
viii)	Relative Humidity (Design)	:	100 %
ix)	Maximum allowable pressure drop across dryer	:	0.2 Kg/cm <sup>2</sup>
x)	Oil content in inlet air	:	Nil.





### 06.06 DRAINAGE AND DEWATERING SYSTEM

Presently four (4) nos. electrical driven dewatering pump have been installed for the power house. All the four (04) pumps are working in alternate manner. Apart from that two (02) nos. diesel driven pump has been installed to operate during emergency. The scope of the bidder is to replace existing one no (1) emergency diesel driven pump with new diesel driven engine pump set along with pipe, valves including supports etc for the dewatering system.

### Details of the dewatering pump to be supplied:

Pump type	Horizontal turbine pump
Rated head	25.49 m
Rated flow	226.90 m <sup>3</sup> /hr

At present 28.348 kW rating diesel engine has been installed in Maithon Power House. Bidder to supply same capacity or higher capacity of diesel engine to operate the dewatering pump. New Dewatering system including replacement of DG driven dewatering pumps, pipes, valves, pump-motor sets, water float valves with interlock system etc. Replacement of discharge pipe line for the exposed portion including delivery point at surge chamber including common piping portion..

- A) Horizontal pumps MOC: Horizontal turbine pumps MOC shall be as per the following:
  - a) Impeller; 19-10 Molybdenum Austenitic Stainless Steel AISI-316 or ASTM A296 CF 8M,
  - b) Casing/ bowl: 2.5 % Ni Cl,
  - c) Casing ring: Cast iron (IS 210FG 260),
  - d) Line shaft: Chromium steel AISI-410 (heat treated), solid shaft,
  - e) Shaft sleeve: SS 410H,
  - f) Column pipe and discharge head: Carbon steel, IS 2062-1992,
  - g) Coupling: Stainless steel,
  - h) Suction strainer: SS 316.




### B) Diesel engine for pump set

#### General

- The diesel engine shall be complete with all standard accessories, battery sets, battery charger, instruments & control panel, base frame etc.
- The diesel engine shall be compression ignition mechanical direct injection type, capable of being started by a battery powered electric starter motor, and shall accept full load within 15 seconds from the receipt of signal to start.
- The diesel engine shall be natural aspirated, super charged or turbo charged and either air or water-cooled. In case of charge air-cooling by means of a belt driven fan or of a belt driven auxiliary water pump, there shall be multiple belts such that half the belts should be capable of driving the fan or pump.
  - The diesel engine shall be capable of operating continuously (24 hours) on full load.
  - The diesel engine shall be provided with an automatically adjustable governor to control the engine speed with 10% of its rated speed, under any condition of load up to the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load.
  - The diesel engine shall be provided within-in-built tachometer to indicate the speed of the engine in rpm.
  - Any manual device fitted to the engine, which could prevent the engine starting, shall return automatically to the normal position.
  - Engines after correction for altitude and ambient temperature shall have bare engine horsepower rating of 10% in excess of maximum horse power required to drive the pump at its duty point.
  - The coupling between the engine and the pump shall allow each unit to be removed without disturbing the other.



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## Cooling System

- The engine shall be cooled by water from the discharge of the pump (takes off prior to the pump discharge valve) direct into the engine cylinder jackets via a pressure reducing device to limit the applied pressure to a safe value as specified by the engine manufacturer. The outlet connection from this system shall be terminated at least 150 mm above the engine water outlet pipe and be directed into an open tundish so that the discharge water is visible.
- The discharge from the engine shall be collected and drained into the nearest drainage channel.

#### Air Filtration

The air intake system ensures sufficient clean air to the engine. It shall incorporate suction air filter, which shall be of oil bath type to supply clean air to the engine.

#### Exhaust System

The hot exhaust gases shall be let-off with suitable system. All the hot parts located at the working level shall be insulated. The exhaust system shall include:

• Exhaust manifold

• Silencer: The exhaust gas shall be let off through suitable silencer. The total back pressure shall not exceed the engine manufacturer's recommendation. Sufficient length of straight pipe shall be provided after the exhaust silencer to leave the exhaust gases at nearest to the emergency exit/ or in other gas escape area for easy & speedy evacuation of the flue gas.

• Expansion joint in SS construction to reduce the forces and moment likely to be transmitted on the engine frame.

#### Fuel System

- Fuel for the engine shall be high-speed diesel oil as per IS : 1460 1974.
- Fuel tank and fuel feed pipe shall be provided for the engine.



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- The fuel tank shall have the capacity sufficient enough to allow the running of the engine at full load for 3 hours.
- The fuel tank shall be of welded steel construction. The tank shall be mounted above the engine fuel pump to give gravity feed. The tank shall be fitted with a level gauge calibrated in liters, filling in and cleaning hand holes drain cocks, self supporting from and connection to the engine fuel oil system.
- Valves in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and they shall be located in open position. Plastic tubing shall not be used.
- Filter to suitable capacity shall be provided for the fuel feed pipe between the fuel tank and fuel pump.
- Suitable sludge and sediment trap shall be provided for the fuel feeding system.
- The fuel tanks shall be supplied with hand pump for tapping the fuel tank from oil barrel.

## Lubricating System

The lubrication system shall be self-contained with the following equipment.

- Sump: To store sufficient lube oil for circulation, suitable sump shall be located in the engine.
- Pump: Suitable pump for forced lubrication.
- Filter
- Lubricating oil cooler
- Interconnecting piping & tubes in seamless construction.

## Starting System

The engine shall be capable of manual starting by electric starter motor. Since the pump driven by the diesel engine is not required to run continuously for long period and the operation will not be frequent, special features shall be built –in the engine to allow it to start within a very short period, even if it has been remained idle for a considerable long period.

The engine shall be designed in such a way that is shall be started by one





operator, if necessary, without any preliminary heating of the combustion chamber. All controls/mechanism, which has to be operated in the starting process, will be within easy reach of the operator.

Automatic cranking shall be effected by a battery driven 24V DC motor having high starting torque to have adequate ampere-hour capacity to provide the starting power for the diesel engine. A control panel for starting of the engine through battery to be provided. Engine START/STOP/TEST buttons shall be provided on control panel. The battery capacity shall be adequate for ten (10) Consecutive starts without recharging with a cold engine under full compression.

The battery shall be used exclusively for starting the diesel engine and kept fully charged all the time. Arrangement for both the trickle and booster charge shall be provided. However, when the engine starts or is running, provision shall be kept to ensure that the charger is automatically disconnected and the battery is charged by the engine dynamo. At no times it should happen that the battery gets disconnected and is not available to start the engine.

The charger shall give constant D.C output voltage irrespective of incoming voltage variation specified. The charger shall be with fully controlled bridge circuit with diodes.

## Governing System

The governor shall be fitted with a speed control device, which will control the speed under all conditions of load.

The governor shall offer the following features:

Engine should be provided with an adjustable governor capable of regulating engine speed within a range of 10% between shut-off and maximum load condition of the pump. The governor shall be set to maintain rated pump speed at maximum pump load. Engine shall be provided with an over-speed shutdown device. It shall be arranged to shut down the engine at a speed approximately 20% above rated engine speed and for manual reset, such that the automatic engine controller will continue to show an over-speed signal, until the device is manually reset to normal operating position.

The governor shall be capable of operating without external power supply.



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### **Foundation Frame**

Suitable foundation frame with foundation bolts & nuts shall be provided as per OEM practices.

#### Instruments

The equipment shall be provided with necessary instruments to check the working of the engine continuously. The following instruments shall be minimum which will be provided and the same shall be fixed on a common instrumentation panel mounted directly on the engine base frame:

- Lubricating oil temperature indicator.
- Lubricating oil pressure indicator.
- Cooling water inlet temperature indicator.
- Cooling water outlet temperature indicator.
- Speed-cum-hour meter.

The pressure and temperature gauges shall be of reputed make. The following protections annunciation also shall be provided.

- a. High cooling water outlet temperature
- b. Low lubricating oil pressure

Any other instrument, control and protection equipment required for the safe operation of the engine shall also be provided.

All the pressure gauges, pressure transmitter, pressure switches etc. where viscous fluid enters inside the instruments shall be provided with diaphragm sealed flanged process connection with flanged isolation valves.





## 06.07 VENTILATION SYSTEM

Presently ventilation system comprises three exhaust fans of the axial flow type, each rated for 40,000 cfm of air under a static water head of two (2) inch. The fans are located inside a structure on the top of the emergency exit shaft. The air is drawn in through the main access tunnel and to counter against occasional dust storm the air is fed through mechanical self-cleaning filter. Control louvers of the fixed and adjustable type are provided at key points inside the power house in order to maintain uniform distribution and temperature of the incoming air throughout the power house.

Bidder's scope shall include replacement of existing three nos. exhaust fan motor, cables, starter / switch and other associated auxiliaries, including all associated electrical facilities, suction air filters, dispenser installed in the ducts casing (as required) etc. New Exhaust fans need to be accommodated in existing place/foundation. The capacity and pressure of new exhaust fans should be at least 25% higher than existing fan capacity and shall be accommodated in same frame.

Casing of the exhaust duct, running parallel to emergency shaft is rusted, corroded and badly damaged. Bidder is required to replace the ventilation duct with new color coated sheet/GI sheeting (minimum 6mm thk) along with all hanger & supporting structure. Controlling louvers located at various points of the power house shall also be required to replace with new one. All doors and windows of the ventilation room shall be replaced with new one.

Replacement of Mechanical suction air filter assembly installed at main access tunnel is also included scope of bidder.

## Details of Self cleaning Suction air filter

Exhaust fans of Maithon Hydel Station for ventilation system is installed at top of the power house. The fans are located inside a structure on the top of the emergency exit shaft. The air is drawn through the main access tunnel and to counter against occasional dust storm, the air is fed through self-cleaning suction air filter. Control louvers with adjustable type are provided at the entry of tunnel of the power house in order to maintain uniform distribution and temperature of the incoming air throughout the power house.





The self cleaning suction air filter or self cleaning viscous suction air filter is particularly suitable for industrial application to filter large air volumes with high dust concentrations. The self cleaning viscous air filter has high cleaning efficiency, minimum maintenance, low working cost and easy installation.

The filter media consist of special overlapping panel to form filtering curtain at front and rear of the filter. The panel are made of die stamped carbon steel or of an equivalent materials and can be inserted in a single way or double way. The panel are suspended on two lateral heavy duty endless chains with specially designed links which permit both the panel assembling and the filtering wall rotation. In the upper part of the filter are located the mechanism for the rotation of the whole filter by electric gear motor, that is front mounted in order to permit the mechanical connection of several units and to make checking and service operation easier. In the lower part are located the sprockets for rotation of the filtering is required the reservoir of viscous filtering oil. If an external oil clarifier is required the reservoir is equipped with necessary hydraulic fittings.

The air filtration is achieved by the special louvers die – stamped on panels, forming the filtering curtain that gives direction changes to the air flow and then lap the viscous surface coated with the adhesive oil. The filter utilizes the viscous impingement principle of air filtration. A drive motor actuated by a timer rotates the curtain with intermittent operation, rotating time and stopping time. Thus helping in improvement of self cleaning action of panels that happens by single immersion in the adhesive oil bath. The dust removed from the air by the curtain and washed from the panels settle to the bottom of reservoir as sludge that can be normally removed by hand – scraper or through automatic oil cleaner. Some oil lost during the removal of sludge can be maintain by small addition of oil to maintain the proper level to allow the complete panel submersion in the oil bath.

Bidder to design new Self cleaning Suction air filter considering the ventilation requirement to ensure sufficient and effective ventilation in all the area for safe working of the O&M personnel. All required civil, structural, electrics and instrumentation & control facilities shall be included in the scope of work of the bidder.

Ventilation duct need to be replaced as per requirement. control louvers are also required to be replaced with new one.

The above list is only tentative. Any other area that needs ventilation and not covered above shall also be provided with necessary facilities.



TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL) APRIL COMP

# 06.08 FIRE PROTECTION FACILITIES General

The scope of work covers design, engineering, manufacture/fabrication, shop testing, assembly, packing, supply, transportation to site, comprehensive insurance, unloading, unpacking, storage at site, site handling, fabrication, erection as per approved drawings, commissioning, testing, approval from the competent authority & handing over of complete Fire protection system, sub-systems and integrated systems as described including fulfillment of guarantee of all the system and integrated system required for Maithon Hydel Station.

The fire protection system includes the following:-

- a. Microprocessor based Fire detection and Alarm system for Switch gear (Basement) floor level & QBD detectors for Transformer area.
- b. Portable fire extinguishers at suitable location in and around power house.
   Turbine floor level, Switch gear (Basement) floor level etc.
- c. Modification in water based fire fighting system. Required piping, valves, Pressure switch, Pressure gauge, alarm etc for extension portion of the pipe lines
- d. All associated electrical & Control and instrumentation facilities.
- e. Initial fill of gas and other fire extinguisher media (including quantity required for PG test) and demonstration. The quantity requirement for PG test will be taken by the Bidder from within the supply made under BOQ. However the used up quantity is to be replaced by the Bidder free of cost.
- f. All unforeseen items (items not envisaged in schedule of quantity) required to complete the fire protection system.
- g. Erection, testing, commissioning, of the fire fighting system as required.
- Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required. Reconciliation with customs authorities (if required), as required.
- i. All equipment/system components (including detectors etc ) shall have approval from one of the followings:
  - i) Underwriters Laboratories (UL) of USA.
  - ii) FM of USA.
  - iii) Vds.



# DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



List of main components involved in the fire protection systems as given in the specification are indicative only. Successful bidder shall supply and erect the material as per the actual requirement. The quantities of such material shall be decided during detailed engineering (shall be as per IS code and subject to approval of consultant/ purchaser) and shall be supplied accordingly. Bidder shall therefore base the offer on his own assessment. No extra price/ claim shall be entertained later during detailed engineering.

Any other facilities to complete the plant as per system requirement of CEA/TAC/ other statuary authority requirement within the defined battery limits.

## 06.08.01 Technical Specification For Portable Fire Extinguisher

## a. General

Various units of Hydel Power Plant shall be protected by Portable Fire Extinguishers as first-aid firefighting facility. Portable fire extinguishers of different type and capacity shall be supplied and erected at various plant premises.

The distribution of extinguishers in terms of their numbers and types shall be done in accordance with IS 2190 (latest edition). All the areas of the power house shall be covered with fire fighting facilities including remote installation. In any case every room shall have portable fire extinguisher facility.

## b. Material of Construction

All the fire extinguishers shall be of welded construction except Carbon-dioxide type. In case of Carbon-dioxide extinguishers, the cylinders shall be of cold drawn seamless steel. Riveted joints will not be acceptable.

All the extinguishers shall bear metallic parts viz. unions, caps, inner containers etc. as per IS.

All the extinguishers shall be treated with lead-tin alloy for anti-rust, anti-corrosive treatment by electrolytic process or by dip coating process as per IS.

All extinguishers shall be supplied along with the wall brackets/fasteners for wall mounted extinguishers. All the parts shall have IS approval. All the extinguishers shall bear IS marking on their body.



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## c. Erection

All wall mounted portable extinguishers shall be supplied with mountings accessories and installed along the columns/walls near entry/exit at a height of approximately 1200 mm from the finished floor level.

Wherever extinguishers are required to be installed on the steel columns of the building, the welding of the supporting fixture to columns shall be done with prior approval.

SI.No	Parameter	Description
1.	Make	As per approved vendor list
2.	Design Standard	IS 15683 (2018).
3.	Quantity	As per IS, during detailed engineering.
4.	Rating	21B
5.	Performance	
	Capacity	4.5 kg
	Class of Occupancy	Group C & D
	Class of Risk Fire	HH
	Working Temperature	(-) 30 <sup>o</sup> C to (+) 55 <sup>o</sup> C
	Cylinder Test Pressure	250 kg/cm <sup>2</sup>
	Filling Tolerance	+/- 5% by mass
	Minimum effective discharge time	8 second (minimum)
	Bulk Range Discharge	2m (minimum)
6.	Construction Feature	
	Dome & Dish	Concave
	Filling Density	0.667 max
	Design & Construction of Valve	As per IS: 3224
	Design & Construction of	Seamless as per IS <sup>,</sup> 7285
	Cylinder	
	Gas Storage Pressure	50 kg/cm <sup>2</sup> (approx)
	Seal & Temper Indicator	Provided
	Safety Release	Provided
7.	Material of Construction	As per IS:2878-2004
		First Coats: 2 coats of red oxide primer
8	Painting	Outside Coats: 2 coats of red oxide primer
0.	i cinting	and 2 coats of synthetic enamel paint
		Finish Coat: Fire Red (IS: 5) Shade no. 536
9.	Marking	IS:15683-2018
		Verification of Test certificates from
10.	Inspection & Testing	approved test houses at site by purchaser
		Inspection team
11.	Approval	BIS

## d. Technical Parameters of CO<sub>2</sub> Extinguisher



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# (MECHANICAL & CIVIL)

e.	Technical	Parameters	of DCP	Extinguisher
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S.N.	Parameter	Description
1.	Make	As per approved vendor list
2.	Design Standard	IS 15683 (2018).
3.	Quantity	As per IS, during detailed engineering
4.	Performance	
	Capacity	6 kg
	Class of Occupancy	Group C & D
	Class of Risk Fire	HH
	Working Temperature	(-) 30 <sup>o</sup> C to (+) 55 <sup>o</sup> C
	Cylinder Test Pressure	35 kg/cm <sup>2</sup>
	Filling Tolerance	+/- 5% by mass
	Minimum effective discharge time	8 second (minimum)
	Bulk Range Discharge	2m (minimum)
5.	Material of Construction	As per IS: 2171-1999
6.	Painting	First Coats: 2 coats of red oxide primer Outside Coats: 2 coats of red oxide primer and 2 coats of synthetic enamel paint Finish Coat: Fire Red (IS: 5) Shade no. 536
7.	Marking	IS:15683-2018
8.	Inspection & Testing	Verification of Test certificates from approved test houses at site by purchaser inspection team
9.	Approval	BIS

NOTE:- If during detailing, other capacity and type of portable fire extinguishers need to be provided, the same shall be in the scope of Bidder without any cost implications.

#### 06.08.01 Water System For Fire Fighting

#### a. Scope of work

Already water based fire fighting system has been installed in the power house.

The scope of work shall include the following activities:-

- i. Additional one no fire water connection near to Unit # 2 (switch gear floor of the power house) needs to be provided.
- ii. Pressure gauges to be provided in the fire water header at the remotest point.
- iii. Extension of existing pipe line and additional Connections and near to lubricating oil system (unit 1, 2 & 3) to be provided.
- iv. Extension of existing pipe line and additional Connection near to proposed drain oil tank to be provided.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



- v. Valve chambers for all isolation for all isolation valves.
- vi. Housing chambers for all isolation valves.
- vii. LHS cable for over ground cable trays/ anchors.

#### b. Fire Detection & Alarm System (FDA)

Fire Detection and Alarm System (FDA) will be intelligent addressable microprocessor based automatic system. The Intelligent Addressable Microprocessor based Automatic Fire Detection and Alarm system will be software controlled automatic system and will provide necessary programmed activities and various controls. The system shall consist of central processing units, man machine interface, communication system, microprocessor based fire alarm control panels, TFT monitor, printer Addressable Intelligent Automatic sensors and Interface unit as applicable.

Fire alarm control panel shall function as communication interface between Central Processing Unit and sensors and controlled devices. Addressable Intelligent type microprocessor based Detectors / Manual Pull Stations and required field devices in the various areas shall be connected to fire alarm control panels by class A wiring to the loop module.

In all the electrical premises Intelligent addressable type microprocessor based photoelectric detector in double configuration / rate of rise-cum- fixed type heat detectors shall be provided as applicable. Siren/hooter shall be mounted on suitable support.

There will be interlocks to shut off the exhaust fans and simultaneous tripping of A/C and ventilation system.

#### c. Scope of work

The scope of work includes design, engineering, supply, erection, testing, commissioning, performance tests and handing over of intelligent addressable type Fire Detection and Alarm system for various premises of the project as mentioned in following Table-1.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



## TABLE-1

# List of Rooms

SI. No.	Description	False ceiling	Type of System	
1.	Cable Gallery and Unit	No	Addressable Automatic Fire	
	Aux. Board, LAVT.		Detection and Alarm (FDA)	
	NGTR, Service Aux.		system and Passive Fire	
	Board		Protection including fire	
			extinguisher	
2	Operating floor/ Office	Yes	FDA system with Fire	
2.	room and Control Room.		extinguisher	
3.	UAT	No	Fire Extinguisher	
4	Battery & Battery	No	FDA system including Fire	
7.	charger room		Extinguisher	
5	DG ROOM	No	FDA system with Fire	
5.			extinguisher	
	Cable tray/ anchor from	No	FDA system with Fire	
6.	Power House to 33kV		extinguisher	
	Switch Yard: LHS Cable			
7	All other areas including	No	Fire Extinguishers	
/.	above areas			
	1	1	1	



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



#### 06.09 DRAIN OIL TANK (DOT) FOR GENERATOR TRANSFORMER.

Three nos. oil pits need to be constructed (one nos. each for a transformer) to collect drain/leakage oil from transformer. Oil pits are designed to collect the transformer oil - which generally comes out from transformer because of leakages, overflows or some time heavy draining out of oil for any case of any emergency.

In case of emergency or during maintenance of generator transformer, oil in the transformer is to be drained in drain oil tank. For collection of leakage oil, one nos. oil pit need to be constructed at a corner of every transformer room. Oil pit shall be below level of transformer floor level for effective depth/easy collection of oil. Oil pits are connected through drain oil tank via pipe. One no. common drain oil tank is proposed to be installed at switch gear level i.e 310.50ft.floor level. Dirty oil tank need to be joined with three nos. oil pit located in the generator transformers room.

Drain oil system to be furnished by the Bidder shall comply with the following requirements:

- i) Storage volume: Drain oil tank volume shall be 130 % of the oil volume of the single transformer oil storage capacity.
- The tanks will be made of IS:2062 quality steel plates of tested quality. Thickness of plate will be 6 mm (minimum). The tanks will conform to IS: 800. The tanks will be hydraulically tested. Oil drains from transformers (three nos.) will be led to this tank. The location of the tanks and drainpipes routing will be such that drains flow to the tank by gravity (at switch gear level i.e 310.50ft.floor level). One no drain with valve connection to be provided at bottom point to drain the stored oil.
- **iii) Drain oil pipe line**: There shall be three nos. drain pipe line from individual oil pit connecting one no common header nearest to drain oil tank. From common header one nos. single pipe shall be connected to drain oil tank.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



## **ANNEXURE-1**

Brief Scope of Work for R&M of Unit # 1 & 3 of Maithon Hydel Station:-

(for detail scope of work please refer concern technological chapter) :-

SI. No.	Component	Brief Scope of Work for R&M (typically indicated, applicable for both units)		
Α	Water Conductor Syste	m		
1	Penstock	<ul> <li>Refurbishment:</li> <li>a) Penstock inner surface shall be mechanically (high pressur water jet/ manually/ or other method as required by bidde subject to approval of purchaser/consultant) &amp; chemically (required) cleaned. All cavities will be filled up by welding smooth, finish to curvature profile and painted with water</li> </ul>		
		<ul> <li>resistant epoxy after suitable surface preparation</li> <li>b) Replacement of dewatering valve &amp; piping to drain out water to draft tube during maintenance. Existing manual valve shall be replaced with new one.</li> <li>c) Re-welding of existing welding joints</li> </ul>		
2	Spiral Case	Refurbishment         Cleaning of spiral case shall be done (high pressure water jet manually/ or other method as required by bidder- subject to approval of purchaser/consultant); All cavities will be filled up by weld filling, smooth, curvature profile and painted with wate resistant epoxy after suitable surface preparation.         Damaged weld portion need to be re-weld after surface preparation         Replacement of all gauges, instruments , manhole sea etc.		
3.	Draft Tubes	<b>Refurbishment</b> All cavities shall be filled up by welding, machined to smooth curvatures and painted with water resistant epoxy paint after surface preparation. Draft tube manholes to be refurbished.		



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



SI. No.	Component	Brief Scope of Work for R&M (typically indicated, applicable for both units)
		Civil damages also need to be repaired. Rung ladders both Unit # 1& 3 to be replaced.
4.	Stay Vane	Refurbishment
		The surface of the stay vanes shall be cleaned of mud and
		rust, etc. (high pressure water jet/ manually/ or other method as
		required by bidder - subject to approval of
		purchaser/consultant). The eroded portion of the stay vanes
		shall be weld filled and machined smooth and painted with
		water resistant epoxy paint after surface preparation.
5	Draft tube	Refurbishment
		Draft tube to be cleaned with high pressure water jet/ manually/
		or other method as required by bidder- subject to approval of
		purchaser/consultant). All cavities shall be filled up by welding,
		machined to smooth curvatures and painted with water
		resistant epoxy paint after surface preparation. Damaged weld
		portion to be re-welded. Draft tube manholes to be refurbished.
В	Turbine and Associated	d Equipment (New Turbine along with auxiliaries)
1	Turbine Shaft and intermediate shaft	Replacement of turbine shaft and intermediate shaft.
2	Coupling Bolts	Replacement of coupling bolts.
3	Guide Bearing	Replacement of guide bearing along with oil cooler, pipes
		& fittings and instrumentations.
4	Thrust Bearing	Replacement of thrust bearing along with oil cooler, pipes
		& fittings and instrumentations.
5	Runner and cone,	Replacement of runner assembly & cone along with
	labyrinth seal	labyrinth seal (both static and rotating).
6	Wicket Gates/ guide	Replacement of wicket Gates /guide vanes as per new
	vanes	machine.
B 1 2 3 4 5 6	Turbine and AssociatedTurbineShaftAndShaftIntermediate shaftCoupling BoltsGuide BearingGuide BearingThrust BearingShaftRunnerAndIabyrinth sealCone,WicketGates/GuideGates/StatesSuideStatesSuide	Replacement (New Turbine along with auxiliaries)         Replacement of turbine shaft and intermediate shaft.         Replacement of coupling bolts.         Replacement of guide bearing along with oil cooler, pipes         & fittings and instrumentations.         Replacement of thrust bearing along with oil cooler, pipes         & fittings and instrumentations.         Replacement of thrust bearing along with oil cooler, pipes         & fittings and instrumentations.         Replacement of runner assembly & cone along with         labyrinth seal (both static and rotating).         Replacement of wicket Gates /guide vanes as per new         machine.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



SI. No.	Component	Brief Scope of Work for R&M (typically indicated, applicable for both units)	
7	Wicket gate levers,	Replacement of total system as per detailed description	
	linkages shear pin	and requirement of new machine.	
	arrangement,		
	regulating ring, bushes,		
	regulating ring etc.		
8	Shaft sleeve	Replacement.	
9	Shaft seal	Replacement	
10	Compressed air system	Replacement of old compressors (02 nos.), piping, fittings	
		and valves with new compressed air system with air dryer	
		(02 nos.), PRVs (2 nos), & air receivers (02 nos.), as per	
		detailed description & requirement of the system.	
11	Servomotors	<b>Replacement</b> of Servomotors of wicket gate with connecting pipes, valves, fittings, etc i.e total system.	
	(Wicket Gate)		
С	Generator & Associated	d Equipment (New Generator along with auxiliaries)	
1	Generator	Replacement with New generator assembly total complete	
		in nature along with RTDs and instrumentations facilities.	
2	Rotor Shaft	Replacement with New Rotor shaft.	
4	Brackets	Replacement with New brackets	
5	Generator Air Cooler	i. New Air cooler suitable new machine.	
		ii. New set of instruments/ gauges etc.	
		iii. New cooling water pipe lines, fitting, valves etc.	
6	Generator Guide	Replacement with new guide bearings with oil cooler, pipes	
	bearing	& fittings and all instrumentations.	
7	Braking & Jacking system	Replacement. With New braking and jacking system.	



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



SI. No.	Component	Brief Scope of Work for R&M (typically indicated, applicable for both units)
8	Rotor Spider and Fan	Replacement of Rotor Spider and Fan.
9	Generator bus duct system	11kV Bus duct system: 11kV Bus duct from generator to generator disconnecting switch panel and then to generator transformer with tapping and termination arrangement for existing Unit Auxiliary Transformer and new excitation transformer with all accessories are including termination at both end.
		Refurbishment
10	Generator Fire Fighting System	Existing fire fighting system for Unit #1 & 3 (CO <sub>2</sub> based) shall be reuse. Replacement of pipe valve, fitting as per requirement. However, inside flooding arrangement shall be newly
		provided.
11	Excitation system and AVR	Excitation system and AVR: New excitation system with new excitation transformer and dual channel digital AVR for renovated machine.
12	Fire Protection Facilities	<b>New</b> Fire protection system, sub-systems and integrated systems as described including fulfillment of guarantee of all the system and integrated system required for Maithon Hydel Station as per description
13	11kV UAT#1 Isolator Pane	11kV UAT#1 Isolator Panel: Replacement of 11kV UAT#1 isolator panel along with motorized isolator. CTs and associated busbars with busduct for connection with 11kV side UAT#1 busbar.
D	Protection & Control Sy	/stem
1	Protection and Metering System	New Micro processor based numeric relays for generator and generator transformer.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



SI. No.	Component	Brief Scope of Work for R&M (typically indicated, applicable for both units)	
	Control &	Control & Instrumentation system as per Scope (detailed	
2.	Instrumentation System	indicated in section B, Vol-III)	
Е	Common Facilities		
1	Cooling Water System	Replacement of corroded piping, strainer, valves, filters;	
		New set of instruments and gauges.	
2	Drainage and	Replacement, piping and water level detection instrument.	
	Dewatering system	Replacement of Diesel driven dewatering pumps (01 nos.),	
		piping, valves, water level floats with interlock	
		Strengthening of pipe supports, if any.	
3	Ventilation System	Three nos. new ventilation fans in ventilation room for	
		ventilation system.	
		Replacement of ventilation ducts with new color coated	
		sheet(only for emergency exit portion) /GI sheet along with	
		replacement controlling louvers.	
		Replacement of self cleaning filter installed at inlet	
		Maithon Hydel Station.	
4	Drain oil tank	One no common new drain oil tank for three nos.	
		transformer including pipes, valves, fitting and two nos.	
		pumps.	
5	Oil centrifuge	One nos. portable type oil centrifuge.	
F	Transformer and Electr	ics	
1	Generator Transformer	<b>Replacement</b> , New Generator Transformer for both Unit # 1 & 3.	
2	Generator LA – VT Panel, NGTR panel	<b>Replacement</b> with new. All CTs and PTs shall be as per the requirement of latest meters and protection system.	
		New Lightening arrestor shall be provided. New Neutral grounding transformer and secondary resistance.	
3	Generator Disconnecting Switch	Replacement with New motorized cum manual isolator.	



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SI. No.	Component	Brief Scope of Work for R&M (typically indicated, applicable for both units)	
4	DC System	DC System: Two (02) nos. new 220V, 200AH Battery Bank	
		for Power House & Control Room, Two (02) nos. new Float	
		Cum Boost Charger (FCBC) and retrofitting of two (02) nos.	
		FCBC, One (01) no Common DCDB for Control Room and	
		two (02) nos. change-over panel for Chargers at Power	
		House & Control Room.	
	Cables, Cable trays,	Cables, Cable trays, Support structure & materials: New	
	Support materials	33kV UE 2RX3CX240sq.mm cable per GT from GT upto	
_		33kV Switchyard, LT power, Control and Instrumentation	
5		cables as per scope of work of this contract including	
		termination at both end, cable tray, bus duct and tray	
		supporting structure etc.	
6	Miscellaneous (Illumination, earthing)	<ul> <li>Refurbishment <ul> <li>a) Illumination system by providing new light fittings, new SLDB and new LDBs</li> <li>b) New separate panel and Equipment earthing New GI flexible/flats are to be provided for connecting all equipment within battery limit to existing earth grid.</li> <li>c) New Local push button station, junction box: New push button stations near generator transformer and for local control of each drive/mechanism are to be provided.</li> </ul></li></ul>	
7	33 kV breaker	Replacement with new SF6 breaker	
8	33kV isolator	33kV isolator for GT #1 bay & GT # 3 bay: Replacement with two (2) set new motorized cum manual isolator with earthling switch associated connectors and pipe bus.	
9.	33kV CT	New two (2) sets CT for GT# 1 bay & GT # 3 bay.	
10	Surveillance system	New Surveillance system (CIRCUIT VIDEO MONITORING (CCVM) SYSTEM) to be provided for Maithon Power House.	
12	Diversion of GT of 33kV	Diversion of GT through existing 33kV Bus Coupler	
	Bus coupler	Circuit Breaker: As per scope of work	



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(MECHANICAL & CIVIL)



SI. No.	Component	Brief Scope of Work for R&M (typically indicated, applicable for both units)
G	CIVIL WORKS	
1	Civil Works	<ul> <li>Repair / Refurbishment / Strengthening Works for the project primarily comprises of Renovation &amp; Retrofitting Works for Civil Structures for Unit No # 1 &amp; 3 of Power House.</li> <li>Renovation/ strengthen of building structure</li> <li>Renovation/ strengthen of the various equipment foundation as per requirement.</li> <li>Civil works in emergency exit, Access Tunnel, tail tunnel.</li> <li>Drain, cable trench and other civil works required to complete the project.</li> </ul>

# GUARANTEES, PERFORMANCE TESTS AND LIQUIDATED DAMAGE

CHAPTER NO - 07



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



### 07.00 GUARANTEES, PERFORMANCE TESTS AND LIQUIDATED DAMAGE:

#### 07.01 GUARANTEE:

Following items shall be specifically guaranteed and demonstrated during performance guarantee tests at site:

SI. No.	Description	Guaranteed value
1	Turbine output, MW (a) At design net head of 35.3 m	
	(b) At maximum head of 48.8 m	
	(c) At minimum head of 23.1 m	
2	Rated generator output, MVA at 0.85 pf	
3	Overall TG output at Design Head	
4	Turbine efficiency at rated net head for:	
	(a) 100% rated output	
	(b) 80% rated output	
	(c) 60% rated output	
	(d) Weighted Average Efficiency	
5	Generator efficiency at	
	(a) 100% rated output	
	(b) 80% rated output	
	(c) 60% rated output	
	(d) Weighted Average Efficiency	
6	Weighted average efficiency of TG at design head	

#### Note:

- 1. Efficiency at 100%, 80% & 60% are for information. Based on these values, guaranteed weighted average efficiency will be calculated as per the formula given in Tender document.
- 2. Bidder numerical guarantee parameters shall quote for the only values symbols such as than or equal without the use of > / < (greater to / less than or equal to). In case if the numerical values are quoted along with symbols, numerical values shall only prevail and the symbols will not be taken into cognizance.





**3.** The non-achievement of guaranteed parameters are stipulated under of Clause- 7.01 above shall be applied with Liquidated Damage (LD) as per provision of Commercial part (Volume -1) of the Tender Document

## 07.02 PERFORMANCE TEST:

The bidder shall study the specification and satisfy himself thoroughly regarding the workability of the plant, equipment and systems offered and also take full responsibility for the guaranteed operation and performance of the same as well as for their smooth, safe and reliable working.

All equipment shall be guaranteed for workmanship, materials design and satisfactory performance to the parameters in accordance with the specification document and relevant clauses of the Commercial Volume. The guarantee for performance shall cover individual items and systems for their ratings / outputs.

The bidder shall also guarantee the integrated operation of all the systems and equipment covered in his scope as a whole including interfaces required to be established with other related systems and equipment.

The supplier shall conduct performance / acceptance tests on each of the major items of equipment supplied to demonstrate that the equipment and system supplied are capable of achieving the performance parameters specified and contracted for, in accordance with the General Conditions of Contract. The total system performance shall also be guaranteed and demonstrated.

Should the tests specified show that the unit has failed to achieve the guaranteed parameters, the supplier shall carry out necessary modifications or part replacements to achieve the guaranteed parameters and for successful demonstration the tests shall be repeated

Values of critical plant sigma as determined as per IEC code 193A should be given in the form of curves of different guide vane positions for different heads. Plant sigma curves as recommended by the manufacturer shall also be plotted on it clearly to show the safety margin available.

Bidder will study the temperature & quality of water given in chapter no: 06 of this





volume for the submerged components of the turbine to be designed and material to be selected so that considerable erosion or corrosion due to cavitation will not occur.

Demonstration of functional and operation/ control logics of DCS/ PLC are to be established.

Bidder shall incorporate necessary provisions at the time of executing civil work and manufacturing of electro-mechanical equipment, so that the performance testing of the unit can be done.

Bidder shall clearly indicate the method he proposes to carry out the Performance guarantee test, with facilities he proposes to provide during construction of civil works, manufacturing and erection of equipment.

Bidder shall carry out the performance test to prove the guaranteed efficiency and performance of turbine in accordance with the IS / IEC publication no.60041 latest edition, (field acceptance tests to determine the hydraulic performance of hydraulic turbines). The total system performance shall also be guaranteed and demonstrated. If will be prefer to measure the flow in Penstock direct flow measurement method. Alternatively flow measurement in Penstock will be carried out by indirect method. The discharge measurement will be done as per IEC 60041 Cl.10.2.4.

Bidder shall state and guarantee the rated output of the unit at generator terminal at rated head and discharge, which will be duly verified and established at site. The Bidder shall also furnish output at max. head & discharge within vibration limits & class "B" temperature limits. Similarly, the max. & min. output at rated head shall be furnished along with corresponding discharges with smooth operation within permissible vibration & class B temp. rise limits.

The minimum guaranteed weighted average efficiency for Francis turbine cannot be less than 93%, peak efficiency of turbine shall be higher than 94% and for generator is 98.5%. Bidder shall state and guarantee the weighted average efficiency of the turbine and generator at rated head output. Bidder has to conduct the performance guarantee test immediately after successful commissioning & trial operation.

Bidder will guarantee the vibration of the machine components in accordance with ISO:10816-3 for measurement of vibration of non rotating components (for hydro





generator) and ISO:7919-5 for measurement of shaft vibration(for hydro generator).

Bidder shall guarantee the noise limits in accordance with IEC 34 - 9 (noise limits) and as per the General Technical Rules.

In case the rated output at generator terminals and efficiency of Turbine are lower by more than 2% of the guaranteed value, even after three repeated performance test, the plant will be liable for rejection. However, the Purchaser at his option may give chance to the contractor to rectify the same and if the same is not rectified to the satisfaction of the Purchaser within reasonable time, the Purchaser shall have the right to rectify the same by other agencies and the works for rectifying the same will be done on the cost and risk to the Bidder.

All equipment shall be guaranteed for workmanship, materials design and satisfactory performance to the parameters in accordance with the tender specification document and relevant clauses of the general conditions of contract. The guarantee for performance shall cover individual items and systems for their ratings/outputs. All machines / equipments shall be guaranteed for Twelve(12) months from the date of final take over.

Bidder shall also guarantee the integrated operation of all the systems (unit wise) and equipment covered in his scope as a whole including interfaces required to be established with other related systems and equipment. Bidder shall study the specification and satisfy himself thoroughly regarding the workability of the plant, equipment and systems offered and also take full responsibility for the guaranteed operation and performance of the same as well as for their smooth, safe and reliable functioning.

Bidder shall conduct performance acceptance tests on each of the major items of equipment supplied to demonstrate that the equipment and system supplied are capable of achieving the performance parameters specified and contracted for, in accordance with the general conditions of contract. The total system performance shall also be guaranteed and demonstrated.

Bidder shall guarantee the guide vanes, runner, discharge ring and other hydraulic passages against excessive pitting caused by cavitation for 18 months from the date of commissioning or 8000 hours of operation whichever is earlier.





Excessive pitting shall be defined as the removal of metal from runner and other hydraulic passages of a weight W=0.15  $D^2$  per 1000 hrs. Of operation, where "D" is the diameter of the runner in meter and "W" is the weight of the runner blades in kg. In case of cavitation pitting exceeding the guarantee, the turbine supplier shall take corrective measures, such as modification of design, finish, replacement, repair, etc. at his own cost and the turbine after modification shall be subject to cavitation guarantee as per the original equipment. Cavitation and pitting evaluation shall be in accordance with IEC 60609 (Cavitation, pitting evaluation in hydraulic turbines, storage pumps and pump turbines).

## 07.03 ITEMS UNDER LIQUIDATED DAMAGE (LD)

The non-achievement of guaranteed parameters under SI. No -1 to 5 of Clause-07.01 above shall be applied with Liquidated Damage (LD) as per provision of Commercial part (Volume -I) of the Tender Document.

# TECHNICAL PARAMETERS

CHAPTER NO - 08



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



#### 08.00 GUARANTEED TECHNICAL PARAMETERS

#### 08.01 General

Bidder shall provide detailed information of the offered equipments. In case data sheet of any component is not included in this chapter, same shall be furnished by the bidder.

#### 08.02 **Turbine**

SI. No.	Item Description	Unit	Value
	TURBINE	I	I
1.	Name & address of manufacturer		
2.	Type (i.e. Francis horizental) of turbine and		
	shaft orientation		
3.	Critical sigma		
4.	Plant sigma		
5.	Guaranteed rated output at rated net head and rated discharge	kW	
6	Guaranteed max output max head	kW	
7	Guaranteed max, output at minimum head	kW	
8	Min. output at min. head and min. discharge	kW	
9.	Min, output at max, head	kW	
10.	Guaranteed efficiencies at rated net head ar	nd following	outputs
i)	100% of full load	%	
ii)	80% of full load	%	
iii)	60% of full load	%	
iv)	Best efficiency at an output	%	
v)	Performance curves including model hill curves (Montion No. of drawings onclosed)		
11	(Mehior No. of drawings enclosed)	oration	
2	Parts subjected to max presion	Ka/1000	
a		hours of	
		operation	
h	Operational restriction for turbine if any for	operation	
2	above quarantee		
12.	Efficiency at max, head and max, discharge	%	
13.	Efficiency at minimum head and minimum	%	
	discharge		
14.	Efficiency at minimum output and max. head	%	
15.	Efficiency at max. output and minimum head	%	
16.	Rated Speed		
i.	Specific speed	RPM	
17.	Max. runaway speed	RPM	
18.a	Guaranteed minimum factor of safety under		
	worst conditions based on the yield point of the		
	material		



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TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



## (MECHANICAL & CIVIL)

SI. No.	Item Description	Unit	Value		
b	Name and location of the part having the factor				
	of safety in (a) above				
С	Direction of rotation when viewed from				
	generator end				
19.	Momentary rise in speed on suddenly reducing load to zero at rate				
	speed from				
а	100% of full load not exceeding	%			
b	<sup>3</sup> ⁄ <sub>4</sub> full load not exceeding	%			
С	1/2 full load not exceeding	%			
20.	Time of GV gate closing for regulation				
а	Full load rejection	Seconds			
b	<sup>3</sup> / <sub>4</sub> full load rejection	Seconds			
C	1/2 full load rejection	Seconds			
21.	Momentary drop in speed on increasing lo	ad from zer	o at rated		
-	speed to	<u> </u>	1		
a	100 % load (full load)	%			
b	<sup>3</sup> / <sub>4</sub> full load	%			
C	1/2 full load	%			
22.	Time of GV gate opening in item (21) above		1		
а	Full load	Seconds			
b	<sup>3</sup> / <sub>4</sub> full load	Seconds			
C	1/2 full load	Seconds			
23.	Fly wheel effect		1		
a	The generating unit for regulation stated above	Kg/m2			
b	Generator	Kg/m2			
C	I urbine runner and shaft	Kg/m2			
d	Flywheel (if any)	Kg/m2			
24.	Max. water hammer pressure % of rated head				
25.	RUNNER				
a	Material and composition				
b	No. of runner blades				
C	Runner discharge diameter	mm			
d	Weight of complete runner	Kg			
e	Source of runner casting				
<u>g</u>	Weight of runner	Kg			
n ·		mm			
	Velocity of water at runner avit				
J L	velocity of water at runner exit	m/s			
K 26					
<u>∠0.</u>					
a	ИОС				
<u>ل</u>	NUCC Cooling arrangement				
<u>a</u>	Cooling arrangement				
	i) Meanum of Cooling	m2/hr			
	III) Flessule	rg/cm2			
e	Flow monitoring device				



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TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



SI. No.	Item Description	Unit	Value
f	Pressure monitoring device	•	
27	Shaft Gland		
а	Type		
 b	Cooling arrangement		
C	Material		
28	Face Cover/ Head cover		
20.	Material and Construction		
a b		mm	
0 C	Diameter	mm	
d	No. of sections		
u A	Weight of each section	Ka	
F	Applicable standard for material	Ng	
۱ ۵	Total weight	Ka	
9 29	Facing plate	Ng	
20.	Material and Construction		
a b		mm	
0	Total weight	Ka	
30	Hydraulic Thrust	Ng	
- 50. i	Maximum thrust	N	
 	Minimum thrust		
31	Turbine Thrust Bearing		
01. a			
a b			
0 C	Diameter and no of segment	mm	
0 d	Working temperature of bearing surface	°C.	
а 6	Medium of lubrication	U	
f	Recommended grade and make of lube oil		
n n	Quantity of lubricating oil		
9	Material of bearing		
i	Weight	Κα	
i	Max runaway speed the bearing can withstand	RPM	
k	Max. duration of above runaway speed	Seconds	
	Whether the bearing can withstand the runaway		
	speed with or without cooling water		
32.	Turbine guide bearing		I
а	Location		
b	Type of bearing		
С	Diameter and length	mm, mm	
d	Working temperature of bearing surface	°C	
е	Medium of lubrication		
f	Recommended grade and make of lube		
	oil/water		
g	Quantity of lube oil/water		
ĥ	Material of bearing		
i	Weight	Kg	
j	Max. runaway speed the bearing can withstand	RPM	
k	Max. duration of above runaway speed	Seconds	



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3





SI. No.	Item Description	Unit	Value
	Whether the bearing can withstand the runaway		
	speed with or without cooling water		
33.	Discharge ring		
а	Material & composition		
b	Thickness	mm	
С	No. of parts/segments		
d	Weight of each part/segment	Kg	
е	Total weight of the assy.	Kg	
34.	Noise at a distance of 1m from the turbine	db	
35.	Vibration (Location also to be mentioned)		
i	Horizontal		
ii	Vertical		
iii	Axial		
36.	Servo System		
а	Range of adjustment of guide vane / opening time	sec	
b	Range of adjustment of guide vane /needle	sec	
C	Range of pressure for satisfactory operation	Ka/cm2	
	Size of runner vane distributing valve	mm	
۵ ۵	Size of runner distributing valve	mm	
37	Oil System		
a	No. of pumps provided		
b	Type of pumps		
C C	Make of pumps		
	Working pressure	Ka/cm2	
e	Nominal discharge		
f	Type of grade of oil used	ipo	
<u>،</u> م	Volume of oil in the entire system	I	
<u> </u>	Volume of oil in sump tank	-	
i	Pressure oil receivers (oil pressure vessels)		
i	Capacity of oil receiver	1	
k	Volume of oil in oil receiver		
<u> </u>	No. of complete operations of servo-motors	-	
•	possible with stored oil without pumps running		
m	Oil pipeline material		
n	Design pressure	Ka/cm2	
0	Test pressure	Kg/cm2	
 p	Oil Lubricants		
٢	i) Specification of governor oil		
	ii) Specification of other lubricants		
	iii) Minimum pour point temp of governor oil		
	iv) Minimum temp. for solidification of lubricants		



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

#### 08.03 GENERATOR, EXCITATION SYSTEM AND AVR GENERATOR

SI. NO.	DESIGNATION	VALUE	REMARKS
	GENERATOR		
1.	Normal voltage and voltage range.		
2.	Power factor		
3.	Frequency and frequency range		
4.	Guaranteed rated output for temperature rise m	nentioned	in
	specifications under conditions of		
i)	0.85 power factor at any voltage in the operating range.		
ii)	Rated voltage, zero leading power factor during line charging with 5% full load positive excitation margin.		
iii)	0.85 power factor lagging continuous overload capacity at any voltage		
iv)	95% rated kV, zero leading power factor during line charging with 5% full load excitation margin.		
5.	Flywheel effect of the rotating parts of the generator, GD <sup>2</sup>		
6.	Inertia constant of the generator based on the generator rated KVA.		
7.	Short circuit ratio.		
8.	Runaway speed at which all parts are guaranteed to withstand safety.		
9.	Minimum factor of safety based on yield point of materials		
10.	Maximum temperature rise for the output quaranteed under item 4 (i)		
11.	At any voltage and frequency in the operating r	ange	
i)	Stator winding by embedded temperature detector.		
ii)	Rotor winding by resistance measurement.		
iii)	Bearing by embedded temperature detector		
iv)	Other parts by thermometer.		
12	Guaranteed under item 4 (iii) at any voltage and	d frequen	cy in the
	operating range	-	-
i)	Stator winding by embedded temperature detector.		
ii)	Rotor winding by resistance measurement		
iii)	Bearing by embedded temperature detector		
iv)	Other parts by thermometer		
13.	Overall efficiency of generator while operating		
	at rated voltage, 0.85 power factor lagging and 75°C winding temperature at		
i)	110% full load		



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



SI. NO.	DESIGNATION	VALUE	REMARKS
	GENERATOR		
ii)	100% full load		
iii)	80% full load		
iv)	60% full load		
,	Weighted average efficiency.		
14.	Inherent regulation i.e. increase in voltage at		
	constant speed and excitation on taking off.		
i)	110% full load		
ii)	100% full load		
iii)	60% full load		
15.	Reactance (referred to rated generator KVA		
	base)		
i)	Synchronous reactance		
	a) Direct axis (X <sub>d</sub> ) sat/unsat.		
	b) Quadrature axis (X <sub>q</sub> )		
ii)	Sub transient reactance		
	a) Direct axis (X'd) sat/unsat.		
	b) Quadrature axis (X' <sub>g</sub> )		
iii)	Sub transient reactance		
	a) Direct axis (X" <sub>d</sub> ) sat/unsat.		
	b) Quadrature (X" <sub>g</sub> ) sat/unsat.		
iv)	Negative phase sequence reactance		
	(X <sub>2</sub> ) sat/unsat.		
v)	Zero phase sequence reactance (X <sub>6</sub> )		
vi)	Armature leakage reactance		
vii)	Ratio of quadrature axis sub-transient reactance to		
	direct axis sub-transient reactance (X" <sub>q</sub> /X" <sub>d</sub> )		
16.	Guide Bearing.		
i)	Temperature rise by RTD's rated output with		
	cooling water supply at 30°C.		
	a) Pads.		
	b) Oils.		
II)	Temperature rise by RTD's of the bearing while		
	delivering the maximum output with cooling water		
	supply at 30°C.		
47	D) Ulls.	-1	
17.	Operating capability of guide bearing (in minu	ites) for t	ne tollowing
i)	At rated speed without cooling water supply		
1) ji)	At runaway speed with cooling water supply.		
iii)	At runaway speed without cooling water supply		
iv)	At low speed of 4% of rated speed with lubrication		
17)	system 'ON'		



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

#### 08.03.01 Schedule of Other Technical Particulars

SI. NO.	DESIGNATION	VAL	UE I	REMARKS
1.	Make of generator			
2.	Type and reference			
3.	Rated synchronous speed for synchronous			
	frequency of 50 Hz			
4.	Direction of rotation			
5.	Name and location of part of party stressed to			
	maximum under runaway condition			
6.	Maximum permissible continuous negative			
	phase sequence current.			
7.	Generator resistance at 75°C.			
i)	Armature winding per phase.			
ii)	Field winding			
iii)	Damper winding		İ	
8.	Generator time constants	].		
i)	Direct axis transient open circuit time constant			
ii)	Direct axis transient short circuit time constant			
iii)	Quadrature axis transient short-circuit time			
,	constant			
iv)	Direct axis sub-transient time constant			
v)	Short-circuit time constant of armature winding.			
vi)	Short-circuit time constant of damper winding			
,	with excitation winding shorted.			
9.	Maximum $(I_2/I_n)^2$ t value.			
10.	Synchronizing power at rated voltage 50Hz, 0.90			
	power factor lagging.			
11.	Allowable continuous single phase loading at			
	rated voltage and power factor			
12.	Calculated generator capacitance per phase to			
	ground of stator winding.			
13.	Voltage waveform			
i)	Waveform deviation factor			
ii)	No load harmonies in the voltage wave			
14.	Telephonic harmonic factor			
i)	Balance			
ii)	Residual			
15.	Schedule of losses (At Rated voltage, power	factor	and fr	requency)
SI. No.	Lossos (in KW)	10%	100%	60%
	F F	.L	F.L	F.L
i	Friction windings losses			
ii	Core losses			
iii	Armature I <sup>2</sup> R losses at 75 <sup>o</sup> C			
iv	Stray load losses			
V	Field I <sup>2</sup> R losses at 75 <sup>o</sup> C			
vi	Static Excitation system losses			
	Total losses.			



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

SI. NO.	DESIGNATION	VALUE	REMARKS
16.	Generator stator		
i)	Material of stator core		
ii)	Number of sections in which stator is divided for		
	transportation.		
iii)	Grade thickness and insulation of stator		
	Laminations.		
iv)	Insulation thickness of winding.		
	a) Slot portion		
	b) Over-bang portion		
V)	Stator core dimensions		
	a) Inside diameter.		
	b) Outside diameter.		
	c) Length without/with air ducts.		
	d) Ratio of stator core diameter and length		
	e) I otal number of slots		
	t) Finished slot size.		
	g) Net weight of active iron		
	vi) Outside diameter of stator frame.		
VII)	Dimension of stator foundation		
VIII)	Width of air gap at centre of pole top		
IX)	Flux density at rated voltage on no load in		
	a) Air gap.		
	b) Statof core.		
	c) leeth		
	d) Pole body.		
X)	Current density in stator winding		
XI)	cross sectional area of copper winding stator,		
vii)	Weight of copper in stator winding		
viii)	Resistance of stator winding per phase at $I^2 R$		
, , , , , , , , , , , , , , , , , , , ,	losses at 25°C		
xiv)	Calculated capacitance of stator winding per		
	phase.		
xv)	Detail of transposition of stator		
xvi)	Total weight of stator		
17.	GENERATOR ROTOR		
i)	Materials		
,	a) Pole Punching.		
	b) Rim punching.		
	c) Spider arms		
	d) Spider hub.		
	e) Pole and plates.		
ii)	Type of rotor rim construction		
iii)	Construction of field poles		
iv)	Method of attaching field poles to the rotor rim		
v)	Class of insulation o field winding		
vi)	Material and thickness of insulation.		


MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

SI. NO.	DESIGNATION	VALUE	REMARKS
vii)	Width and height of pole body		
viii)	Weight of active iron in each field pole		
ix)	Maximum current density in rotor winding.		
x)	Cross-sectional area of copper in field winding.		
xi)	Weight of copper in filed winding per pole		
xii)	Damper winding.		
	a) Number and diameter of damper bars per		
	pole		
	b) Whether connected between poles.		
xiii)	Resistance of filed winding at 25°C		
xiv)	Factor of safety at maximum speed based on		
	yield strength of material.		
xv)	Type of collector rings.		
XVI)	Number of brushes/collector rings		
	Diameter of assembled rotor	mm	
XVIII)	I otal weight of rotor		
18.	SHAFT	1	1
<u>i)</u>	Material and construction		
<u> </u>	Diameter (nominal)	mm	
	Length	mm	
iv)	Diameter of axial bore	mm	
<u>v)</u>	Diameter of coupling flanges.	mm	
vi)	Weight of assembled shaft.	Т	
vii)	Computed critical speed of		
	a) Without considering unbalanced		
	magnetic force (pull)		
	b) Considering unbalanced magnetic force		
	(pull) Televenee for eheft elignment		
VIII)	Foretance for shall alignment		
IX)	the material)		
19	GUIDE BEARINGS		<u> </u>
i)			<u> </u>
ii)	Location and number		
ii)	Number pads and size		<u></u>
iv)	Effective bearing area		
V)	Material of bearing pads		
vi)	Normal working temperature of bearing		
vii)	Maximum permissible temperature of bearing for		
	a) Alarm		
	b) Trip		
20.	ÓIL		
i)	Type and grade of specification		
ii)	Standard to which it shall conform		
iii)	Quantity of oil for first filling of thrust and guide		
/	bearing oil.		
	Pump motor rating for lubrication system		



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TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



SI. NO.	DESIGNATION	VALUE	REMARKS
21.	BEARING BRACKETS		
i)	Material and composition		
ii)	Type and construction		
iii)	No. of arms		
iv)	Weight		
22.	GENERATOR BRAKES	1	
I)	No. of brake units		
<u> </u>	Size of brake shoe		
) 	Size of piston		
(V)	Material of brake ring.		
<u> </u>	Material of brake liner.		
VI)	All pressure required for operation.		
VII)	Speed at which the air brakes are applied.		
VIII)	applying mechanical brakes		
	applying mechanical blakes.		
	a) In normal shut down.	]	
23			
23 i)	Type and method of cooling		
<u>1)</u>	Number and location of fans		
) 	Number of surface air coolors		
iv)	Tomporature of air optoring generator from		
10)	coolers		
V)	Maximum number of surface air cooler required		
•)	for maximum output of generator.		
vi)	Details of other method cooling (if required)		
24	Weight of generator rotating parts		
25	Weight of complete generator		
26	HEAVIEST PACKAGE FOR TRANSPORTATIO	N	
	i) Name		
	ii) Weight		
	iii) Dimensions (L x B x H)		
27	Largest package for transportation.		
	i) Name		
	ii) Weight		
	iii) Dimensions (L x B x H)		
28	Heaviest assembly to be lifted by power house c	rane.	
	i) Name		
	ii) Weight		
	iii) Dimensions (L x B x H)	<u> </u>	
29	Largest assembly to be filled by power house cra	ne.	
	i) Name		
	ii) Weight		
	iii) Dimensions (L x B x H)		
30	a. Maximum clearance required for the EOT		
	crane hook above service bav for lifting		



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



SI. NO.	DESIGNATION	VALUE	REMARKS
	of assembled generator.		
	b. Whether the available EOT crane clearance is good enough for the assembled generator		
31	Largest assembly to be taken out through the stator bore.		
	i) Name		
	ii) Weight		
	iii) Dimensions (L x B x H)		

## 08.03.02 Excitation and AVR system

#### 08.03.02.01 Guaranteed Technical Particulars

ITEM	DESIGNATION	Unit	Value
	EXCITATION SYSTEM AND AVR		
1.	Manufacture		
2.	Place of manufacture		
3.	Type designation		
4.	Applicable standards		
5.	Rating of excitation system at rated genera	tor output	and rated
	power factor (hot rotor winding)		
i)	Field voltage	Volt	
ii)	Field current	А	
iii)	Field power	kW	
iv)	No load excitation voltage	Volt	
v)	No load field current	А	
vi)	Field flashing current and duration	А	
6.	Ceiling voltage in per units of rated field vo	ltage	
i)	Ceiling voltage at no load	Volt	
ii)	Ceiling voltage at rated load.	Volt	
7.	Field current at rated ceiling voltage.	А	
8.	Excitation system voltage response ratio		
9.	Response time to reach 95% of the difference		
	between rated ceiling voltage and full load		
10	Time to rach+0.5% of ceiling voltage from	Seconds	
10.	rated voltage.	00001103	
11.	Maximum time period for operation at ceiling	Seconds	
	voltage power factor 0.9 and maximum		
	generator power.		
12.	Data of excitation system at 110% rated get	nerator terr	ninal
	voltage, power factor 0.85 and maximum ge	enerator po	ower.
i)	Field voltage		
ii)	Field current		
13	Maximum continuous output capability of e	excitation s	ystem.
i)	Maximum field current		
ii)	Maximum field voltage	Volt	
14	Maximum duration of over excitation	Seconds	



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3





ITEM	DESIGNATION	Unit	Value
	EXCITATION SYSTEM AND AVR	•	
15	Time to reach 5% limit of generator terminal	Seconds	
10	voltage in case of load rejection	Coolinao	
16	Maximum overshoot of generator terminal		
10	voltage in case of load rejection		
17	Setting time to reach 0.5% limit of generator	Seconds	
	terminal voltage after over speed conditions	Coconac	
18	Range of voltage level setting		
19	i) Range for manual control of		
	excitation.		
	ii) Frequency range of operation		
	iii) % transformer drop compensation		
20	EXCITATION TRANSFORMER	I	I
i)	Type		
ii)	Transformer continuous three Phase power	KVA	
,	rating.		
iii)	Transformer voltage ratio		
iv)	Transformer no-load losses (three-phase) at		
,	rated voltage, and rated frequency.		
V)	Vector group / connection.		
vi)	Transformer total losses (75°C three-phase)		
,	at full load at rated voltage and rated		
	frequency.		
vii)	No-load current at rated voltage frequency.		
viii)	Impedance voltage (75°C) at rated frequency		
	on 100% rated kVA.		
ix)	Transformer temperature rise after continuous		
	operation with rated kVA, under rated		
	conditions.		
	<ul> <li>Winding (by resistance)</li> </ul>		
	- core		
x)	I ransformer rated voltage at rated frequency		
	and no-load.		
a)	High-voltage	KV	
D)	Low voltage	VOIt	
XI)			
XII)			
a)	Conductor		
(C)_(C)			
	DIL Temperatura rico	Deg C	
XV)		Deg C	
∠ I :\			
<u> )</u> ;;)			
<i>)</i>  ;;)	Accuracy of voltage regulation		
i)	Papage of voltage setting		
IV)	range of voltage setting.		



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



ITEM	DESIGNATION	Unit	Value
	EXCITATION SYSTEM AND AVR		
a)	Auto mode		
b)	Manual mode		
v)	Voltage regulation from no load to full load.		
22	Rectifiers		
i.	Type of rectifiers		
ii.	Type of thyristors		
iii.	Number of thyristor per Interchangeable		
	module.		
iv.	Number of modules per bridges or stacks		
V.	Number of bridges or stacks		
vi.	Number of parallel paths.		
vii.	Number of thyristors		
	a) In series		
	b) In parallel per path		
viii.	Rated current of rectifiers		
ix.	Rated voltage of rectifier		
Х.	Average forward current rating per thyristor.		
xi.	Forward voltage drop per thyristor		
xii.	Maximum safe operating temperature.		
xiii.	Maximum surge current rating.		
xiv.	Max. permissible duration of surge current.		
XV.	Cooling fans for rectifiers (if necessary)		
	number of fans.		
xvi.	Fan ratings		
xvii.	Electrical fan motor ratings		
a)	Rated voltage		
b)	Rated power consumption		
xviii.	Auxiliary transformer(s) for cooling fans and		
	other		
<u>a)</u>	Ratings		
b)	Rated primary voltage		
C)	Rated secondary voltage		
23	Field circuit breaker		
l)	Rated current		
<u> </u>	Rated voltage		
) 	Kated breaking current		
IV)	I otal opening current		
V)	Total clasing time		
VI)			
VII)	Operating sequence		
24	AC-liela flashing equipment		
i)	Duration of flashing		
ii)	Power rating of field flashing transformer.		
iii)	Rated voltages of transformer		
a)	Primary		



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



ITEM	DESIGNATION	Unit	Value
	EXCITATION SYSTEM AND AVR		
b)	Secondary side		
25	DC-field flashing equipment		
i)	Power requirements		
ii)	Supply voltage		

### **Other Auxiliaries**

SI. No	Description	Unit	Value						
1	COOLING WATER SYSTEM								
a)	Source								
b)	Total cooling water required	m3/hr							
c)	Required head	mWC							
d)	Cooling water pipeline material and standard								
e)	Design pressure	Kg/cm2							
f)	Working pressure	Kg/cm2							
g)	Test pressure	Kg/cm2							
2.	Cooling water filter								
i)	Туре		Automatic						
			self cleaning						
			duplex type						
ii)	Make								
iii)	Material of construction details								
iv)	No. of filters required								
V)	Filtered water quality	microns							
3	Isolation Valves								
i)	Туре								
ii)	Make								
iii)	Material of construction								
iv)	No. of valves of each type								
V)	Design pressure	Kg/cm2							
vi)	Working pressure	Kg/cm2							
vii)	Test pressure	Kg/cm2							
4	DRAINAGE/DEWATERING SYSTEM								
i)	No. of diesel driven pumps								
ii)	Туре								
iii)	Make								
iv)	Discharge flow	m3/hr							
V)	Total dynamic head	mWC							
vi)	NPSHR	mWC							
vii)	Pumps rated speed	RPM							
viii)	Pumps shaft power	KW							
ix)	Complete pipeline , valves ( type & make ) ma	aterial and s	tandard						
x)	Design pressure	Kg/cm2							
xi)	Working pressure	Kg/cm2							
xii)	Test pressure	Kg/cm2							



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

5	COMPRESSED AIR SYSTEM		
a)	No of compressor		
b)	No of air dryer		
c)	No of air receiver		
d)	Pipeline		
i)	Material		
ii)	Standard & make		
iii)	Design pressure		
iv)	Working pressure		
V)	Test pressure		
f)	Valves		
i)	Туре		
ii)	Make		
iii)	Material of construction		
iv)	No. of valves of each type		
V)	Design pressure	Kg/cm2	
vi)	Working pressure	Kg/cm2	
vii)	Test pressure	Kg/cm2	
6	CLOSED CIRCUIT VIDEO MONITORING (C	CVM) SYS	ТЕМ
a)	Type of camera		
b)	Make of camera		
c)	No of camera		
d)	Network video recorder (NVR)		
e)	Туре		
f)	Make		

# QUALITY CONTROL, INSPECTION & TESTING OF PLANT / EQUIPMENT

CHAPTER NO - 09





## 9.0 QUALITY CONTROL, INSPECTION & TESTING OF PLANT / EQUIPMENT

#### 1.00.00 **QUALITY ASSURANCE PROGRAMME**

To ensure that the equipment and services under the scope of contract whether manufactured or performed within the bidder's works or at his sub-contractor's premises or at the owner's site or at any other place of work are in accordance with the specifications, the Bidder shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Bidder and shall be finally accepted by the Owner / Consultant after discussions. The QA programme shall be generally in line with ISO-9001/ISO-14001.

- 1.01.01 A quality assurance programme of the contractor shall generally cover the following:
  - a) Organisation structure for the management and implementation of the proposed quality assurance programme.
  - b) Quality System Manual.
  - c) Design Control System.
  - d) Documentation Control System.
  - e) Qualification data for Bidder's key Personnel.
  - f) The procedure for purchase of materials, parts, components and selection of sub- contractor's services including vendor analysis, source inspection, incoming raw- material inspection, verification of materials purchased etc.
  - g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
  - h) Control of non-conforming items and system for corrective actions.
  - i) Inspection and test procedure both for manufacture and field activities.
  - j) Control of calibration and testing of measuring testing equipment.
  - k) System for Quality Audits.
  - I) System for indication and appraisal of inspection status.
  - m) System for authorising release of manufactured product to the Employer.
  - n) System for handling storage and delivery
  - o) System for maintenance of records.





- p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.
- q) Finalising categorization plan for each items during approval of Engineering document.

## 2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in dashboard form. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer/consultant for approval.
- 2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Manufacturing Quality Plan shall be submitted in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD.
- 2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site. Submission of the Field Quality Plans and accordingly approval of the same by the Employer is to be done as per the approved schedule.





- 2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/ acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
- 2.05.00 The Bidder shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) for site activities. The FQA setup shall be in place before the start of site activities.
- 2.06.00 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to pre-despatch final inspection based on approved QAPs & Inspection Categorization Plan and verification of records of all previous tests/inspections by Employer/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
- 2.07.00 All material used for equipment manufacture shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis shall be recorded on certificates. Tests shall be carried out as per applicable material standards and/or agreed details.
- 2.08.00 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Bidder for procurement of major bought out





items including semi- finished and finished components/equipment etc., list of which shall be drawn up by the Bidder and finalised with the Employer, shall be subject to Employer's approval. The Bidder's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. Along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre- awards discussion and identified in "DR" category prior to any procurement. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.

- 2.09.00 For components/equipment procured by the Bidders for the purpose of the contract, after obtaining the written approval of the Employer, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Bidder and sub- contractor.
- 2.10.00 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials arts and equipment. Bidder shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

The stage inspection / final inspection will be carried out by manufacturer's representatives, Bidder, DVC/ Consultant as per approved MQP.

2.11.00 Test Certificates & Documents For each of the items being manufactured





as per approved QAP, following test certificates and documents as applicable for each of the equipment in requisite copies including original duly endorsed by the manufacturer & successful Bidder with appropriate linkage to project, purchase order and acceptance criteria etc. shall be submitted to the consultant / purchaser.

- Raw material identification, physical & chemical test certificates as applicable for all materials used to manufacture the equipment.
- WPS, PQR & WPQ documents as per applicable code.
- Detail of stage-wise inspection & rectification records for fabricated items, castings, forgings & machined articles.
- Control dimension chart with record of alignment, squareness, etc.
- Manufacturer's material and performance/ relevant test certificates for all brought-out items.
- Details of Heat Treatment & Stress relieving chart as per specification.
- Non-destructive Test report as per respective code carried out by NABL accredited lab.
- Static / Dynamic Balancing Certificates for rotating components / machines.
- Hardness Test Certificate
- Pressure / leakage test certificate.
- Performance Test Certificates for all characteristics.
- Routine / Type Test / Calibration / Acceptance / Special Tests (Type Test etc.) certificates for electrical / power electronics / automation / instrumentation.

However, Equivalent Type Test & Special Tests shall be accepted for components like Bus duct & Transformer subject to approval from DVC/Consultant.

- 2.12.00 For all modular spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- 2.13.00 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

## 2.14.00 Environmental Stress Screening

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the Bidder / sub – contractor should meet the following.

1) The Bidder / Sub-contractor shall furnish the established procedure being followed





for eliminating infant mortile components. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

or

In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

# 1. Elevated Temperature Test Cycle

Elevated temperature test shall be conducted till steady state temperature rise of components. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

## 2) Burn in Test Cycle

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.





The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards/ technical specification. Wherever standards/ technical specifications have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during finalization of Manufacturing Quality Plan on mutually agreed basis.

## 3.00.00 **QUALITY ASSURANCE DOCUMENTS**

3.01.00 The bidder/Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick () mark.

Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's subsupplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.

- 3.02.00 Typical contents of QA Documentation are as below:
  - a) Quality Plan
  - b) Inspection Categorization Plan
  - c) Material mill test reports on components as specified by the specification and approved Quality Plans.
  - Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
  - e) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure).
  - f) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. Certificate of Conformance (COC) wherever applicable.
- 3.03.00 Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as





per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

- 3.04.00 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Engineer/Inspector regarding the readiness of the quality document (or applicable section) for review.
  - (a) If the result of the review carried out by the Engineer/Inspector is satisfactory, the Engineer/Inspector shall stamp the quality document (or applicable section) for release.
  - (b) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Engineer/Inspector.
  - If a decision is made for despatch, whereas all outstanding actions cannot (c) be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document review status signed by the Supplier Representative to the Engineer/Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Engineer/Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment





### TRANSMISSION OF QA DOCUMENTATION

- 3.05.00 On release of QA Documentation by Engineer/Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.
- 3.06.00 Material Dispatch Clearance Certificate (MDCC) will be issued by DVC, after inspection and receipt of all necessary approved engineering documents, all the relevant TCs along with the request letter for issuance of MDCC from the main Contractor.

#### 4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

- 4.01.00 The word 'Inspector' shall mean the Engineer and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.
- 4.02.00 The Engineer or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer, i.e DVC shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
- 4.03.00 The Contractor shall give the Engineer /Inspector fifteen (15) working days (within India) and/or forty five (45) working days (outside India) written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Engineer /Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within (15) working days (within India) and/or forty five (45) working days (outside India) of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.





4.04.00 During raising Inspection Call, Contractor has to submit the approved engineering documents, approved MQP and other necessary documentation as per the approved documents/ NIT, failing to which the Inspection Call will not be accepted.

- 4.06.00 Engineer /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Engineer /Inspector or to his authorised representative to accomplish testing.
   The inspection by Engineer / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming
- 4.07.00 To facilitate advance planning of inspection in addition to giving inspection notice the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- 4.08.00 All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by DVC. Wherever asked specifically, the contractor shall re- calibrate the measuring/test equipment in the presence of Engineer / Inspector

### 5.00.00 ENERAL REQUIREMENTS

a part of the contract.

The equipment and work performed shall be subject to shop and site test as per Owner's approved quality assurance plan.

Hydrostatic and pneumatic tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.

All instrument piping/ tubing shall be hydrostatically tested upon completion





of erection. The test pressure shall be 1.5 times the maximum process pressure. The test shall be performed either with the testing of associated process piping or without the associated process piping (by closing the root valve. In both the cases the instrument shall be isolated by closing the shutoff valve).

All air headers & branch pipes shall be air tested by pressure decay method as per ANSI B31.1. Flexible hoses and short signal tubing shall be tested at normal pressure for leakage. Long signal tubing shall be tested by charging each tube with air at 2 kg/ sq. cm. through a bubbler sight glass.

# (a) SHOP TESTS

Shop tests shall include all tests to be carried out at Contractor's works, at works of his sub-contractor and at works where raw material supplied from manufacture of equipment is manufactured. Testing requirement of major equipment over and above the respective code/standard requirements are given elsewhere in this specification.

## (b) SITE TESTS

The Contractor shall prepare and submit detailed field quality plans in the format prescribed by owner setting out the quality practice and procedures to be adopted by him for assuring quality for each equipment of material at this specification from the receipt of material at site, during storage erection, pre commissioning to final commissioning of the system. These procedures shall necessarily include all checks/tests conducted at site for preservation, assembly, alignment, positioning of the equipment, foundation preparation, welding/bolting, non-destructive examination, hydraulic test, running test, performance test etc. The Contractor shall also furnish detailed quality procedure proposed by him for storage, preservation, painting, hydraulic test, air/gas tightness test etc. as applicable to the Employer. The same shall be discussed and finalised with the employer during detailed engineering stage.





## 6.00.00 GENERAL REQUIREMENTS

- I. The contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests is given for various equipment in this specification titled 'Type Test Requirement' mentioned elsewhere in this specification. For the balance equipment, type tests may be conducted as per by relevant standard where applicable or if required by mutual agreement between contractor and Employer. Detail shall be finalized during detail engineering.
- II. Submission of type test results and certificate shall be acceptable provided.
  - (a) The same has been carried out by the bidder/ subvendor on exactly the same model /rating of equipment.
  - (b) There has been no change in the components from the offered Equipment & tested equipment.
  - (c) The test has been carried out as per the latest standards along with amendments as on the date of bid opening.
  - (d) Type test report is not more than five (5) years old.
  - (e) Type tests shall be carried out from CPRI/ National Test House/ NABL accredited laboratories only.

However, at site or manufacturing shop/ fabrication shop required NDTs carried out by ASNT level-II personnel and test results of the same is also acceptable.

## 7.00.01 **TYPE TEST REQUIREMENTS**

I. In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the bidder within the quoted price and no extra cost will be payable by the purchaser on this account.





- II. The Type test certificates for all the items shall be reviewed and approved by the DVC or his authorized consultant.
- III. The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.
- IV. For the type tests to be conducted, contractor shall submit detailed test procedure for approval by purchaser. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.

### 7.00.02 Special Requirement for Solid State Equipment/ Systems

The minimum type tests reports, over and above the requirements of above clause which are to be submitted for each of the major C&I systems shall be as indicated below:

### 7.00.03 Surge Protections for Solid State Equipment/ Systems

- All solid state systems/ equipment shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipment shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Hence, all front end cards which receive external signals like analog input & output modules, binary input & output modules etc. including power supply, data highway and data links shall be provided with protections that meets the surge withstand capability as defined in details ANSI 37.90a/IEEE-472. Complete of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of IEC-255-4 which is equivalent to ANSI 37.90a/ IEEE-472 may also be adopted for SWC test.
- II. Dry heat test as per IEC-68-2-2.
- III. Damp heat test as per IEC-68-3.





- IV. Vibration test as per IEC-68-2-6.
- V. Electrostatic discharge tests as per IEC 801-2 or equivalent.
- VI. Radio frequency immunity test as per IEC 801-6 or equivalent.
- VII. Electromagnetic immunity as per IEC 801-3 or equivalent

Test listed at item no. v), vi), vii) above are applicable for front end cards only as defined under item i) above.





# QA MECHANICAL



# DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



# (MECHANICAL & CIVIL)

# 9.11.

# QUALITY ASSURANCE

# DASH BOARD OF HYDRAULIC TURBINE

	INPROCESS TEST FINAL TESTS																
Tests / Check Items / Components	Chemical Analysis	Mechanical Prop.	Heat Treatment	Run out	Ultrasonic test	Radiographic test	Dye Penetration Test	Magnetic particle test	Balancing	Hyd. Test	Proof Load Test	Vibration	Noise	Strip Down Test	Dimensional	Performance Test	Turbine Performance Test
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10	13	15	16	17	18.	19	20.
Turbine Shaft & Intermediated shaft	Y <sup>c</sup>	Y <sup>c</sup>	Y	Y	Y <sup>b</sup>	-	Y	Y	Y	-	-						Y
Turbine runner	Y <sup>c</sup>	Y <sup>c</sup>	Y	Y	Y	-	Y	Y	Y	-	-						
Cone	Y	Y	Y	-	Y	-	Y	Y	Y	-	-						
Turbine Bearing (Thrust, guide bearing)	Y	Y	Y	-	Y	-	Y	Y	-	-	-						
Guide vanes	Y	Y	Y	-	Y	-	Y	Y	-	-	-						
Discharge ring	Y	Y	Y	-	Y	-	Y	Y	-	-	-						
Servo motors	Y	Y	-	-	Y		-	Y	-	Y	-					Y	
Shaft Seal	Y	Y	-	-			Y				-						
Regulating ring, lever and linkage	Y	Y	Y	-	Y	-	Y	Y	-	-	-						
Coupling bolts	Y	Y	Y	-	Y	-	Y	-	-	-	Y						$\mathbf{Y}^{\mathrm{f}}$
Fabricated Items	Y <sup>c</sup>	Y <sup>c</sup>	-	-	Y d		Y	-	-	Ye	-						
Turbine final Assembly														$\mathbf{Y}^{\mathrm{f}}$			

## Y. To apply

- a. UT for shaft dia  $\geq$  50mm and Plate thickness  $\geq$  16mm.
- b. Chemical / Mechanical shall be one per heat/HT batch.
- c. 10% Random on Butt Welds & 100% on Fillet Weld.
- d. Pressure containing parts.





## e. Turbine testing

Vibration on Turbine shall be measured in transverse, Horizontal and Vertical directions at all measuring points.

Noise Level on Turbine shall be measured at a distance of 1.5 meter above floor level in elevation and 1 meter horizontally from the nearest surface of the equipment.

Strip down test shall be conducted only in case abnormal performance such as Excessive vibration, High noise, high bearing temperature etc. is observed during performance test.

## Shop Assembly and Tests

All components/sub-assemblies should be properly match-marked to ensure correct re-assembly and alignment in the field.

The following shop assembly and testing requirements in Supplier's works should essentially be included in quality assurance plan (Reaction Turbine):

- Draft Tube Liner for matching segments
- Wicket gate Mechanism to be assembled and following parameters should be checked:
- Clearances between end faces of wicket gates and spiral casing.
- Clearances between consecutive wicket gates in fully closed position at three places along their length,
- Opening between consecutive wicket gates in 50%, 75% and 100% open positions at three places along their length,
- Minimum force required at regulating ring to move the wicket gate mechanism freely.
- G.V. Servomotor hydraulic testing, stroke checking and oil leakage past piston and piston rod
- Turbine Runner –
- Guide bearing for proper fitting
- Oil Pumping Unit for operational check
- Pressure Vessels soundness of weld joints and hydrostatic test
- Governor complete performance testing as per relevant IEC code
- Oil Head Distributor hydraulic testing and leakage of oil
- Inlet valve for free movement
- Inlet valve servomotor hydraulic testing, stroke checking and oil leakage past piston and piston rod
- All bought out items as per quality plan submitted and agreed at sub- supplier's works





## **Tests on Sub Assemblies**

Tests on sub-assemblies should be carried out to verify their accuracy and proper functioning.

Radiographic, magnetic particle, dye penetration, ultrasonic inspections and hydrostatic testing (as applicable) should be performed to ensure soundness as per agreed quality plan and applicable National/International Standards.

## **Material Tests**

Material tests for important components such as runner hub, runner blades, levers, wicket gates, turbine shaft, intermediated shaft, guide bearing, thrust bearing pads / bushes, piston rods and other important components should be carried out as per agreed quality plan. Purchaser's Engineer should review the test certificates during inspection.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



# 9.12

# QUALITY ASSURANCE

### DASH BOARD OF Horizontal Centrifugal Pumps/Vertical Centrifugal Pump/Submersible Pump/ Sump Pumps/Sludge Pumps/

					INPF	ROCE	SS TI	ESTS					FINAL TESTS							
Tests / Check Items / Components	Chemical Analysis	Mechanical Prop.	Heat Treatment	Run out	Ultrasonic test	Radiographic test	Dye Penetration Test	Magnetic particle test	Balancing	Hyd. Test	Inclusion rating	Pressure Drop	Performance Test	NPSH Test	Vibration	Noise	Strip Down Test	Dimensional		
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10	11	12.	13	14.	15	16	17	18.		
Pump Casing	Y <sup>c</sup>	Y <sup>c</sup>	-	-	-	-	Y	-	-	Y	-									
Shaft	Y <sup>c</sup>	Y <sup>c</sup>	Y	Y	Y <sup>b</sup>	-	Y	Y	-	-	Y									
Impeller	Y <sup>c</sup>	Y <sup>c</sup>	Y	-	-	-	Y	-	Y	-	-									
Rotor	-	-	-	Y	-	-	-	-		-	-									
Fabricated Items	Y <sup>c</sup>	Y <sup>c</sup>	-	-	-	Y <sup>d</sup>	Y	-	-	Y <sup>e</sup>	-									
Strainer																				
a) Body	Y	Y	-	-	-	-	Y*	-	Y	Y	-	-								
b) Assembly	-	-	-	-	-	-	-	-	-	-	-	Y**								
Pump final Assembly		·	·	·	·	·	·						Y <sup>f</sup>	Y <sup>g</sup>	Y <sup>h</sup>	Y <sup>i</sup>	$\mathbf{Y}^{\mathrm{j}}$	Y		

Y. To apply

a. UT for shaft dia 50mm and Plate thickness 16mm.

b. Chemical / Mechanical shall be one per heat/HT batch.

c. 10% Random on Butt Welds & 100% on Fillet Weld.

- d. Pressure containing parts.
- e. Performance Test on each Pump to determine the characteristic curve (Head, Capacity, efficiency & Power) at Design speed and to ensure Compliance with design requirements specified in the specification. Measurements shall be carried out at 0%, 25%, 50%, 65%, 80%, 100% and 125% of Design Flow with cold water.
- f. NPSH (R) test shall be carried out on one Pump using cold water at pump flows of 25%, 50%, 65%, 80%, 100% and 125% of Design Flow at Design Speed. This shall be preferably done at 1% and 3% head break by Suction Throttling Procedure / varying suction pressure.





- g. Vibration on all Pumps shall be measured in transverse, Horizontal and Vertical directions at all measuring points.
- h. Noise Level on each Pump shall be measured at a distance of 1.5 meter above floor level in elevation and 1 meter horizontally from the nearest surface of the equipment as per HIS. The measurement shall be taken at six points around the equipment for each flow condition.
- i. One Pump shall be dismantled for visual inspection after completion of performance test and NPSH Test. For other Pumps strip down test shall be conducted only in case abnormal performance such as Excessive vibration, High noise, high bearing temperature etc. is observed during performance test.

## Note:

- 1) Quantum of In-Process Checks/ Tests is 100% until & unless specified otherwise.
- 2) Bidder shall furnish details of proposed test procedure including test lay out, type and level of accuracy of instruments, sample calculation, etc.
- \* In case of fabricated construction.
- \*\* One per type and size.
- Results must show no minus tolerance with regard to flow and head. No minus tolerance on efficiency or positive tolerance on power input at motor terminals shall be allowed.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



9.13.

## QUALITY ASSURANCE

## DASH BOARD FOR MECHANICAL ITEMS

SI No	Tests/Checks	Material Test	WPS/ WQS/PQR	DPT/MPI	Ultrasonic Test	Radiographic Test	PWHT	Assembly / Fit up	Dimensions	Hydraulic	Pneumatic Test	Balancing	Functional/operational	Performance Test	Other Tests	All Tests as per relevant Std
1	Pipes & Fittings	Ya							Y	Y <sup>5</sup>						Y
2	Diaphragm Valves	Ya							Y	Y <sup>5</sup>			Y		Y <sup>6</sup>	Y
3a	Cast Butterfly Valves	Ya		Y <sup>3</sup>	Yb			Y	Y	Y <sup>5</sup>			Y		Y <sup>7</sup>	Y
3b	Fabricated Butterfly	Ya	Y	Y <sup>3</sup>	Y <sup>12</sup>	Y <sup>12</sup>	Y <sup>12</sup>	Y	Y	Y <sup>5</sup>			Y		Y <sup>7</sup>	Y
4	Gate/ Globe/ Check Valves	Ya		Y <sup>3</sup>	Yb			Y	Y	Y <sup>5</sup>	Y		Y		Y <sup>8</sup>	Y
5	Dual Plate Check	Ya		Y3	Yb			Y	Y	Y <sup>5</sup>	Y		Y		Y <sup>4</sup>	Y
6	Plug / Ball Valves	Ya		Y <sup>3</sup>	Yb			Y	Y	Y <sup>5</sup>	Y		Y			Y
7	Rolled & Welded Pipes	Ya	Y	Y <sup>3</sup>		Y <sup>1</sup>			Y	Y <sup>20</sup>						
8	Coating & Wrapping	Ya							Y							Y <sup>2</sup>
9	Strainers	Ya		Y <sup>3</sup>					Υ	Y <sup>20</sup>					Y <sup>9</sup>	
10	Rubber Expansion Joints	Ya						Y	Y	Y <sup>10</sup>					Y <sup>11</sup>	
11	Site Welding		Y	Y <sup>3</sup>		Y <sup>1</sup>				Y <sup>20</sup>						
12	Compressors/ Blowers	Ya		Y <sup>3</sup>	Yb			Y	Y	Y <sup>20</sup>		Y		Y <sup>18</sup>	Y <sup>19</sup>	Y
13	Atmospheric Storage Tanks/ Mixing Tanks	Ya	Y	Y <sup>3</sup>				Y	Y	Y <sup>20</sup>					Y <sup>13</sup>	Y
14	Pressure vessels /Air Receiver & Heat exchangers	Ya	Y	Y <sup>3</sup>		<sub>Y</sub> 21	Y <sup>22</sup>	Y	Y	Y <sup>20</sup>					Y <sup>23</sup>	Y
15	Air Drying unit	Y <sup>a</sup>	Y	Y <sup>3</sup>		Y <sup>21</sup>	Y <sup>22</sup>	Y	Y	Y <sup>20</sup>	Y		Y		Y <sup>24</sup>	
16	Fans	va		_ <b>√</b> 3	vp			Y	Y			Y		Y	v14	Y
	NOTES		1	1 1		1	1	1	J	1	1	]	1	1		
Y	To apply															
а	One per heat/heat trea	tment	batc	h/lot.												
b	For shaft/spindles/forg	jings c	liam	eter	50 m	nm & F	Plate th	nickr	ness	16 n	nm					



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

# (MECHANICAL & CIVIL)

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1	Weld Joints not subjected to hydraulic test shall be subjected to 100% RT.
2	Tests for primer and enamel / Coal Tar Tapes as per AWWA-C-203 / IS 15557
3	On machined surfaces of castings/shaft/spindles/forgings. DPT/MPI on root run (after back gouging/chipping – as Applicable) for 100% and on finish butt & fillet welds for 10%.
4	Dry Cycle Test on Dual Plate Check valve spring for one lakh (10 <sup>5</sup> ) Cycles shall be carried out as a type test.
5	Valves shall be tested for Body, seat & back seat leakage as applicable. Hydraulic test pressure shall be as per relevant standard. & shall be done as per relevant standard. Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator. Valves shall be offered for hydro test in unpainted condition
6	50,000 cycles shall be carried out.
7	In addition to Body & seat hydro test, disc-strength shall be carried out as per relevant standard
8	Blue matching for metal-seated valves, Wear travel for gate valves, pneumatic seat leakage test & reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg absolute for valves to be tested for vacuum operation for internal pressure 25 mm of Hg absolute for a period of 15 minutes
9	Pressure drop across the strainer for each type and size as a special test shall be carried out
10	During hydraulic and vacuum tests in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test permanent set in dimension should not exceed 0.5%.
11	Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149, ageing test and adhesion strength of rubber to fabric & rubber to metal shall be carried out.
12	<ul> <li>a) For fabricated butterfly valves: UT as per ASTM A-435 on plates for body and disc shall be carried out.</li> <li>b) 100% RT as per ASTM, Section-VIII, Division-I, on butt joins of body and disc</li> <li>c) Post Weld Heat Treatment (PWHT) as per ASME, Section-VIII, Division-I on butt joints of body and disc of thickness above 30mm shall be carried out.</li> </ul>
13 14	Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted. All fans shall be subjected to run test and Vibration, noise, temperature rise, and current drawn shall be measured during the run test. Performance test of one fan of each type and size shall be carried out as per applicable standard for air flow static pressure speed.
15	In case of diaphragm/plunger, only proven material shall be used and certificate in this regard shall be submitted for review.
16	All pumps to be performance tested as per Hydraulic Institute Standard/Relevant standard. Performance test to Include check for noise, vibration level and bearing temperature rise.
17	Pumps shall be tested at 200% of pump rated head or at 150% of pump shut-off head whichever is higher for 30 min duration.
18	Performance testing of each compressor/ Blower / Vacuum Pump shall be carried out at shop as per BS-1571/ IS: 5456 /ISO 1217/ Pneurop 6612/ equivalent as applicable. Noise & vibration shall also be measured during performance testing.
19	For Compressors capacity control and operation of safety valves shall be checked during inspection at shop
20	Pressure retaining parts shall be hydraulic tested. Hydraulic test pressure shall be as per applicable std / 1.5 x design pressure or 2 x working pressure whichever is higher for 30 minutes duration. Atmospheric tanks shall be water fill tested
21	RT on weld joints shall be as per respective code requirements. Heat Treatment of the Tank/Vessel shall be done as per fabrication code requirement.
22	Dished ends shall be stress relieved as per relevant code. However, dished ends welds (if manufactured by using welded plates) shall be subjected to 100% RT and stress relieved.
23	Tube to tube sheet joints of heat exchanger shall be subject to mock up test. Coolers/heat exchanger shall be hydro tested on tube side and shell side
24	Refrigerant compressors shall be tested as per relevant std and certification from manufacturer for the same shall be submitted. Due point measurement & function of auto drain trap shall also be carried out.
25	Concentricity/ centering & Axial Run out Shall also be measured
26	Pressure drop across the strainer may be demonstrated at site.





## 9.14 QUALITY ASSURANCE

#### FIRE DETECTION & PROTECTION SYSTEM

#### HYDRANT SYSTEM : Shop Tests

- i) Hydrant Valve :
- a) All valves shall be hydro tested for body and seat.
- b) Capacity test / flow test shall be done as per relevant standard.

### ii) Water Monitor, Hoses, Branch Pipes, Couplings and Nozzles

- a) All tests including hydraulic test shall be done as per relevant Indian / International standard.
- iii) For Pumps, Diesel Engine, Gear-Box refer the requirements indicated separately.

### HIGH / MEDIUM VELOCITY WATER SPRAYS SYSTEM: Shop Tests i)

For Pipes, Fittings, Valves and specialties, requirements are indicated separately.

#### ii) Deluge Valve and Spray Nozzles

- a) All valves shall be hydro tested for body and seat.
- b) Performance test / functional test of 'Deluge Valve' and 'Spray Nozzles' shall be carried out.

#### iii) Detectors

 All 'Detectors' shall be tested as per relevant Indian / International Standards. Detectors shall also meet the requirements of UL / FM / LPC etc.

#### iv) Inert Gas Extinguishing System: Shop Tests

- a) Complete system selection / Major components shall be approved by TAC / UL / FM / LPC etc.
- b) Storage Cylinders / Containers with all accessories, all piping, valves, fittings and nozzles shall be subjected to all tests as per the design code to which they are supplied and shall also meet the requirements of TAC / UL / LPC / FM / NFPA etc.
- c) Storage Containers shall also meet the statutory requirements of approval / acceptance by CCE.
- d) Test for fill density, weight, leakage etc. shall be done for charged cylinders / containers.



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TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

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#### Vertical / Horizontal Centrifugal Pump: Shop Tests

- a) UT on Pump Shaft ( >= 50mm dia ) and MPI / DPT on Pump Shaft and Impeller shall be carried out.
- b) All rotating components of the pumps shall be statically and dynamically balanced as per ISO : 1940 Gr. 6.3 or better.
- Hydraulic test shall be conducted on pump casing with water at 1.5 times the shut off pressure or twice the head pressure whichever is higher for a minimum duration of 30 minutes.
- d) Performance test and Standard Running test:
  - All the pumps shall be tested in the manufacturer's (i) works for capacity, efficiency, head and brake horse power. Pump shall be given running test over the entire operating range covering the shut off head to the The duration of test shall be minimum maximum flow. one hour. A minimum of five readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pump shall be in accordance with stipulations of Hydraulic Institute Standard (HIS) and / or as per applicable Indian Standard or equivalent. Tolerance on parameters shall be as per HIS.
  - (ii) The test shall be conducted at the rated speed preferably with the type tested contract drive motor being furnished. However, in case of any limitation, test bed motor duly calibrated can also be used.
  - (iii) Noise and Vibration shall be measured.
  - (iv) Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level / vibration are observed during the shop test.

### 1.05.00 Diesel Engine

#### 1.05.01 Shop Tests:

- a) All pressure parts shall be subjected to Hydraulic pressure tests at 1.5 times the design pressure.
- b) All Diesel engine shall be performance tested as per relevant IS / equivalent code.
- c) All gear boxes shall be tested at No-load for back lash , gear ratio, noise vibration and temp. rise.





## 1.05.02 **Performance Test :**

a) Performance test of diesel engine shall be carried out as per BS-5514/ IS or equivalent international code to determine the rated power and specific fuel consumption and governor's function. Performance test of engine in shop shall be done with actual job accessories for minimum four hours (three hours for full load and one hour for over load at 110% of full load). All the engine parameters like RPM, inlet air temp. and pressure, water inlet and outlet temp. And pressure, lube oil pressure, fuel consumption, ambient condition shall be measured and recorded for every half an hour. No positive tolerance shall be allowed on the specific fuel consumption (contractor to specify in the offer)

#### 1.06.00 **Pressure And Storage Vessels**: Shop Test

#### 1.06.01 Atmospheric Tank

- a) All weld joints shall be DP Tested and complete tanks shall be water fill tested.
- b) All atmospheric storage tanks fabricated and erected at site shall be subjected to all tests (Hydro, NDT, Vacuum) according to design code as applicable.

#### 1.06.02 **Pressure Vessel**

- a) Each finished vessel shall be Hydraulically tested to 150% of the design pressure for a duration of 30 minutes.
- b) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below :
  - (i) 100 % DPT on root run of butt weld.
  - (ii) 10% DPT on all finished butt welds and fillet welds.
  - (iii) 10% RT (covering all 'T' / cross joints) of butt welds.
- 1.06.03 Butt welds of dished ends shall be stress relieved and subjected to 100% RT.

#### 1.07.00 **PACKAGE AIR COMPRESSOR**

a) In addition to Hydraulic tests of pressure parts, performance run test of the compressor shall be done for FAD, pressure , power consumption, as per relevant code.



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## 1.08.00 PIPING, VALVE AND SPECIALITIES

- 1.08.01 Shop Tests
  - a) All pipes and fittings shall be tested as per applicable code.
  - b) DPT of pipe welds (in case of rolled and welded pipes only) shall be carried out for root and finished welds.
  - c) All strainers shall be subjected to Hydraulic pressure test for leakage and Pressure drop v/s Flow for each type and size.
  - All valves shall be hydraulically tested for body, seat and back-seat ( if applicable ) as per relevant standard. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.
  - e) Valves shall be offered for hydro test in unpainted condition.
  - f) Functional checks of the valves for smooth opening and closing shall also be done.
  - g) Anti-corrosive protection shall be tested as per applicable code.

#### 1.09.00 **FOAM SYSTEM**:

#### 1.09.01 Shop Test

- a) For tanks, pipes, fittings, valves and specification refer respective section of the specifications.
- b) System shall meet test requirements as specified in TAC / UL / FM / NFPA etc.

### 1.10.00 **PORTABLE & MOBILE FIRE EXTINGUISHERS**

#### 1.10.01 Shop Test

- a) All Fire Extinguishers shall be tested as per relevant standard.
- b) Performance / function test shall be carried out on sampling basis as per relevant code /standard.

### 1.11.00 EOT/HOT Crane

a) Chain pulley Blocks shall be tested as per IS: 3832.



# DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION

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## (MECHANICAL & CIVIL)



- b) Electrical wire rope hoists shall be tested as per IS : 3938
- c) Following NDT requirements shall be met :
  - (i) 100% RT of Butt welds in tension and 10% RT of butt welds in compression.
  - (ii) DP at random on all weld metals.
- d) Deflection, load, overload & travel check on EOT/ HOT crane assembly shall be carried out as per IS:3177.

### 1.12.00 **SITE TESTS** :

#### a) Fire Extinguishers:

A performance demonstration test at site of five (5) percent or one (1) number, whichever is higher, of each type and capacity of the extinguisher shall be carried out by the contractor. All consumables and replaceable items require for this test would be supplied by the contractor without any extra cost to employer.

#### b) Foam System:

- (i) The operation of the foam generation shall be demonstrated by the vendor after installation either in the tank to be protected or in the dyke area.
- (ii) Any other equipment found necessary for the demonstration of the above testing like portable foam water monitor hose etc. shall be provided by the contractor during testing.

### c) **Piping Protection:**

- (i) Thickness, Holiday by spark test, Adhesion test shall be carried out as per relevant standard.
- (ii) Complete piping shall be Hydro pressure tested, at 1.5 X DP or 2 X MWP whichever is higher , before protection.

### d) Welding of Pipes:

 ERW Black / rolled welded 100% DPT on root of butt and finish weld of butt and fillet. RT on 10% randomly selected joints shall be carried out ( for underground piping ).

### (ii) GI Pipes

Welding on GI Pipes in general shall not be done. Welding of GI Pipes, if permitted by design (butt / socket / fillet weld) shall be done strictly as per approved drawing and procedure approved by DVC / consultant





# QUALITY ASSURANCE

#### AIR CONDITIONING AND VENTILATION SYSTEM

- 1.00.00 FANS:
- 1.01.00 20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.
- 1.02.00 DPT of fan shafts shall be carried out after machining.
- 1.03.00 UT of fan shafts (dia equal to or above 50mm) shall be carried out.
- 1.04.00 Rotating components of all fans shall be dynamically balanced to ISO-1940 Gr. 6.3
- 1.05.00 All Centrifugal Fans shall be subjected to run test for 4 hrs. or till temperature stabilization is reached. Vibration, Noise level, Temp. rise and current drawn shall be measured during the run test.
- 4.06.00 One fan of each type and size will be performance tested as per corresponding BIS code for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise, Vibration and Temp. Rise.

#### 2.00.00 LOW PRESSURE AIR DISTRIBUTION SYSTEM

- 2.01.00 Functional test for fire damper along with solenoid shall be done.
- 2.02.00 Prototype tests report of fire damper (duly approved/accepted by ENGG) for each type and size as per UL-555 for fire rating shall be furnished.
- 2.03.00 Site Test- After completion, all ducting system shall be checked/tested for air leakages/tightness (smoke test) at site.

#### 3.00.00 INSULATION:

- 3.01.00 Insulation material shall be tested for all mandatory tests only as per relevant code/standard.
- 3.02.00 Thermal conductivity tests (for thermal insulation only) shall be done once in 12 months for insulation material manufactured during 12 months period for the same density and thickness of material as applicable as per IS:3346 or equivalent standard.

#### 4.00.00 AIR FILTERS:

Pre/Fine filters shall be tested for initial and final pressure drop Vs flow and average synthetic dust weight arrestance as per the requirement of BS 6540/ASHARE-52-76/EN779. HEPA (Absolute) filters shall be tested as per applicable code.


## DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

#### (MECHANICAL & CIVIL)



#### 5.00.00 PIPES & FITTINGS:

- 5.01.00 All pipes and fittings shall be tested as per applicable codes / standard.
- 5.02.00 Site test- Pipes shall be tested at site hydraulically/pneumatically as per application requirement.

#### 6.00.00 VALVES & SPECIALTIES

- 6.01.00 Visual and dimensional check of valves as per relevant codes and approved drawing.
- 6.02.00 All the water line valves shall be hydraulically tested for body, seat and back seat (wherever provided) as per the relevant standard to which these valves are supplied irrespective of the working pressure for which these valves are selected. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.
- 6.03.00 Refrigerant line valves shall be pneumatically tested for body and seat leakage test.
- 6.04.00 Valves shall be offered for hydro test and pneumatic test in unpainted condition.
- 6.05.00 Functional check of the valves for smooth opening and closing shall be done.
- 6.06.00 Performance test to check pressure drop Vs flow shall be carried out for one valve of each type, size and rating for 'Balancing Valve'/Globe Valves with orifice.

#### 7.00.00 Packaged Air Conditioners (PAC)/ SPLIT/CASSETTE AC

- 7.01.00 For PAC Units, Split/Cassette Air conditioner up to 10 TR capacity will be accepted on the basis of Manufacturer Standard Guarantee and Warrantee certificate. However for these units capacity assessment shall be done at site as per approved procedures.
- 7.02.00 For Air Cooled PAC of Capacity more than 10TR, One Unit (Both indoor and out door interconnected) of each type and rating shall be subjected to production routine test inclusive of Performance Test as per IS:8148 at prevalent ambient condition.
- 8.00.00 Air Washer and Unitary Air Filter (UAF)
- 8.01.00 Random 10% DPT on weld joints shall be carried out
- 8.02.00 Hydraulic test of pressure parts at 1.5 times the design. Pressure and water fill test of tanks shall be carried out
- 8.03.00 Trial assembly of Air washer/UAF for one of each size shall be done in shop.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)



# QA ELECTRICAL



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)







#### MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)



						НТ	7LT Ind	luctio	n Moto	r								
Attributes/ Characteristics			ing/TC/General	roperties	Т		licteristics	g(WPS/PQR)		toteristics	Pressure Test	cteristics		cing	IS-325		t voltage &Polarisation	ckness & adhesion
Item/Components/ Sub System/Assembly	Visual	Dimensional	Make/Type/Rat Physical	Mech / Chem. F	NDT /DP /MP /I	Metallography	Electrical Chara	Welding/Brazin	Heat Treatment	Magnetic Chara	Hydraulic/Leak/	Thermal Charao	Run out	Dynamic Balano	All tests as per	Vibration	Over speed Tan delta, shaf Index Test	Paint shade, thi
Plates for stator frame, end shield, spider etc.	Ŷ	Y	Y	Y					Y			·	_					
Shaft	Υ	Y	Y	Y	Y	Y			Y									
Magnetic Material	Υ	Y	Y	Y	Y		Y			Y		Y						
Rotor Copper/ Aluminium	Υ	Y	Y	Y		Y	Y		Y									
Stator copper	Υ	Y	Y	Y			Y		Y			Y						
Insulating material	Υ		Y	Y			Y					Y						
Tube for Cooler	Υ	Y	Y	Y	Y				Y		Y							
Sleeve Bearing	Υ	Y	Y	Y	Y				Y		Y							
Stator/Rotor, Exciter Coil	Υ	Y	Y				Y	Y										
Wound Stator	Υ	Y					Y	Y										
Wound Exciter	Υ	Y					Y	Y										



MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)

Ref Comment

Casting, stator frame, terminal block& bearing housing etc.	Y	Y	Y	Y	Y		Y											
Fabrication & machining of stator, rotor, terminal blocks	Y	Y			Y		Y	Y										
Rotor complete	Y	Y				Y						Y	Y					
Exciter, stator, rotor, terminal blocks assembly	Y	Y				Y												
Accessories, RTD, BTD,CT, Space Heater Bearing, Cable Glands, ,Lugs,Gas kit etc.	Y	Y	Y															
Complete Motor	Y	Y	Y											Y	Y	Y	Y1	Y
Note: 1. This is an indicative list followed along with relevant Supporting documents during Q 2. Additional routine tests for Fla 3. Makes of major bought out ite 4. Y1 = for HT Motor / Machines	of te P fina ame p ems fo s only	sts/ch alizatio proof r pr HT	ecks. Th on. notors sł motors v	e man nall be vill be s	ufactu applio subjeo	re is to furnis cable as per r ct to Owner a	sh a de elevai pprova	etailed ( nt stanc al.	Quality	Plan inc	licating	the pra	actice	s & Pro	bcedu	re		



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3





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TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)



		ſ	Mediu	m Volt	age B	US DUC	Т					
Attributes/ Characteristics Item/Components/ Sub System/Assembly	visual & Dimensional Checks	Electrical / Mechanical / Chemical Properties	WPS & PQR	NDT (RT / DP / MPI / UT)	NDT /DP /MP /UT	Painting Quality & Adhesion Test	Galvanising Test as per IS: 2629 / 2633 / 6745	Electrical clearance & Creep age distance	Functional/Operational check	Vlake / Type Rating / Model / TC / Embossing/Printing of make & batch /General Physical Inspection	Trial Assembly at works.	Routine Test as per relevant
Enclosure / Cubicle	Ý	Y		Y		Y		Y				Y
Bus bar Conductor / Flexible Connector & Dis connector Link	Y	Y										
Galvanised Steel Structure & Plate (Steel as per IS:2062)	Y						Y					
Epoxy / Seal-off Bushing & Epoxy / Porcelain Post /Support Insulator	Y	Y						Y		Y		Y
Welding of enclosure & conductor	Y		Y	Y								
Gasket, Silica gel Breather, Elastomer Spring Head	Y	у							Y	Y		
Complete Bus Duct & Cubicles IS:8084	Y	-			Y	Y		Y			Y	Y
Note: 1) This is an indicative list of tests / checks. The mail	nufactu	irer is to fi	urnish	a detai	ed Qu	ality Plan	indicating	the prac	tice and i	procedure along v	vith releva	ant

 This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2) All major Bought out Items will be subject to Owner approval.



## MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3







MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



				LT	XLPE FI	RLS Pov	wer Ca	ble								
Attributes/Characteristics Item/Components/ Sub System/Assembly	be, Rating& T.C	v/Surface finish	al properties	Composition	t (as applicable)	Properties	est(XLPE)	h & Sequence	verage, cross over, looseness een two wires	l marking/surface finish/cable length	ngation before and after ageing on outer nsulation	tability on outer sheath	t and anti termite properties of outer d anti rodent coating on wooden drums	onal requirement feature as per approved specification	Acceptance test as approved QAP	Sts
	/ake, Typ	Dimension	Aechanic	Chemical	spark Tes	Electrical	Hot Set Te	Lay lengt	Armour co gap betw	Sequentia	.S. & elo theath & i	hermal s	Anti roder theath an	Construct echnical	Routine 8	FRLS Te
Aluminium (IS-8130)(Conductor)	Y	Y	Ý	Y	0,	Y	_ <b>_</b>			0)	~~ v		4 0	<u> </u>		
XLPE Compound (IS-7098 Part-II)(Insulation)	Y		Y			Y					Y					
PVC Compound(IS-5831) -Inner Sheath	Y		Y								Y					
FRLS PVC Compound(IS-5831,IEC-754 Part- 1,ASTM-D2843,ASTM-2863)(Outer sheath)	Y		Y								Y	Y				Y
Armoure wire/Strip	Y	Υ	Y													
Insulated Core		Y			Y		Y					Y				



#### MAITHON HYDEL STATION

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## (MECHANICAL & CIVIL)



Laid up core		Y		Y								
Inner sheath(PVC-ST2 IS:5831/84)		Υ										
Armouring		Y			Y							
Outer sheath(PVC-ST2 IS:5831/84)		Y				Y	Y	Y	Y	Y		Y
Power Cable-Finished(IS-7098 Part-I), IS- 5831,ASTM D-2843/IS-10810(Part-58),ASTM- 2863,IEC 754 Part-1),SS 4241475,Flammability test IEC-332 Part-3	Y	Y	Y		Y	Y	Y	Y		Y	Y	Y
Wooden Drum(IS-10418)/Steel Drum		Y							Y			
Notoc:												

Notes:

1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedures along with relevant supporting documents.

2) Make of all major brought out items will be subject to DVC approval.

MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



<b>ROUTINE TESTS</b>	Folle	owing routine tests shall be carried out on each drum of finished cables for all types (	PVC / XLPE insulated) &
	size	S.	
1	Con	ductor Resistance test	
2	Higl	h voltage test	
ACCEPTANCE TEST	TS		
Following Acceptan	ce te	ests shall be carried out on each size of each type (PVC / XLPE insulated) of cables, in	the offered lot.
A) For Conductor (a	is pe	r sampling plan mentioned in IS: 1554 / 7098)	
	1)	Annealing test (Copper)	
	2)	Tensile Test ( Aluminium)	
	3)	Wrapping Test ( Aluminium)	<u> </u>
	4)	Resistance test	<u> </u>
B) For Armour Wire	s/Fo	prmed Wires ( If applicable ) (as per sampling plan mentioned in IS: 1554 / 7098)	
	1.	Measurement of Dimensions	<u> </u>
	2.	Tensile Tests	<u> </u>
	3.	Elongation Test	l
	4.	Torsion Test For Round wires only	l
	5.	Wrapping Test	<u> </u>
	6.	Resistance Test	l
	7.	Mass of Zinc coating test For G S wires / Formed wires only	
	8.	Uniformity of Zinc coating For G S wires / Formed wires only	l
	9.	Adhesion test For G S wires / Formed wires only	l
	10.	Freedom from surface defects	I
C) For PVC / XLPE	insul	ation & PVC Sheath (as per sampling plan mentioned in IS: 1554 / 7098)	
	1.	Test for thickness	
	2.	Tensile strength & Elongation before ageing (for tests after ageing see "D")	<u> </u>
	3.	Hot set test (For XLPE insulation)	



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



		This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured PVC insulated, unarmoured PVC insulated, armoured XLPE insulated, unarmoured XLPE insulated) will be bunched together, as per calculations in line with the IEC. All sizes of PVC & XLPE insulated, armoured & unarmoured cables shall be covered. For one particular type, cables with OD less than or equal to 30 mm shall be
		clubbed together in touching formation while cables with OD greater than 30 mm shall be clubbed together leaving a gap equal to OD of cable having least diameter. Cable OD shall be taken as nominal overall diameter as per OWNER approved datasheet.
H) Following tests	shall be o	carried on one length of each size of each type (PVC / XLPE insulated) of offered lot:
	1.	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / Batch (outer sheath extrusion batch ) number marking on sheath
	2.	Measurement of Eccentricity & Ovality.



MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)







## MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3



						Contr	ol Cabl	е							
Attributes/ Characteristics Item/Components/ Sub System/Assembly	/lake, Type, Rating& T.C	bimension/Surface finish	/lechanical properties	chemical Composition	spark Test (as applicable)	ectrical Properties	ay length/ Sequence	rrmour coverage, cross ver, looseness, ap between two wires	sequential narking/surface	.S. & elongation efore and after geing on outer	hermal stability on sulation and outer sheath	unti-rodent and anti-termite properties of outer sheath and anti-rodent oating on wooden drums	Constructional requirement feature is per approved technical specification	coutine & Acceptance test as approved QAP	RLS Tests
Cu Conductor (IS-8130)	Ϋ́	Y	Y	Y		Y		<u> </u>	0, 2 0				0 0	<u>u</u>	
PVC Compound (IS-5831)(Insulation)	Y		Y			Y				Y					
FRLS PVC Compound(IS-5831,IEC-754 Part-1,IS-10810 Part-58,ASTM- D2843,ASTM-2863)(Outer sheath)	Y		Y							Y	Y				Y
Armoure wire/Strip(IS-3975)	Y	Y	Y												
Insulated Core		Y			Y						Y				
Laid up core		Y					Y								
Inner sheath(PVC-ST1 IS:5831/84)		Y													
Armouring		Y						Y							
Outer sheath(PVC-ST1 IS:5831/84)		Y							Y	Y	Y	Y	Y		Y



Υ

Notes:	

Wooden Drum(IS-10418)/Steel Drum

3

1)This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedures along with relevant supporting documents.

2) Make of all major bought out items will be subject to DVC approval.

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MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3



ROUTINE TESTS	Foll	owing routine tests shall be carried out on each drum of finished cables for all types (PVC / XLPE insulated) & sizes.
1	Con	ductor Resistance test
2	Hig	h voltage test
ACCEPTANCE TEST	S	
Following Acceptance	ce tes	sts shall be carried out on each size of each type (PVC / XLPE insulated) of cables, in the offered lot.
A) For Conductor (as	s per	sampling plan mentioned in IS: 1554 / 7098)
	1)	Annealing test (Copper)
	2)	Tensile Test ( Aluminium)
B) For Armour Wires	s / For	rmed Wires ( If applicable ) (as per sampling plan mentioned in IS: 1554 / 7098)
	1.	Measurement of Dimensions
	2.	Tensile Tests
	3.	Elongation Test
	4.	Torsion Test For Round wires only
	5.	Wrapping Test
	6.	Resistance Test
	7.	Mass of Zinc coating test For G S wires / Formed wires only
	8.	Uniformity of Zinc coating For G S wires / Formed wires only
	9.	Adhesion test For G S wires / Formed wires only
	10.	Freedom from surface defects
C) For PVC / XLPE in	nsula	tion & PVC Sheath (as per sampling plan mentioned in IS: 1554 / 7098)
	1.	Test for thickness
	2.	Tensile strength & Elongation before ageing (for tests after ageing see "D")



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3

(MECHANICAL & CIVIL)



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Chap-09



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)







MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3

(MECHANICAL & CIVIL)

CABLING,EARTHING,L	IGHTNING	GPROTE	CTION											
ATTRIBUTES/ CHARACTERISTICS ITEMS/COMPONENTS/ SUB SYSTEMS	Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV&IR	Galvanise Test (If Applicable)	Functional	Bought out item/ Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per Employer
Wall Mounted-Lighting Panel(IS- 513,IS:5,IS:2629,2633,6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Switch box/junction box/ Receptacles Panel (IS-513, IS:5, IS:2629,2633,6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Cable glands (BS-6121)	Y											Y		
Cable lug (IS-8309)	Y											Y		
Lighting wire(IS-694)	Y											Y		
Flexible conduits	Y											Y		Y
Conduits(Galvanise &Epoxy)IS- 9537&IS-2629,2633,6745	Y		Y								Y	Y		Y
RCC Hume Pipe(IS-458)												Y		

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#### MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3

## (MECHANICAL & CIVIL)



Cable termination &straight through joint(VDE-0278)	Y								Y		Y
Cable Trays, Flexible supports system &accessories IS-513, 2629,2633,6745	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Trefoil clamp	Y										Y
GI flats for earthing &lighting protection (IS 2062, 2629, 6745,2633)	Y	Y					Y		Y		Y
GI wire(IS-280)	Y								Y		
Fire Sealing System(BS–476)									Y	Y	Y

Note:

1. This is an indicative list of tests /checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2.\* Deflection Test on cable trays and Proof Load test on cable trays support system will be as per details given in the OWNER technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot. This test is not applicable on bends, tees & Crosses.
3. Make of all items will be subject to OWNER approval.



MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)







MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



				MV (3	8.3 kV	/ 6.6	6. kV	/ 11 k	V / 33	kV) C	ables							
Attributes/ Characterist ics tem/Components/ Sub System/Assembly	Make, Type, Rating & T.C	Dimension/Surface finish	Mechanical properties	Chemical Composition	Spark Test (as applicable)	Curing Properties	Electrical Properties	Hot Set Test/Eccentricity and Ovality	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two	Sequential marking/surface	T.S. & elongation before and after ageing on outer sheath	Thermal stability on outer sheath	Metallic (Cu) screening (if applicable)	Anti-rodent and anti-termite properties of outer sheath and anti-rodent coating on wooden drums	Constructional requirement feature as per approved technical specification	Routine & Acceptance test as approved QAP	FRLS Tests
Aluminium (IS-8130)(Conductor)	Ý	Y	Y	Y			Y											
Semiconducting Compound(Conductor and Non Metallic Insulation Screening)	Y		Y			Y	Y											
KLPE Compound (IS-7098 Part- I)(Insulation)	Y		Y			Y	Y					Y						
FRLS PVC Compound(IS-5831,IEC-754 Part-1,ASTM-D2843,ASTM-2863)(Inner & Duter sheath)	Y		Y									Y	Y					Y
Triple Extrusion & curing/ Manufacturing of Core		Y			Y			Y	Y									



MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



Copper Tape(Metallic Insulation Screening)	Y	Y	Y			Y											
Polyester tape	Y	Y															
Armoure wire/Strip	Y	Y	Y														
Copper Taping	Y	Y				Y											
Inner sheath	Y	Y															
Armouring									Y				Y				
Outer sheathing		Y								Y	Y	Y		Y	Y		Y
Power Cable-Finished	Y							Y	Y	Y	Y	Y			Y	Y	Y
Wooden Drum(IS-10418)/Steel Drum		Y												Y			
Notes: 1)This is an indicative list of tests/o supporting documents. 2) Make of all major bought out ite	checks. 7 ms will b	The m e sub	anufac ject to	cturer is DVC/co	to furnis Insultant	h a det 's appr	ailed oval.	quality	plan in	dicating	the pra	ctice a	ind pro	cedures a	long with I	relevant	

MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



ROUTINE TESTS	Foll	owing routine tests shall be carried out on each drum of finished cables for all types (PVC / XLPE insulated) & sizes.
1	Con	ductor Resistance test
2	Hig	h voltage test
3.	Part	ial discharge test (for Screened cables only)
ACCEPTANCE TESTS	Follo	owing Acceptance tests shall be carried out on each size of each type (PVC / XLPE insulated) of cables, in the offered lot.
For Conductor (as per	sam	pling plan mentioned in IS: 7098 Part II)
	1)	Annealing test (Copper)
	2)	Tensile Test ( Aluminium)
B) For copper tape / W	/ires	(as per sampling plan mentioned in IS: 7098 Part II)
	1.	Measurement of Dimensions
	2.	Conductivity check
C) For Armour Wires /	Form	ned Wires ( If applicable ) (as per sampling plan mentioned in IS: 7098 Part II)
	1.	Measurement of Dimensions
	2.	Tensile Tests
	3.	Elongation Test
	4.	Torsion Test For Round wires only
	5.	Wrapping Test
	6.	Resistance Test
	7.	Mass of Zinc coating test For G S wires / Formed wires only
	8.	Uniformity of Zinc coating For G S wires / Formed wires only
	9.	Adhesion test For G S wires / Formed wires only
	10.	Freedom from surface defects
D) For PVC / XLPE ins	ulatio	on & PVC Sheath (as per sampling plan mentioned in IS: 1554 / 7098)
	1.	Test for thickness
	2.	Tensile strength & Elongation before ageing (for tests after ageing see "E")
E)Ageing Test		

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TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



	Criteria	Condition	Test Requirements	Remarks
PVC	Samples as per relevant IS, from each size of cables	All sizes which	The size which has maximum	In case the size
insulation &	in the offered lot, shall be tested for tensile strength &	meet the criteria	negative deviation from type test	does not meet
outer	elongation (Before ageing). Tensile & elongation		report values will be put on	the requirement
sheath:	testing shall preferably be done with a		Accelerated ageing test. The	in accelerated
	computerized machine. The values will be		Samples shall be aged in air oven	ageing test <b>then</b>
	compared with corresponding values mentioned in		at temperature of 130°c+/- 2°c for	all sizes (which
	the Type Test report accepted by OWNER. These		5 hours and tested for TS &	had met the
	values of Tensile Strength & Elongation (before		elongation. Acceptance norms	criteria) will be
	ageing) should be within +/ - 15% of the		shall be as per IS.	put on ageing
	corresponding values of Type Test report. (Please			test as per IS.
	note that test values should be more than the	Sizes which do not	Every size will be put on ageing	
	minimum values indicated in	meet the criteria	test as per IS.	
	relevant standard).			
XLPE	Samples as per relevant IS, from each size of cables in	the offered lot, will be	e put on ageing test as per IS.	
insulation				
E) Following tests will	be carried out on completed cables as per IS on eac	ch size of each type	PVC / XLPE insulated)	
	1. Insulation resistance test (Volume resistivity	method)		
2.	High voltage test			
F) Following tests shall	Il be carried out on only one size of offered lot (com	prising of all sizes &	types)	
	1. Thermal stability test on PVC insulation and c	outer sheath		
	2. Oxygen index test on outer sheath			
	3. Smoke density rating test on outer sheath			
	4. Acid gas generation test on outer sheath			
G) Flammability test as	s per IEC 60332 - Part- 3 (Category- B) on completed	cables as per follow	ving sampling plan:	

	टाषानि	DAMODAR VALLEY CORPORATION (DVC)											
	DVC	MAITHON HYDEL STATION											
		TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3	मेकॉन										
		(MECHANICAL & CIVIL)	9001 Comp										
	This test wi	I be carried out using composite sampling i.e. irrespective of size	; cables of one	particular type (i.e. armoured									
	PVC insulation	VC insulated, unarmoured PVC insulated, armoured XLPE insulated, unarmoured XLPE insulated) will be bunched ogether, as per calculations in line with the IEC. All sizes of PVC & XLPE insulated, armoured & unarmoured cables shall											
	be covered	ether, as per calculations in line with the IEC. All sizes of PVC & XLPE insulated, armoured & unarmoured cables shall povered. For one particular type, cables with OD less than or equal to 30 mm shall be clubbed together in touching											
	formation w	hile cables with OD greater than 30 mm shall be clubbed togethe	r leaving a gap	equal to OD of cable having									
	least diame	ter. Cable OD shall be taken as nominal overall diameter as per (	OWNER approv	ved datasheet.									
H) Following tests shall b	e carried on one	ength of each size of each type (PVC / XLPE insulated) of off	ered lot:										
1.	Constructio	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap											
	between tw	between two consecutive armour wires / formed wires, Sequential marking, drum / Batch (outer sheath extrusion batch)											
	number ma	rking on sheath											
2.	Measureme	ent of Eccentricity & Ovality.											



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3





MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



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MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)







MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



			HT Star	ter Pane	I(HT Swit	chgear)							
Attributes/ Characteristics Item/Components/ Sub System/Assembly	Make, Type, Model, Rating & T.C	Electrical Properties	Mechanical properties	Chemical Properties	Dimensions & Finish	Functional & Operative Features as per approved Drawing	Item to conform relevant standards	Paint Shade, Thickness, and adhesion. & Finish	Functional Checks	HV & IR Test	Degree of Protection Routine Test as per Spec	CB Operation timing check	Routine Test as per relevant standard
Aluminium Bus bar Material(IS-5082)	Y	Y	Y	Y	Y		Y						
CRCA steel sheet/ Aluzinc*/ Zinc alum*/ Galvalum*	Y		Y	Y			Y						
Copper Bus bar Material(IS:613)	Y	Y	Y	Y	Y		Y						
Bus bar support Insulator	Y	Y	Y		Y		Y			Y			
HT Circuit Breaker(IEC-62271-100)	Y				Y	Y	Y		Y			Y	Y
Protection & Auxiliary Relays(IS:3231/8686)	Y				Y	Y	Y		Y				Y
HT CT's & PT's(IS:2705/3156)	Y				Y		Y						Y
HT Fuses(IS:9385)	Y				Y	Y	Y						
Surge Arrester(IEC:99-4)	Y				Y		Y						Y
LT Contactors(IS:13947)	Y				Y	Y	Y		Y				





## MAITHON HYDEL STATION

(MECHANICAL & CIVIL)

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

# Roman Contract

Control & Selector Switches(IS:6875)	Y			Y	Y	Y		Y				
Indicating Meters(IS:1248)	Y			Y	Y	Y		Y				Y
Indicating Lamps(IS:13947)	Y			Y	Y	Y		Y				
Push Buttons(IS:4794)	Y			Y	Y	Y		Y				
LT Fuses(IS:13703)	Y			Y	Y	Y						
Control Transformer(IS:12021)	Y			Y	Y	Y		Y				Y
Energy Meters(IS:722)	Y			Y	Y	Y		Y				Y
Transducers(IEC:60688)	Y			Y	Y	Y		Y				Y
Diodes	Y	Y		Y	Y	Y		Y				
Terminal Blocks	Y	Y			Y	Y						
Synthetic Rubber Gasket(IS:11149/3400)	Y	Y		Y		Y						
Breaker Handling Trolley	Y			Y	Y		Y	Y				
HT Switchgear Panel(IEC-62271-200 & IEC- 60694)	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2. Make of all major Bought Out Items will be subject to OWNER approval.

3. Temperature rise test reports for diode plates with actual heat sink will be verified.

\*. CRCA Galvanized steel with metal coating composed of AI (55%), Zn (43.4%) & Si (1.6%),



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)







## MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



l		J		(M	ECHANIC	AL & CIVI	L)							
		•			LT SWIT	CHGEAR	2		•					
( N	ICC, PCC,	, ACDB, I	DCDB, Fl	JSE BO	ARDS, LOC	AL PUSH	BUTTON S	TATION,	LOCALM	OTOR S	STARTE	RS)		
Attributes/ Characteristics Item/Components/ Sub System/Assembly	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per tech spec	Item to conform to relevant Standards	Pre-treatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per Tech Spec	All Routine tests as per EMPLOYER spec.& relevant IS
Sheet Steel (IS :513)	Y	Y		Y	Y		Y							
Aluminium Bus bar Material(IS: 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar Material(IS: 613)	Y	Y	Y	Y	Y		Y							
Support Insulator	Y	Y	Y	Y			Y							
Air Circuit Breaker (IS: 13947)	Y	Y				Y	Y			Y	Y			Y
Energy Meters ( IS :13010, 13779)	Y	Y				Y	Y			Y				Y
Power &Aux. Contactors(IS : 13947)	Y	Y				Y	Y			Y				
Protection &Aux. Relays(IS : 3231)	Y	Y				Y	Y			Y				Y
Control & Selector Switches(IS: 13947)	Y	Y				Y	Y			Y				
CT's & PT's (IS 2705 / 3156)	Y	Y					Y							Y

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MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

#### (MECHANICAL & CIVIL)



MCCB ( IS : 13947)	Y	Y				Y			Y				
Indicating Meters (IS: 1248)	Y	Y			Y	Y			Y				Y
Indicating Lamps (IS: 13947)	Y	Y			Y	Y			Y				
Air Break Switches( IS : 13947 )	Y	Y			Y	Y			Y				
Control Terminal Blocks	Y	Y			Y	Y							
Fuse ( IS 13703)	Y	Y			Y	Y							
Control Transformer(IS: 12021)	Y	Y			Y	Y			Y				Y
Push Buttons ( IS :4794 )	Y	Y			Y	Y			Y				
Transducer (IEC :60688)	Y	Y			Y	Y			Y				Y
MCB ( IS : 8828)	Y	Y			Y	Y			Y				
Breaker Handling Trolley	Y	Y			Y			Y	Y				Y
Synthetic Rubber Gasket(IS: 11149)	Y	Y	Y	Y		Y							
LT SWITCHGEAR ( IS : 8623 )	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2. Makes of all major Bought out Items will be subject to OWNER approval.





## MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



				LT	Bus d	uct									
Attributes/ Characteristics Item/Components/ Sub System/Assembly	Dimension & Surface Finish	Make, Type, Rating & TC	Electrical Properties	Mechanical Properties	Chemical Properties	tem to conform to relevant IS	WPS Approval, Welder Qualification	Weld Quality Check ( DP test & x-ray Test)	Paint Shade, Thickness, Adhesion & Finish	Tightness by Torque measurement	Electrical Clearances	Galvanizing Test as per IS 2629/ 2633/ 4759	IR – HV – IR Test	Millivolt Drop Test & Phase Sequence Check	Air Tightness & Degree of Protection routine test as per IS & specification
Aluminium Sheets /Plates / Strips Flexibles / tubes( IS : 5082 / 737 )	Y	Y		Y	Y	Y	Y	Y							
CRCA Flats / ISMC (IS 2062)	Y	Y		Y	Y	Υ									
Neoprene / Synthetic Rubber Gaskets (IS 11149/3400)	Y	Υ		Y	Y										
Rubber Bellows (IS :3400)	Y	Y		Y	Y										
Support Insulator ( BS: 2782,IEC : 660, IS : 10912 )	Y	Y	Y	Y											

	TECH		AR VALLEY MAITHON HY SPECIFICATIC (MECHANIC	CORPC (DEL ST ON FOR I CAL & C	DRAT ATIO R&M IVIL)	TION N OF U	( <b>DVC)</b> NIT # 1 8	\$3	100 2001 C					
Galvanized Structure & GI Earthing Flat(IS 2629 / 2633 /4749)	Y	Y			Y						Y			
Space Heater & Thermostat		Y	Y									Y		
LT Bus duct (IS : 8623 PART 2)	Y	Y		Ň	Y	Y	Y	Y	Y	Y		Y	Y	Y

Notes:

1)This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedures along with relevant supporting documents.

2) Make of all major bought out items will be subject to DVC approval.
## 

## TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3





MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

			DIE	SEL ENG	INE						
TESTS/CHECKS ITEMS/COMPONENTS	//aterial Test	Id//d0	JT( On forging and piston Bonding)	aalancing	Hydraulic/ water fill test	Assy./fitup	Dimension	-unctional/ Operation test	PerformancetestasperBS-5514/or squivalent IS/ISO-Standard ncluding SoverningTestfor3hoursatfullload	-uel consumption, rated oower measurement ,rated speed	All other tests(if applicable) as per Spec./relevant standard
Crankshaft	Y	Y	Ϋ́	Y						ш со о	
Cylinder blocks/heads	Y				Y						
Liner/Radiator	Y				Y						
Rotating/moving parts other than crankshaft	Y	Y									
Piston	Y	Y	Y								
Diesel Engine						Y	Y	Y	Y	Y	Y
Notes: 1)This is an indicative list of tests/checks.	The man	ufacturer is	s to furnish	a detailec	l quality p	olan indicati	ng the pra	actice and	procedures a	along with	

relevant supporting documents. 2) Make of all major bought out items will be subject to DVC approval.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

					Α	LTE	RN	ATO	R									
TESTS/CHECKS			g/TC/General Physical	perties	, , , , , , , , , , , , , , , , , , ,		steristics	(WPS/PQR)		steristics	Pressure Test	eristics		bu	325/IS-4722			oltage & polarization
ITEMS/COMPONENTS	Visual	Dimensional	Make/Type/Ratin Inspection	Mech/Chem. Pro	NDT/DP/MPI/UT	Metallography	Electrical Charac	Welding/Brazing	Heat Treatment	Magnetic Charac	Hydraulic/Leak/ F	Thermal Charact	Run out	Dynamic Balanci	AlltestsasperIS-3	vibration	Over speed	Tan delta, shaft v index test
Plates for stator frame, end shield, Spider, etc.	Ý	Y	Y	Ŷ					Y									=
Shaft	Y	Y	Y	Y	Y	Y			Y									
Magnetic Material	Y	Y	Y	Y	Y		Y			Y		Y						
Rotor Copper/ Aluminum	Y	Y	Y	Y		Y	Y		Y									
Stator copper	Y	Y	Y	Y			Y		Y			Y						
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y									
Insulating Material	Υ		Y	Y			Y					Y						
Tubes for Cooler	Υ	Y	Y	Y	Y				Y		Y							
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y							
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y										
Castings, stator frame ,terminal box and bearing housing, etc.	Y	Y	Y	Y	Y			Y										
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y				Y									

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MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

						AL	TERN	ATOR										
TESTS/CHECKS	isual	imensional	ake/Type/Rating/TC/General hysical Inspection	ech/ Chem. Properties	DT/DP/MPI/UT	etallography	lectrical Characteristics	(elding/Brazing(WPS/PQR)	eat Treatment	agnetic Characteristics	ydraulic/Leak/Pressure Test	hermal Characteristics	un out	ynamic Balancing	IltestsasperIS-325/IS-4722	bration	ver speed	an delta, shaft oltage& Polarization
TTEMS/COMPONENTS	<u>&gt;</u> Y	<u> </u>	≥⊡	Σ	Z	Σ	Ξ Y	≥   Y	Ĩ	Σ	Í	F	Ř	۵°	A		0	∠ ⊣
	·																	
Wound Exciter	Y	Y					Y	Y										
Rotor complete	Y	Y					Y						Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y											
Accessories, RTD, BTD, CT, AVR Brushes, Diodes, Space heater, antifriction bearing, cable	Y	Y	Y															
Alternator(IS4722)	Y	Y	Y												Y	Y	Y	Y1
Note: 1. This is an indicative list of tests / checks. The during QP finalisation. 2. Make of all major BOIs will be subject to OV	he ma WNEI	anufac R appl	turer is to	o furnis	h a det	ailed C	uality F	Plan indic	ating th	ne practi	ce and F	Procedure a	long w	ith relev	antsupp	orting d	ocumen	S

Y1= for HT Machines only.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



		FINAL A	ASSEMB	SLY						
TESTS/CHECKS ITEMS/COMPONENTS	est		R/Welding	TU/IAM	mpleteness	/Leak/Pressure test	al Tests	e test as per Spec/IS	est for one hour of st assembly	es & Alignment
Base frame	A Material T	Dimensio	APS/PQF	A NDT/DP/A	Check col	Hy draulic/	Functiona	All routine	No load t <sub>i</sub> the DG se	Clearance
Fuel Tank	Y	Y	Y	Y	Y	Y				
Battery(IS-1691)								Y		
Battery Charger								Y		
Control Panel								Y		
Assembled DG Set		Y			Y		Y		Y	Y
NOTES:									_	

This is an indicative list of tests/checks. The manufacturer is to furnish detailed Quality Plan indicating the practice and procedure along with relevant supporting 1. documents during QP finalization.

2. Make of all major Bought Out Items will be subject to EMPLOYER approval.

TS VOL-II Section – A

Chap-09

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MAITHON HYDEL STATION



टामानि		DAMC	DDAR V	ALLE	Y COR	PORA		I (DVC	C)		$\sim$					
DVC			MAI	THON H	HYDEL	STATI	ON			6	100					
	TEC	HNICA	L SPEC	IFICAT	ION FC	R R&N		UNIT 7	#1&3	K	मेकॉन					
	•		(N/				)	•••••		130	9001 Company					
			(1)				-)									
		T	AUXI		RANS	FORM	ERS	1		1			1	T		
Attributes/ Characteristics Item/Components/ Sub System/Assembly	Visual & Dimensional checks	Mechanical Properties	Electrical Strength	Thermal Properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test	Voltage Ratio, Vector Group & Polarity, Magnetic Balance	ke/Type/Rating/Model/TC/General Physical	Functional Check	WPS & PQR	Routine Test as per relevant standard	Vacuum & Pressure Test	Magnetic balance test, Oil BDV, jacking test (DP test)	Leakage test on completely assembled transformer
Tank, H.V, & L.V. Cable Box / Flange throat Y		Y					Y			Ma				Y		
Conservator / Radiator / Cooler / Pipes Y		Y					Y									
Copper Conductor (IS:191) Y		Y	Y		Y											
Insulating Material Y		Y	Y	Y	Y	Y										
CRGO Lamination & Built Core Y		Y	Υ		Υ	Y										
Bushing / Insulator (IS:2544 / 5621) Y		Y										Y	Y			
Bushing CT (IEC 185)												Y	Y			
Gasket Y							Y	Y		Y						
Transformer Oil (IS : 335)													Y			
Off-Circuit Tap Changer Y												Y				
Core Coil Assembly & Pre-tanking Y										Y						



#### MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

#### (MECHANICAL & CIVIL)



Marshalling Box	Y	Y			Y	Y				
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay Globe & Gate Valve	Y					Y Y				
Welding (ASME Sect-IX)	Y					Y				
Complete Transformer	Y						Y	Y	Y	Y
Notes:								÷		·

1)This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedures along with relevant supporting documents.

2) Make of all major bought out items will be subject to DVC approval.





MAITHON HYDEL STATION





MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



Assembly/fit up

Y

	Pas	senger/S	ervice Elev	ators				
TESTS /CHECKS Items	/ Material Test	DPI/MPI	Ultrasonic Test	Dimensions/Physic al	Functional/ Operational Test/ Run Test Performance Test	Other Test	All routine tests as per applicable standard	Plain shade, thickness & adhesion
Shaft//Gears/Pinion/Pulley/Sheave	Y	Y	Y	Y				
Spring	Y	Y	Y	Y			Y	
Plates	Y			Y				
Wire Ropes				Y		Y5		
Safety Device								
Geared Machine					Y			
VVVF Drive					Y		Y	
Power control & Trailing Cable				Y			Y4	
Control Panel				Y				Y
ARD System					Y		Y	
Electrical motor							Y	
Controller assembly with VVVF drive					Y	Y3		
Complete Lift/Elevator				Y	Y1 Y	Y2		

MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)

Y1 –Test to Be Done At Site

Y2 - Load/Overload Test to Be Done At Site as Applicable.

Y3 - Burn in test on electronic card

Y4 – Routine tests including FRLS tests as per Tech. Spec.

Y5- Test report as per relevant std.

NOTE:

1. This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the applicable practices and procedures followed along with relevant supporting documents during QAP finalization. Relevant supporting documents during QAP finalization. 2. Makes of all bought out items shall be subject to EMPLOYER approval.



MAITHON HYDEL STATION







MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)

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Date	$\rightarrow$
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	(人) 注句話

	VFD N	IODULE		
Attributes/ Characteristics	al & Dimensional Ks	e/ Type/ Rating etc.	Inspection as ISS /	arks
Item/Components/ Sub System/Assembly	Visua	Make	Final IFC	Rem
HT Breaker (IEC 56)	Y	Y	Y	
Hollow insulators for HT Breaker (IEC 233, IS 5284)	Y	Y	Y	
DC Reactor		Y	Y	For details refer table for DC Reactor
Transformer	Y	Y		For details refer table for Transformer
Motor	Y	Y		For details refer table for Motor
VFD Panel		Y	Y	For details refer table for VFD
Note : 1) This is an indicative list of tests/checks. T & Procedure followed along with relevant supportin	he manufacture ing documents dur	s to furnish a d ring QP finalisa	etailed Quality tion.	Plan indicating the practices

2) Make of all major Bought Out Items will be subject to owner approval.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



Attributes/ Characteristics Item/Components/ Sub System/Assembly	Visual	Dimentinoal	Mech. & Chem Property	Electrical Characteristics	Pre treatment by Seven Tank	Painting by Stove Enamling	Final Inspection as per IS-2026	Welding/NDT
Winding Material (Aluminium)	Y	Y	Y	Y				
Insulation Material	Y	Y		Y				
Sheet Steel	Y	Y	Y					
Winding	Y	Y		Y				
Fabrication of Enclosures	Y	Y			Y	Y		Y
Assembly	Y	Y						
Routine Tests	Y	Y					Y	
Notes: 1)This is an indicative list of tests/checks. The r procedures along with relevant supporting docu 2) Make of all major bought out items will be sul	nanufacturer ments.	is to furnish a	a detailed o	quality pla	n indicati	ng the pr	actice an	d



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



TRANSFORMER (OIL FILLED)																	
Attributes/ Characteristics Item/Components/ Sub System/Assembly	Visual & Dimensional checks		Mechanical Properties	Electrical Strength	Tharmal Pronartias	Chemical Composition	Compatibility with oil		Ageing Test	Voltage Ratio, Vector Group & Polarity, Magnetic Balance	Make/Type/Rating/Model/TC/General Physical	Functional Check	WPS & PQR	Routine Test as per relevant standard	Vacuum & Pressure Test	Magnetic balance test, Oil BDV, jacking test (DP test)	Leakage test on completely assembled transformer
Tank, H.V, & L.V. Cable Box / Flange throat	Ŷ	Υ			I		Ŭ	Y	- `					_ *	Ŷ		
Conservator / Radiator / Cooler / Pipes	Y	Y						Y									
Copper Conductor (IS:191)	Y	Υ		Y		Y											
Insulating Material	Y	Υ		Y	Y	Y	Y										
CRGO Lamination & Built Core	Y	Υ		Y		Y	Y										
Bushing / Insulator (IS:2544 / 5621)	Y	Υ											Y	Y			
Bushing CT (IEC 185)													Y	Y			
Gasket	Y							Y	Y		Y						
Transformer Oil (IS : 335)														Y			
Off-Circuit Tap Changer	Y												Y				
Core Coil Assembly & Pre-tanking	Y										Y						
Marshalling Box	Y	Y								Y		Y					



MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay Globe & Gate Valve	Y						Y	Y				
Welding (ASME Sect-IX)	Y							Y				
Complete Transformer	Y								Y	Y	Y	Y
Notes: 1)This is an indicative list of tests/checks. supporting documents. 2) Make of all major bought out items will	The mar	iufacturer is to ct to DVC appi	furnish a c oval.	letailed qua	lity plan indicating the p	oractic	e an	d proc	edure	⊧s along	ı with re	levant



MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)



#### 1easurement of capacitance & tan delta Voltage Ratio, Vector Group & Polarity Routine Test as per relevant standard Attributes/ Characteristics 1ake / Type / Rating / Model /TC General Physical Inspection Visual & Dimensional check Mechanical properties Chemical Properties Thermal Properties Electrical strength between winding NDT / DP / MPI WPS & PQR Items/ Routine Test Components Sub Systems Enclosure door, H.V.& Y Υ Y L.V. Cable Box/ Flange Throat Copper Conductor Y Υ Y Y Y Insulating Material Y Y **CRGO Lamination & Built Core** Y Bushing/Insulator(IS:2544 Y Υ Υ / 5621) Gasket Y Y Υ Off-Circuit Tap Changer Υ Υ Core Coil Assembly Υ Y Y Marshalling Box Y WTI, Thermistor, Terminal Y Y Connector Welding Υ Complete Transformer Y Y Υ (IS:11171/IEC60076) Notes:1)This is an indicative List of test/ checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents

DRY TYPE TRANSFORMER

during QP finalization for all item. 2) All major Bought out Items will be subject to OWNER approval.



#### MAITHON HYDEL STATION

#### TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)



Attripries / Antrian A	Degree of Protection Test	Final testing as per Relevant
Sheet Steel (IS-513)         Y         Y         Y         Y         I		
Aluminum/Copper Bus-bar(IS- 5082/IS-613/IS-1987)       Y		
Control/Selector Switch(IS-6875)     Y     Y     Y		
Contactor/ MCB(IS-13947)         Y <td></td> <td></td>		
Fuse/Fuse carrier(IS-13703)         Y<		
Timers(IS-3231)         Y         Y         Y           Push Button/Lamp/(IS-6875)         Y         Y         Y           Control Transformer(IS-12021)         Y         Y         Y		
Mimic, AnnunciatorYYYGASKET(IS-11149)YYYYFabricationYYYYPretreatment &PaintingYYY		
VFD panel Y Y Y	Y	Y

NOTE:

1. This is an indicative list of Test /Checks. The manufacturer to furnish a detailed Quality

Plan indicating the practice and procedure along with relevant supporting documents.

2. All major Bought out Items will be subject to OWNER approval.



MAITHON HYDEL STATION







MAITHON HYDEL STATION



		S	TAT	ION	LIG	HTI	NG						
Attributes Characteristics	Make, Type , Rating/ TC	Dimension	Pre-Treatment of sheet	Paint Shade Thickness Adhesion & Finish	Galvanization Tests	IP Test	Bought Out Items/ Bill of Material	HV & IR	Functional Check as per spec.	Constructional Feature as per OWNWER spec.	Routine Test as per relevant std. and spec	Acceptance Test as per relevant std. and spec.	Item to conform to relevant standard
5 Sec.1 ( non –LED type)	Y					Y		Y			Y	Y	Υ
Electronic Ballast	Y										Y	Y	Y
Lighting Wire (IS-694)	Y										Υ		
Fans (IS-374)	Y										Y		
Pole (IS-2713)	Y			Y						Y	Y	Y	
Lamps (IS-9800, IS-9974)	Y										Y	Y	
Lighting Mast (with raise & lower lantern type)	Y	Y			Y					Y	Y	Y	
Wall Mounted Lighting Panel (IS-513, IS-5)	Y	Y	Y	Υ	Y	Y	Υ	Y	Υ	Y	Υ	Y	
Switch Box/ Junction Box/Receptacles/ Local Push Button Station / Lighting Panel (IS-513, 2629, 2633, 4759, 6745)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Cable Gland (BS-6121)	Y			1							Υ		
Cable Lug (IS-8309)	Y			-							Υ		
Flexible Conduit	Y										Y		
Lighting Transformer (IS-11171)	Y									Y	Y		
Epoxy & Galvanised Conduit (IS- 9537, 2629, 2633, 4759, 6745)	Y										Y		Υ



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)



## LED Luminaire quality requirements:

- 1) LED modules to conform to IS: 16103 part 2. Manufacturer to issue a certificate of compliance for the same.
- 2) Control gear to conform to IS 15885 part 2 section 13. Manufacturer to issue a certificate of compliance for the same.
- 3) LED luminaire to conform to IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same.
- 4) LED luminaire marking to be as per IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same.
- 5) Acceptance tests as per IS 16107 part 2 section 1 to be carried out on LED luminaire except long duration tests i.e. a) Chromaticity coordinates & correlated color temperature (CCT); b) Color rendering index (CRI). Manufacturer will submit a COC for above tests i.e. CCT & CRI
- 6) LED driver make, model, type & rating may be as per recommendations of LED module manufacturer.

Notes:

- 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
- 2. Make of all major Bought out Items will be subject to OWNWER approval.



MAITHON HYDEL STATION







## MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



		LE	AD AC	ID BATTERY	(						
ATTRIBUTES / CHARACTERISTICS ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY	Dimensions & Finish	Conformance to relevant part drg. & Manufacturer's standards	Chemical composition	Lead Coating Thickness (min. 25 microns, IS 6848 App.F) & Adhesion	Conformance to CPWD Spec. for Teak	Paint Process checks, Paint Shade, Thickness, Adhesion & Finish	Constructional requirements as per IS	Insulation Resistance	Marking (Routine & Acceptance Tes)	Checking of Polarity & absence of short circuit (Routine & Acceptance Tect)	Test for Capacities for 10 hrs. discharge rate along with the test for voltage during discharge (Acceptance)
Container & Lids (IS:1146)	Y	Y									
Vent Plugs	Y	Y									
Sealing Compound (IS:3116)		Y	Y								
Positive & Negative Plates		Y	Y								
Separators (IS : 6071)	Y	Y									
Electrolyte (Water / Sulphuric Acid) (IS:1069/266)		Y	Y								
Inter-cell Connectors & Fasteners	Y	Y		Y							
Battery Stand	Y	Y			Y	Y					
Cell Insulators	Y	Y					Y				
Stack Assembly	Y	Y									
Lead Acid Battery (IS : 1652)	Y							Y	Y	Y	Y
									•	•	

#### Notes:

1)This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedures along with relevant supporting documents.

2) Make of all major bought out items will be subject to DVC approval.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

				Ν	li- Cd E	BATTERY	,							
ATTRIBUTES /														
CHAR ACTERISTICS	nsions & Finish	st Strength	ormance to relevant part & Manufacturer's standards	tance to Alkali	nical Composition	I Plating thickness	Shade, Thickness, sion & Finish	essure Test after heat Ig	ng & Mass (Routine & otance Test)	essure Test (Acceptance	ntion of Charge Test ptance Test	est (Acceptance Test)	ation Resistance eptance Test)	ity & absence of short t (Routine & Acceptance
ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY	Dimei	Impad	Confo drg. 8	Resis	Chem	Nicke	Paint Adhe	Air Pr sealin	Marki Accep	Air Pr Test)	Reter (Acce	AH Te	Insula (Acce	Polari circuit Test)
Container & Lids	Υ	Y	Y	Y										
Vent Plugs	Y		Y	Y										
Perforated Steel Strips	Y		Y	Y	Y									
Active Material for Positive & Negative Plates			Y		Y									
Separators	Y	Y	Y											
Electrolyte		Y	Y											
Inter-cell Connectors & Fasteners	Y	Y	Y	Y										
Battery Stand	Y		Y			Y								
Cell Insulators	Y	Y	Y											
Stack Assembly	Y	Y					Y	Y					Y	Y
Ni-Cd Battery (IS : 10918)								Y	Y	Y	Y	Y	Y	Y
Notes: 1)This is an indicative list of tests/checks. The	ne m	anufa	cturer is	s to furr	nish a	detaileo	l qualitv	plan in	dicating	the prac	ctice and p	procedure	s along w	vith
relevant supporting documents.							1	1		,				

2) Make of all major bought out items will be subject to DVC approval.



MAITHON HYDEL STATION







## MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



1			CH	ARGER							
ATTRIBUTES /							pu				
CHARACTERISTICS	1ake, Model, Type, Rating and Finish	chemical and Mechanical tests	sheet steel pretreatment and painting	conforming to relevant standard nickness.	complete physical examination or constructional	emperature Rise test Jynamic response test	<pre>tipple content test, load limiter a nnunciator and AVR operation test</pre>	perational and functional checks	IV & IR Test	turn In Test at 50 deg C for 48 hours	begree of protection test.
Rectifier transformer (IS:2026)	Y	0	0)	Y ≠		Y Y	<u>r a</u>	0	Y	ш	
Electronic components including potentiometer (venire type)	Y			Y							
PCB and electronic cards	Y			Y							
19"standard racks for electronic card	Y				Y						
Control and selector switches (IS:6875)	Y			Y				Y			
Indicating meters (IS:1248)	Y			Y				Y			
Indicating lamps (IS:13947)	Y			Y				Y			
Air break switches/ Fuses(IS:13947/13703)	Y			Y				Y			
Control terminal blocks (IS:13947)	Y			Y							



## MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

#### (MECHANICAL & CIVIL)



Control transformer (IS:12021)	Y			Y							Y			
Push buttons (IS:4794)	Y			Y							Y			
MCB ( IS:8828)	Y			Y							Y			
PVC insulated copper control wires (IS:694)	У			Y										
Sheet steel ( IS:513 )	Y	Y	Y	Y										
Synthetic rubber gaskets	Y	Y		Y										
Annunciator	Y										Y		Y	
Battery charger	Y					Y	Y	Y	Y	Y		Y	Y	Y
Notes: 1)This is an indicative list of tests/checks. T	he manufac	turer	is to fu	urnish a	a deta	ailed	quality pla	an indica	ting th	e practi	ce and p	rocedure	s along w	ith

relevant supporting documents.

2) Make of all major bought out items will be subject to DVC approval.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1&3 (MECHANICAL & CIVIL)





हाम	A	DA	MODAR		EY CO	ORPC	RAT	ION (E	OVC)			(					
			М	AITHON	HYDE	EL ST		N			(	12					
	В	ECHNI	CAL SPE	ECIFICA	TION	FOR I	R&M (	OF UN	IT # 1 &	3	K	मेकॉन	$\rightarrow$				
	<u>8//</u>			(MECHA	NICA	L & C	IVIL)				2	0 9001 Co	mparts				
					RΔN	SEOF		)									
			0011					<u> </u>									
Attributes/ Characteristics Item/Components/ Sub System/Assembly	Visual & Dimensional checks	Mechanical Properties	Electrical Strength	Thermal Properties	Chemical Composition	Compatibility with oil		NDT / DPT / MPI / UT	Ageing i est Voltage Ratio, Vector Group & Polarity, Magnetic Balance	ke/Type/Rating/Model/TC/General	Physical	Functional Check	WPS & PQR	Routine Test as per relevant standard	Vacuum & Pressure Test	Magnetic balance test, Oil BDV, jacking test (DP test)	Leakage test on completely assembled transformer
Tank, H.V, & L.V. Cable Box / Flange throat	Y	Y					Y			Ма					Y		
Conservator / Radiator / Cooler / Pipes	Y	Y					Y										
Copper Conductor (IS:191)	Y	Y	Υ		Y												
Insulating Material	Y	Y	Y	Y	Y	Y											
CRGO Lamination & Built Core	Y	Y	Y		Y	Y											
Bushing / Insulator (IS:2544 / 5621)	Y	Y											Y	Y			
Bushing CT (IEC 185)													Y	Y			
Gasket	Y						Y	Y		Y							
Transformer Oil (IS : 335)														Y			
Off-Circuit Tap Changer	Y												Y				

	राषानि	DA	MODAR VAL	LEY CO	RPORAT	ION (D\	/C)		_	]			
	Т	ECHNI	MAITHC CAL SPECIFIC										
Ľ			(MECI	HANICAL	. & CIVIL)								
Core Coil Assembly & Pre-tanking	Y						Y						
Marshalling Box	Y	Y					Y	Y					
WTI, OTI, MOG, PRD, Breather, Termina Connector, Bucholz Relay Globe & Gate Valve	al Y							Y	Y				
Welding (ASME Sect-IX)	Y								Y				
Complete Transformer	Y									Υ	Y	Y	Y
Notes: 1)This is an indicative list of tests/che supporting documents. 2) Make of all major bought out items	ecks. The man	ufacture t to DV(	er is to furnish a C approval.	a detailed	quality pl	an indica	ting the p	ractice an	d proc	edure	es alon	g with re	levant



## MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



QA DASH BOARD		
SWITCHYARD		
Attributes/ Characteristics Item/Components/ Sub System/Assembly	Make ,Type, Rating & Model & TC	Routine & Acceptance Test as per Relevant IS/IEC
Circuit Breaker (IEC:62271-100)	Y	Y
Hollow insulator (IEC:233/ IS:5621)	Y	Y
Isolator (IEC:62271-102)	Y	Y
Current Transformer (IEC:60044/IS2705/ IEC: 61869)	Y	Y
Voltage Transformer (IEC:186A /358/IS3156/IEC60044/ IEC:61869)	Y	Y
Bus Post Insulator (IEC:168 / 815 / IS:2544)	Y	Y
Disc, Pin & String Insulator (IEC:383 /IS:731)	Y	Y
Surge Arrestor (IEC:99-4/IS:3070)	Y	Y
Hardware fittings for Insulator (IS:2486)	Y	Y
Clamps & Connector (IS:10162 / 5561/ 617)	Y	Y
Aluminium Tube (IS:5082 / 2673 / 2678)	Y	Y
Conductor (IS:398)	Y	Y
Galvanised Steel Structures(IS:2062/2629/4759/6745)	Y	Y
Vibration Damper (IS:9708)	Y	Y
Protection Relays	Y	Y
Event Logger	Y	Y
Time Synchronising Equipment	Y	Y
Notes:	L.	

supporting documents.

2) Make of all major bought out items will be subject to DVC approval.

MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)

## **QA CONTROL AND INSTRUMENTATION**



DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



# MEASURING INSTRUMENTS (PRIMARY & SECONDARY)



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



MEASURING INSTRUMENTS (PRIMARY AND SE	CON	DARY)I	Page-1	/2					
TESTS	Dimensions(R)	/lake, Model, Type, Rating(R)	Process/Electrical connection(R)	2alibration(R)	est as per standard(R)	nsulation Resistance(R)	BR Certification(if applicable)(R)	łydro Test(R)	/aterial Test ertificate®
1. PR Gauge(IS-3624)	Y	Ý	Ŷ	Y	Ý	_	-		
2.Temp.Gauge(BS-5235)	Υ	Υ	Υ	Υ	Y				
3. Pr./D.P. Switch (BS-6134)	Υ	Υ	Y	Υ	Υ	Υ			
4. Electronic Transmitter(IEC-60770)	Υ	Y	Y	Υ	Y	Y			
5.Temp.Switch	Y	Y	Y	Υ	Y	Y			
6. Recorder(IS-9319/ANSI C-39.4)	Υ	Y	Y	Υ	Y	Υ			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Υ		Y			
9. Integrators	Y	Y	Y	Υ					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11.Transducer(IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples(IEC-754 /ANSI-MC-	Υ	Υ	Υ	Y	Υ	Υ			
13. RTD(IEC-751)	Υ	Y	Y	Υ	Y	Υ			
14.Thermowell	Y		Y				Y	Y	Y
R-Routine Test A-Acceptance Test	I	Y–T€	est ap	plic	able			I	
<b>Note:</b> 1)This is an indicative list of tests/ chec quality plan indicating the Practices and Proc	ks. T edur	he ma e ado	anufac pted a	ture llong	r is to ⊨with	furnis releva	h a d nt su	etaile oport	ed ing

documents.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



MEASURING INSTRUMENTS (PRIM	IARY		SECO	NDA	RY)		Pag	e- 2/2	1			
TESTS	Dimensions(R)	Make, Model, Type, Rating(R)	Process/Electrical connection(R)	Calibration(R)	Requirement as per standard(R)	WPS approval(A)	Non-destructive testing(R)	Calculation for accuracy(R)	Insulation Resistance(R)	IBR Certification as applicable (R)	Hydro test(R)	Material test certificate (A)
15.Cold junction compensation	Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)	Y	Y	Y	Y *	Y	Y **	Y **			Y	Y **	Y
17.Flownozzle(BS-1042)	Y	Y	Y	Y *	Y	Y	Y			Y	Y	Y
18. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/ float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20.Analysers	Υ	Y	Y	Υ								
21. Dustemissionmonitors	Y	Y	Υ	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall Not be repeated.												
** If applicable												
					-							



DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



# **INSTRUMENTATION CABLES**


## MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

TESTS	Conductor Resistance®&(A)	High Voltage®&(A)	Insulation Resistance@&(A)	Constructional detail, dimensions(A)	Outer-Sheathe/ core marking, end sealing(A)	Thermal Stability(A)+	Visual, Surface finish(A) +	Electrical Parameters** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity(A)	Swidesh chimney Test (SS-4241475) (A)++	FRLS Test * (A) ++	Tensile & Elongation before & after aging(A)++	Vol.Resistivity.at room & Elevated Temp. (A)++	Spark test report review ®
1. Instrument cable twisted and shielded															
Conductor(IS-8130) Insulation(VDE-207)	Y			Y Y	Y	Y	Y Y						Y		Y
Pairing/Twisting				Y	Y		Y			V					
	V			۱ ۷			۱ V		V	۱ V					
Inner Sheath				Y	Y	Y	Y		1	•		Y	Y		
Outer Sheath				Ŷ	Ŷ	Ŷ	Ŷ					Ŷ	Ŷ		
Overall cable	Y	Y	Y	Ý	Ý	-	Ý	Y			Y	1	-	Y	
Cable Drums(IS-10418)				Y			Y								
Cable Drums(IS-10418)       Y       Y       Y         Note: High Temp cablesshallbe subjected totests as per VDE-207 (Part-6) Compensating cables shall be checked for Thermal EMF / Endurance test as per IS 8784.       Note: This is an indicative list of tests/ checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.         Note: ®-Routine Test A – Acceptance Test       Y - Test Applicable         Note: Sampling Plan for Acceptance test shall be as per IS 8784(As applicable)       * FRLS Tests: Oxygen/Temp Index(ASTMD-2863), Smoke Density Rating(ASTM–D2843), HCL Emission (IEC-754-1)         ** CharacteristicImpedance,Attenuation,MutualCapacitance,CrossTalk( As applicable)       ** CharacteristicImpedance,Attenuation,MutualCapacitance,CrossTalk( As applicable)															





# **POWER SUPPLY SYSTEM**



## MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



POWER SUPPLY FOR C&I	SY	STE	EMS	6 (U	PS/	BA	TTE	RY/	/ BA		ERY	′ C⊦	IAR	GE	R)		
TESTS	Visual/dimension/rating/Paint Adhesi on/Thickness(R)	General arrangement/BOM/make of components/Mimic $\circledast$	Efficiency, regulation(R)	nput voltage variation(A)	Output voltage and	Preliminary light load test(R)	_oad transfer retransfer test (R) *	AC input failure and return test (R)	Parallel operation and current division (R)	Relative harmonic content(R)	Restart with PRIA.C and battery (separately)(R)	System transfer and retransfer (R)*	Asynchronous transfer(R)	Ripple content(R)	Load limiter operation(R)	R/HV(R)	Tests as per standard & specification(R)&(A)
UPS/CONVERTER(IEC-146 PT-									V								
4)		•		•	•	'	•	•	•	•	•	•	•		•	•	
VOLTAGESTABILISER	Y	Y	Y	Y	Y					Y		Y				Y	
LEAD ACID BATTERY (TUBLAR)-IS-1651																	Y
LEADACIDBATTERY(PLANTE)- IS-1652																	Y
NICKEL CADMIUMBATTERY (IS-10918/IEC-623)																	Y
SMF BATTERY																	Y
ACDB/DCDB	Υ	Υ														Υ	Y
BATTERYCHARGER	Y	Y	Y	Y	Y				Y					Y	Y	Y	Y
R-Routine Test	A- /	٩cc	epta	ance	e Te	st					Y	-Te	st a	ppli	cab	le	
*Transfer time and Overshoot/u Note:1)This is an indicative list of te Quality plan indicating the Practices Supporting documents.	unde ests/c anc	rsho cheo I Pro	oot di ks. 1 ocedi	uring The r ure a	loac nanu dopt	d & s ifacti ed a	yster urer i long	n tra s to with	insfe furni: relev	r sha sh a /ant	all be deta	reco iled	ordeo	d.			





# CONTROL VALVE ACTUATORS AND ACCESSORIES



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



CONTROL VALVE ACTUATORS AND ACCESSORIES														
TESTS	MAKE,MODEL, TAG (R)	DIMENSION®	SURFACE FINISH®	HEAT TREATMENT®	MATERIAL TEST CERTIFICATES ®	BR CERTIFICATES®	HYDRAULIC TEST®	UT/RADIOGRAPHY FOR >900 LB RATING ®	WPI/DP ®	PRESSURE RESISTANCE ®	SEAT LEAKAGE ®	TIMING OPEN/CLOSE ®	LINEARITY/HYSTERISIS ®	FUNCTIONAL TEST, REVIEW FOR MAKE AND TC OF ACCESSORIES®
Control Valve and Actuator														
Overall	Y	Y	Y			Y	Y	ł – –	ł – –		Y	Y	Y	Y
Body		Y	Y	Y	Y			Y	Y	Y				
Bonnet		Υ	Y	Υ	Y									
Trim		Y			Y			Y*						
Pneumatic Actuator	Y	Y								Y				
Electro Pneumatic Positioner	Y													Y
R-Routine Test		A-/	Acce	otanc	e Te	st			Y-Te	st Ap	plica	ble		•
Y*- UT on spindle	K-Routine rest     Y-rest Applicable       Y*-     UT on spindle dia>=40 mm.													
Quality plan indicating Supporting documents	cative 1 the s.	e list Prac	or te: tices	and	Proce	s. The edure	e ma e ado	pted	alon	g with	rurn rele	isn a vant	deta	lliea





# ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



ELECTRICAL ACTUATOR WITH IN	TE	GF	RA	LS'	ΤA	RT	Ē	२					
Test/Attributes Characteristics	RPM®	No Load Current ®	IR & HV Test ®	Mounting Dimension ®	All routine Test as per Standard & Specification ®	Correct Phase Sequence ®	Operation & Setting of limit Switch/Torque Switch ®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator	EPT output ®	Grease leakage ®	Local/ Remote ( Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICALACTUATOR WITHINTEGRALSTARTER (IS_9334)													
Motor Final Testing	Y	Ϋ́Υ	Υ	Υ Υ	Y	Y		Y		Y	V		Y
Final Testing       Y       <													





# **PROCESS CONNECTION AND PIPING**



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

PROCESS CONNECTION AND PIPING																	
TESTS	Visual ®	GA, BOM, Layout of Component & Construction teature ®	Dimension ®	Paint Shade / Thickness®	Flattening, flaring, hydro test, hardness check, as per ASTM standard (A)	Component Rating ®	Wiring ®	Vake, Model, Type, Rating ®	R & HV ®	Review of TC for Instrument/devices®	Accessibility of TBs/Devices®	llumination, grounding ®	Tubing ®	Leak/Hydro Test (A)	Chemical/Physical properties of material (A)	Proof pressure test, Dismantling & reassembly test, Hydraulic impulse & Vibration test ®	Tests as per standards & specification
Local Instrument enclosure	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Υ	Y	Y	Y*		Y		Y	Y								
Gauge Board	Υ	Υ	Y	Y		Y		Y		Y			Y	Υ			
Impulse pipes and tubes	Y		Y		Y			Y							Y		
Socket weld fittings ANSI B-16.11	Y		Y					Y							Y		Y
Compression fittings	Y		Y					Y						Y	Y	Y	
Instrument valves & Valve manifolds	Y		Y					Y						Y	Y		
Copper tubing ASTM B75	Y							Y									Y
*-applicable for p R – Routine Test <b>Note:</b> This is an indicating the Pra	ainte t indic actice	ed jund ative l es and	ction list of d Proo	boxe A tests cedu	s. – Acce /chec re ado	eptar ks. T pted	nce Te he ma along	est anufa I with	cture relev	Y r is to ant s	′ – Te furni: uppor	st ap sh a c ting c	plicat detaile docun	ole ed qu nents	ality	plan	





# PLC BASED CONTROL AND INSTRUMENTATION SYSTEM



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

	PR	OGR	AM	MABLE	ELOO	SICC	ON	TRI	LER						
TESTS		omponents®				ke/Type®			corders,	evices®		ontrol Element,			
ITEMS	Visual®	GA, BOM, Lay Out of co	Dimensions®	Paint Shade/ Thickness/Adhesi	Alignment of Section®	Component Rating/Mal	Wiring®	IR&HV®	Review of TC for instruments/Devices/Re	Accessibility of TBS/De	Illumination®	Functional Check for Co Annunciation®	Mimic®	TestasperIEC1131®*	Test as p r Std®&(A)
1.PLCPanel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y
2.ControlDeskWithPL C	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Note:1) Detailed proced Assurance Prog	lure ramı	of Bu me in	irn-ir Gei	n and E neral T	leva echr	ted T lical	Γem Con	pera ditic	ature te ons.	st sl	hall k	be as p	ber C	Qualit	ÿ
<ol> <li>This is an indicative I quality plan indicating the documents.</li> </ol>	<ul> <li>2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure along with relevant supporting documents.</li> </ul>														
*Applicable for PLC			Y-	Test A	oplica	able,	®-R	louti	ne Tes	t (A	.)- A	ccepta	nce	Test	





# **OPTICAL FIBER CABLE**



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

#### OPTICAL FIBER CABLE

QUALITY ASSURANCE FOR 4/8/12 COR SINGLE MODE FIBER OPTIC CABLE	RE, CORRUGATED STEEI	L TAPED ARMORED
Fiber Property (IS 13882 (Part 1) : 1993,	IEC-793-1: 1992, DVC ap	proved Spec/
Datasheet)		
Attenuation ®	Y	Internal Test
Relative Index Profile ®	Y	Certificate shall be
Point defects ®	Y	provided for review
Optical Continuity ®	Y	
Chromatic dispersion ®	Y	
Change of optical transmittance during	Y	
mechanical and environmental tests ®		
Micro bending sensitivity ®	Y	
Fibre cut-off wavelength ®	Y	
Mode field diameter ®	Y	
Concentricity of Mode field diameter	Y	
For Finished Cables : (IS 13882 (Part 1)	: 1993, IEC-793-1: 1992, I	DVC approved Spec/
Datasheet)		
Visual (A)	Y	Acceptance Test
(Cable lay-up & Fibre identification,		Report shall be
Cable surface finish, Winding, Ends		provided.
availability, Cable Length measurement,		
Fibre colour		
performance test, Colour of outer jacket,		
Identification and		
length marking on outer jacket, Colour		
contrast of the marking with the outer		
sheath, Attenuation & Continuity)		
Dimensional (A)	Y	
(Overall dimension of the cable,		
Diameter of cladding, Diameter of		
electrical conductor, Thickness of		
insulation, Thickness of		
sheath)		
Test for corrugated steel tape armour	Y	
(A)		
(Thickness of layers, Extent of		
overlapping, Electrical continuity of		
metallic layers)		



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

## OPTICAL FIBER CABLE

QUALITY ASSURANCE FOR 4/8/12 CO SINGLE MODE FIBER OPTIC CABLE	RE, CORRUGATED	STEEL TAPED ARMORED
For Finished Cables : (IS 13882 (Part 1)	: 1993, IEC-793-1:	1992, DVC approved Spec/
Datasheet)		
<b>Mechanical Tests (A)</b> (Tensile, Crush, Impact, Repeated bending, Torsion, Flexing, Snatch, Kink, Bend)	Y	Acceptance Test Report shall be provided.
<b>Electrical Tests (A)</b> (Conductor resistance, Dielectric strength of Insulation, Insulation resistance)	Y	
Fire conditions (A)	Y	
Environmental characteristics ® (Temperature cycling, Sheath integrity, Water penetration, Cable Ageing)	Y	Internal Test Certificate shall be provided for review.
<b>Note:</b> ® - Routine Test, (A) – Acceptance 1) Internal Test Certificate covering the pa datasheet to be submitted before Final Ins 2) This is an indicative list of tests/checks Plan indicating the Practices and Procedu document.	Test, Y - Test Appl arameters mentione spection. The manufacturer adopted along w	icable. d in the NIT /DVC approved is to furnish a detailed quality ith relevant supporting





# Turbo Supervisory & Vibration Monitoring System



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

TURBO SUPERVISORY &	VIBRA	TION	MONI	ORIN	g sys	TEM					
Attributes/ Characteristics Item/Components/ Sub System/Assembly	Linearity ®	Frequency Response ®	Calibration with simulated output ®	Spectrum (Harmonic) Analysis (A)	Predictive Analysis Functions (A)	Storage & Comparative analysis of vibration (A)	<ul> <li>Storage &amp; Comparative analysis of vibration (A)</li> <li>Generation/analysis of plots (A)</li> </ul>				
VIBRATION MONITORING SYSTEM											
Proximeter	Y	Y									
Accelerometer	Y	Y									
Velometer	Υ	Y									
LVDT	Y										
Monitor	Y		Y*								
Overall system				Y	Y	Y	Y	Y			
Special Cable	Test	Certific	ate to	be pro	duced	for revi	ew				
Special Cable       Test Certificate to be produced for review         *-applicable for monitor electronics.       R – Routine Test       A – Acceptance Test       Y – Test applicable         Note:       1)       Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions       2)         This is an indicative list of tests/checks. The manufacturer is to furnish a detailed											

quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.





# **Solenoid Valves & Accessories**



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(MECHANICAL & CIVIL)

	SO	LEN	DID V	/ALV	EAN	d ac	CES	SORI	ES				
Attributes/ Characteristics	Make. Model, Type, rating ®	Dimension ®	Body Leak test at STP with air with coil energized (A)	Seat leak test ®	Material Test Certificates ®	High Voltage (HV) test for coil (A)	Insulation Resistance (IR) test for coil (A)	Pick up voltage test for coil at maximum pressure (A)	Dropout voltage test for coil at maximum pressure (A)	Coil Resistance ®	Temperature rise - hot & cold power rating (A)	Operation test at maximum & minimum operational pressure with air as fluid at +10% and -15% of the rated voltage (A)	Degree of enclosure Protection
Solenoid Valve (IS 8935)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Note:													
* Accessories to be sup	plied	as pe	er NI⊺	Γ/DV(	C app	prove	d data	ashee	et.				

R – Routine Test A – Acceptance Test Y – Test applicable

1) Internal Test Certificate covering the parameters mentioned in the NIT /DVC approved datasheet to be submitted before Final Inspection.

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.





# PNEUMATIC ACTUATOR & POWER CYLINDER



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)





R – Routine Test, A – Acceptance Test, Y – Test applicable

1) This is an indicative list of Tests/Checks. The Manufacturer is to furnish a detailed Quality Plan indicating his practice & procedure along with relevant supporting documents during QP finalisation for all items.

2) Ingress Protection TC for the Enclosures not more than Five years old from CPRI or NABL accredited lab.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)



# INDICATIVE FIELD QUALITY PLAN

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SI. No.	Component Description	Characteristic Check	Type of Check	Class of Check	Quantum of Check	Reference Document	Acceptance Norm	Format o	of Record	Remarks
i	ii	iii	iv	v	vi	vii	viii	ix	*D	x
1.00	QA & QC SET UP	· · ·								
1.01	Setting QA & QC Field Laboratory	Routine Test for construction materials, as aggregates, bricks, cement, mortar, casting cubes etc.	Physical	A	As required	DVC Speci	fication	Valid Calibration Certificate		All machineries to be calibrated on regular basis. Proper functioning verified each month.
1.02		Sampling for testing of materials	Physical	В	Once prior to fixing of source and as per sampling plan	DVC Speci	fication	SR		
1.03		Submission of weekly/monthly Testing schedule	Physical	с	As agreed	DVC Specification		SR		
1.04		Submission of Test Reports and maintain the same in digital platform giving accessibility to owner	Physical	с	As agreed	DVC Speci	fication	TR		
2.00	SURVEY WORK									
2.01	Initial Survey	Elevation, Chainage, Type of Soil,Details of landmarks, drainage	Measurement	с	100%	DVC Speci	fication	Survey Record		
2.02		Permanent Bench Mark	Physical	С	As required	DVC Speci	fication			





2.03		FGL, Drainage, Road Area, Water Supply line, Fire Water Line, underground sewerage line, sewerage treatment etc	Physical	C As requi		Marking in as b and submission hard copy as we	uilt drawing to owner in ell soft copy	Record	V	
3.00	EARTHWORK									
3.01	Setting Out	Excavation Line, Refernce to Bench Mark, Safe side slope, Depth of Foundation, Recording pre & post level	Measurement/ Verification	С	100%	DVC Spec/ Cor Drawi	nstruction ng	Site Record/ Level Book		
3.02	Excavation	Excavation, shoring, strutting, sheet pile, slope of excavation	Visual/ Verification	С	100%	IS 3764/ DVC Spec		-Do-		
3.03	Blasting	Specialised blasting agencies, safe storing of fuse and detonators, blast hole, safe guard existing structures	Verification	В	100%	IS:4081, DVC Explosive Ac amended up t Explosive Ru	Tech spec, t 1884as o date and ule 1993	SR		
3.04	Back Filling	Type of soil, Dry pit before filling, filling in layers	Verification	В	100%	-Do	-	SR		
3.05	Compaction Test	Core Cutter/ Sand Replacement	Measurement	В	One Test per 500Sqm/ Each Layer fill	IS:2720	DVC Spec	Test Report		





4.00	EARTH WORK IN EMBANI	KMENT/ FILLING WORKS:	BORROW MATERIAL						
4.01	Embankment construction/ Filling Soil	Source approval shall be given by DVC on proposal from the contractor and necessary verification of test results meeting DVC's Technical specification	Measurement	В	Per Change of Source	DVC Spec	Test Record	V	
4.02	Good Earth Sample	Gradation/Particle Size Distribution	Measurement	В	2 Test per 5000cum	IS:2720 (P-1), IS:2720 (P-4), IS:1498, IRC:36	DVC Spec/Soil classified as per PRA classification or IS:1498	Test Record	$\checkmark$
4.03	drawn from Borrow Pit	Liquid Limit	Measurement	В	2 Test per 5000cum	IS:2720 (P-1), IS:2720 (P-5)		-Do-	$\checkmark$
4.04		Plastic Limit	Measurement	В	2 Test per 5000cum			-Do-	$\checkmark$
4.05		Deterination of Standard Proctors Density & Optimum Moisture content	Measurement	В	2 Test per 5000cum	IS: 2720(P-1), IS:2720 (P-7), IRC:36	DVC Spec	-Do-	$\checkmark$
4.06		Moisture Content - Before Rolling/Compaction	Measurement	В	One Test per 250cum	IS:2720 (P-1), IS:2720(P-2)	DVC Spec	-Do-	$\checkmark$
4.07	Compaction Test	Core Cutter/ Sand Replacement	Measurement	В	One Test per 500sqm/ Each Layer fill	IS:2720	DVC Spec	-Do-	$\checkmark$





5.00	RAW MATERIAL FOR CON	ISTRUCTION								
5.01	BRICKS FOR MASONRY	Size & Dimension	Measurement/ Viusal	В	IS 5454	IS 1077	DVC SPEC	Test Report		
5.02	WORK	Compressive Strength	Measurement	В	-Do-	-Do-	-Do-	-Do-		
5.03		Water Absorption	-Do-	В	-Do-	-Do-	-Do-	-Do-		
5.04	-	Efflorescence	-Do-	В	-Do-	-Do-	-Do-	-Do-		
5.05	FINE AGGREGATE	Gradation/Particle Size Distribution & FM	Measurement	В	One Test per 100cum	IS 2386 Part1	IS 383/ DVC Spec	Test Report	$\checkmark$	
5.06		Total percentage of all deletrious materials	Measurement	В	-Do-	IS 2386	IS 383/ DVC Spec	-Do-		
5.07		Moisture Content	Measurement	В	Once in three month	IS 2386 Part3	IS 383, IS 456/ DVC Spec	-Do-		
5.08	COARSE AGGREGATE	Gradation	Measurement	В	One Test per 100cum	IS 2386 Part1	IS 383/ DVC Spec	Test Report	$\checkmark$	
5.09		Deletrious materials	Measurement	В	Once in three month	IS 2386 Part2	-Do-	-Do-		
5.1		Combined Flakiness & Elongation Index	Measurement	В	One Test per 100cum	IS 2386 Part1	-Do-	-Do-		
5.11		Aggregate Crushing Value	Measurement	В	One per change of source	IS 2386 Part4	-Do-	-Do-	$\checkmark$	
5.12		Aggregate Impact Value	Measurement	В	-Do-	-Do-	-Do-	-Do-	$\checkmark$	
5.13		Aggregate Abrasion Value	Measurement	В	-Do-	-Do-	-Do-	-Do-		
5.14		Soundness Test	Measurement	В	-Do-	IS 2386 Part5	-Do-	-Do-		





5.15	Water	Cleanliness	Visual Check	С	100%	IS 456/ DVC Spec			
5.16		Suspended Matter	Measurement	В	Once each change of source	IS 3025 Part17	IS 456/ DVC Spec	Test Report	
5.17		pH Value	Measurement	В	Bi annually	IS 456	-Do-	$\checkmark$	
5.18	Cement	Approved manufacturer, Grade of Cement, manufacturing week	Verification/ Measurement	В	100%	IS 4031	Relevant IS/ DVC Spec	Co-related MTC	 If cement is stored for more than three months, it shall be re-tested for compressive strength & setting time
5.19		Compressive Strength for 3, 7 & 28 Days	Measurement	В	Each Lot of supply	IS 4031 Part6/	DVC Spec	Test Report	
5.20		Setting Time	Measurement	В	-Do-	IS 4031 Part5/	DVC Spec	-Do-	
5.21	Reinforcement	Approved manufacturer, Grade of Steel	Verification/ Measurement	В	100%	IS 1786/IS 432,	/ DVC Spec	Co-related MTC	 If co-related MTC is not available, steel may be tested for Physical & Chemical testing as per relevant IS
6.00	FORM WORK								 
6.01	Selection, Design of Form Work	Types of formwork, supports, bracings, ties	Visual/ Verification	С	100%	IS4990/IS:1468 7	IS:14687, Approved Drawing, DVC Tech. Spec		
6.02		Scaffolding	Visual/ verification	С	100%	IS:4014	IS:4014/ DVC Spec		
6.03		Shape, orientation, Dimension, Diagonal.	Visual/	C	100%	Construction	DVC Spec/		





6.04		Stripping Time	Measurement	В	100%	DVC Spec/	′ IS 456			
6.05	Working Point	marking Elevation, Co-Ordinate	Verification	С	100%	DVC Spec				
7.00	REINFORCEMENT WORK	(								
7.01	Reinforcement Details	Bar Bending Schedule	Measurement/ Verification	В	100%	Approved Drawing/IS:250 2, IS:13920	Approved Dwg/ DVC Tech spec	BBS		
7.02		Nominal Cover	Visual/ Measurement	В	100%	IS:456/ Approved dwg/DVC Technical spec	Pour Card			
7.03	Assembly of Reinforcement	Reinforcement placing, size of bar, length, spacing, number of bars, Laps, bends, development length, proper binding	Measurement/ Verification	В	100%	Approved BBS/ DVC Drawing/ DVC Spec	Pour Card			
8.00				cc	DNCRETING WO	RK				
8.01	Preparation/ Selection of Mix	Design Mix Concrete	Measurement	В	Each Design Mix	IS 10262/ IS 456/ DVC Spec/DVC Drawing	Design Mix & TrialMix Report		Design Mix to bere- established through Trial Mixand SD to be ascertained	
8.02	Admixture for Concrete	Accelerating/ Retarding/Water Reducing/Air- Entraining/Superplasti cizing admixture	Verification	В	100%	IS:9103/ IS:1199/ DVC Spec	-Do-		Verified at Trial Mix	
8.03	Workability	Slump Test/ Compaction Factor/VB Test	Measurement	С	Each Batch	IS 456/ IS 1199	IS 456/ DVC Spec	SR		





8.04	Compressive Strength	Cube Test	Measurement	В	IS 456	IS 516	IS 456/ DVC Spec	Test Report	
8.05	Construction Joints	Construction joints/ Cold Joints	Visual	В	100%	IS:456, IS:11817	DVC SPEC/ DRAWING		
8.06	Embedded Parts	Position & Level of embedded part, Verticality, Dimension & C/L in accordance to Dwg	Measurement	В	100%	DVC Spec			
8.07	Placement of Concrete	Avoid Segregation, adequate compaction	Visual/ Verification	С	100%	IS 456/ DVC Spec			
8.08	Curing	Adequate curing	Visual/Verification	В	100%	IS 456/ DVC Spec			
8.09	Post Concrete Observation	Honeycomb/ termination of concrete without special joints	Visual/ Verification	В	100%	IS 456/ DVC Spec			
8.10	Post Casting NDT (In case doubt regarding pour)	Rebound Hammer Test with UPVT	Measurement	A	Suspected member	IS:13311, IS:456, DVC Spec	Test Report		
8.11	Post Concrete Destructive Strength Test (In case of doubt regarding concrete	Core Test	Measurement/ Verification	A	As required subjected to min 3 cores	IS:456, DVC Specification	Test Report		
	poured)	Load Test for Flexural Memebr	Measurement/ Verification	A	Suspected member	IS:456, DVC Specification	Test Report		
1				1					





9.00	WATER RETAINING STRU	CTURE							
9.01	Construction Joint	Joint Filler, Water Bar, Joint Sealing Compound	Visual/ Verification	В	100%	IS:3370, DVC Specification			
9.02	Joint Sealant	Filler, Water Bar, Sealing compound	Verification	В	100%	IS:3414/ DVC Specification	тс		
9.03	Injection/ Pressure Grouting	Selection of Grout	Verification	В	100%	DVC Specificati on	МТС		
9.04		Planning-Material consumption considering water addition/material wastage, equipment needed	Meaurement	В	100%	DVC Specificati on			
9.05		Injection ports	Visual/ Verification	В	100%	IS:6494/ DVC Spec			
9.06	Grouting	Grouting Pressure, Consisitency of Grout, Sealing of Ports	Meaurement/ Verification	В	100%	IS:6494/ DVC Spec			
9.07	Finishing	Removal of Nozzle and sealing of port	Visual/ Verification	В	100%	IS:6494/ DVC Spec			
9.08	Testing & Acceptance of Water Retention		Visual/ Measurement	В	100%	IS:6494/ DVC Spec	TR		





10.00 MASONRY WORK								
10.01 Setting Out	Founding level, Elevation, dimension, angle setting, diagonal check	Measurement	С	100%	IS 1597/ IS 2212/ DVC Spec			
10.02 Scaffolding	Safe scaffolding	Visual	С	100%	IS 3696/ DVC Spec			
10.03 Soaking of Bricks	Soaking of Bricks	Verification	С	100%	IS 2212/ DVC Spec			
10.04 Mortar	Mix Ratio/ homogeneous mix, workable consistency	Verification/ Measurement	В	100%	IS 2250/ DVC Spec			
10.05 Masonry Work	Dimension, Line, level, plumb, wall face, joint line	Visual/ Verification	С	100%	IS 1597/ IS 2212/ DVC Spec			
10.06 Curing	Adequate curing	Visual/ Verification	В	100%	IS 456/ DVC Spec			
11.00 PLASTERING WORK	1				L		L	
11.01 Joint Preparation	Raking of concrete surface, free from dirt/oil	Visual	С	100%	DVC Spec/			
11.02 Sand for Plaster	Gradation, Fineness Modulus, Deleterious material	Measurement/ Visual	В	Once per change of source	IS 1542/ DVC Spec	Test Report		





11.03	Plastering Work	Mixing Ratio, thickness, Evenness, Number of coats	Visual/ Measurement	В	100%	IS2550, IS 1661/ DVC spec				
11.04	Curing	Adequate curing	Visual/ Verification	В	100%	IS 456/ DVC Spec				
12.00	DAMP PROOF COURSE									
12.01	Concrete	Grade of conc., consistency, shuttering, thickness, water proofing compound, Curing	Measurement/Veri fication	В	100%	DVC Spec	SR			
12.02		Application of Bitumen	Measurement/ Verification	В	100%	IS:702, DVC Spec	SR			
13.00	ANTI TERMITE TREATME	NT						<u> </u>		
13.01	Chemical	Anti-Termite Chemical	Verification	В	100%	IS:8944/ IS:632, DVC Specification	TC/SR	$\checkmark$	DVC recommende d manufacture r	
13.02	Site Treatment	Removal of vegetation, Soil Treatment, Foundation/Plinth/ Wall Treatment	Visual/ Verification	В	100%	IS:6313, DVC Specification	SR			
13.03		Covering of Treated area by overlaying course immediately after treatment	Visual/ Verification	В	200%	IS:6313, DVC Specification				





14.00 PAINTING WORKS									
14.01 Surface Preparation	Cleaning of surface and mending surface defect, application of Putty, POP	Visual	С	100%	IS:428, IS:2402, DVC Spec				
14.02 Cement Paint	Paint Type, Consistency, Application, number of coats, drying time, Finishing	Verification	В	100%	IS:428, IS:2402, DVC Spec	МТС	$\checkmark$	Paint from Approved Manufactur er	
14.03 Oil based Paint	Paint Type, Consistency, Application, number of coats, drying time, DFT, Finishing	Verification	В	100%	IS:2933, DVC Spec	МТС	$\checkmark$	Paint from Approved Manufact urer	
14.04 Acceptance of Painting	DFT/WFT, Finishing, free from brush mark	Visual	В	100%	DVC Spec				
15.00 FALSE CEILING									
15.01	Check for the Materials - Glass Reinforced Gypsum (GRG), Pre-painted coil coated steel false ceiling system etc.	Physical and MTC Review	В	100%	DVC SPECIFICATION	SR/MTC	V		All supports hangers, accessories shallbe as per Tech. Specifications/ approved manufacturer's
15.02	Acceptance of installation	Physical and MTC Review	В	100%	DVC SPECIFICATION	SR/MTC			recommendations





16.00	ROOF WATER PROOFING								
16.01	Grading	Grading towards RWDC	Physical	С	100%	DVC SPECIFICATION , Const Dwg	SR		
16.02		Water Proofing Treatment	Physical	С	100%	DVC SPECIFICATION , Const Dwg	SR		
16.03	Water Tightness Test	Ponding of water to viusally check seepage under roof	Visual	В	100%	DVC SPECIFICATION , Const Dwg	SR		
17.00	DOORS, WINDOWS, VEN	TILATOR & GRILL							
17.01	Check for the material/ items for all type of timber, flush doors, Particle doors, wire gauge, Aluminum doors, Fire proof doors, windows fittings, Anodized aluminum works, Mortise locks, Automatic operating system etc. received at site	Review of MTC / make or/and Physical checks, tests report ( if MTC is not available)	Review of MTC/ Physical	В	100%	DVC SPECIFICATION & CONSTRUCTIO N DWG	SR		
17.02	Wood work in frames	Check for dimensions,surface finish and rebating etc.	Physical	В	100%	DVC SPECIFICATION & CONSTRUCTIO N DWG	SR		





17.03	Wardrobe shutter and show cases	Check for material as per IS 3087 and 3097 - from Owner approved source	Physical	В	One sample from Each type per Lot of Delivery	Tech Specs and Const. Drawings, IS 3087, IS:3097	SR		
17.04		Acceptance of fixing after completion	Physical	В	100%	Tech Specs and Const. Drawings, IS 3087, IS:3098	SR		
17.05	Pelmets	Check for material as per IS 3087/ 3097 - from Owner approved source	Physical	В	One sample from Each type per Lot of Delivery	Tech Specs and Const. Drawings, IS 3087, IS:3097	SR		
17.06		Acceptance of fixing after completion	Physical	В	100%	Tech Specs and Const. Drawings, IS 3087, IS:3098	SR		
17.07	MS Grills	Check for the material for section and weight from Owner approved source	Physical	В	one sample for each section for each lot of delivery	Tech Specs and Const. Drawings	SR	$\checkmark$	
17.08	Acceptance of fixing of MS Grills	Dimension, Gauge, Proper fixing, Plumb	Physical	В	100%	Tech Specs and Const. Drawings	SR		





17.09	Fitting and fixtures - MS sliding door bolts, tower bolts, pull bolt lock, MS handles, Safety Chains, brass locks, brass latch, hydraulic floor springs & door closers, etc.	Check for fitting items as per relevant IS codes, tech specifications and BOQ- from Owner approved source	Physical and acceptance	В	Five samples for each item for each lot of delivery	Tech Specs and Const. Drawings	SR		
17.10	Fitting and fixtures - Aluminum sliding door bolts, tower bolts, pull bolt locks, handles, door stoppers etc.	Check for fitting items as per relevant IS codes, tech specifications and BOQ- from Owner approved source	Physical and acceptance	В	Five samples for each item for each lot of delivery	Tech Specs and Const.Drawings	SR		
17.11	Acceptance of all type fittings after fixing	Acceptance of fittings after completion	Physical and acceptance	В	Random	Tech Specs and Const.Drawings	SR		
17.12	GENERAL STEEL WORK	Check for Material- Review of MTC/ make / Physical checks, tests ( if MTC is not available)	Review of MTC for each delivery	В	For each batch of delivery	Tech Specs and Const.Drawings	MTC/SR		
17.13	Rolling shutters	Check for surface finish and thickness of plate of rolling shutters of approved make and DFT	Physical	В	Random for each batch of delivery	Tech Specs a Drawir	nd Const. ngs	SR	
17.14		Acceptance of rolling shutters after fixing	Physical and acceptance	В	100%	Tech Specs a Drawir	nd Const. ngs	SR	





17.15	Steel Glazed doors and T-iron frames sections	Check for shape, tolerances, thickness, welding and finishing of sections (Check MTC wherever applicable)	Review of MTC for each delivery	В	Random for each delivery	Tech Specs and Const. Drawings		SR		
17.16		Acceptance of Steel Glazed doors and T- iron frames sections after fixing	Physical and acceptance	В	Random for each installation	Tech Specs and Const. Drawings		SR		
17.17	Pressed steel pressed frames/ doors	Check for shape, tolerances, thickness, welding and finishing (Check MTC wherever applicable)	Review of MTC for each delivery	В	Random for each delivery	Tech Specs and Const. Drawings, IS4351, IS2202		SR		
17.18		Acceptance of Pressed steel pressed doors afterfixing	Physical and acceptance	В	Random for each installation	Tech Specs and Const. Drawings		SR		
17.19	Fencing and Gates									
17.20	Check for Materials for fencing and gates	PVC coated chain link fencing (IS 2720), Welded wire mesh (IS 1566), Reinforced barbed tape galvanized (IS 2629) etc.	Review of MTC	В	Each batch of delivery	Tech Specs and Const. Drawings	MTC/SR	√	Mfr.'s T.C. shallbe correlat ed with the consign ment receive d.	
17.21	Check for alignments, erection painting, DFT etc.		Physical / measurements	В	Each installation	Tech Specs and Const. Drawings	SR			




17.22	Acceptance of the installation and working	Physical / measurements	В	100%	Tech Specs and Const. Drawings	SR		
17.23 Galvanized Chicken Wire Mesh	Check for Gauge and Dimensions from Owner approved Source	Acceptance	В	Random for each delivery	Tech Specs and Const. Drawings	SR		
18.00 FLOOR FINISHES AND ALI	ED WORKS							
18.01 Cement Concrete Flooring	Check for execution of concreting	Physical	В	Random in each shift	Tech Specs and Const. Drawings	SR		
18.02	Check for providing and fixing glass/ PVC strips in joints	Physical	В	Random in each shift	Tech Specs and Const. Drawings	SR		
18.03	Check for laying, polishing, curing, finishing for terrazzo, marble chip flooring	Physical	В	Random in each shift	Tech Specs and Const. Drawings	SR		
18.04	Acceptance of lines, levels and finishing	Acceptance	В	100%	Tech Specs and Const. Drawings	SR		
18.05 Vitrified/ Ceramic Tile Flooring	MTC of Tiles, Dimension, Thickness	Verification	В	100%	IS:15622, Tech Specs andConst. Drawings	MTC/SR	 App roved Manuf acture r	
18.06	Proper fixing, Adhesion to backing, sealing of joints	Visual	В	100%	Tech Specs and Const. Drawings	SR		





18.07	Stone Flooring	Type of Stone- Marble/ Granite/ Kota, size, thickness, crack	Visual/ Verification	В	100%	Tech Specs and Const. Drawings	SR		
18.08		Proper fixing, adhesion to backing, sealing of joints, No Crack	Visual/ Verification	В	100%	IS:1130, Tech Specs and Const. Drawings	SR		
19.00	SANITORY INSTALLATION	IS							
19.01		Check for size and surface finish of all sanitary items and fixtures from Owner approved sources, (Check MTC wherever applicable)	Physical / review of MTC	В	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	MTC/SR	 App roved Manuf acture r	
19.02		Acceptance of installations of all sanitary items and fixtures	Acceptance	В	100%	Tech Specs and Const. Drawings	SR		
19.03	SCI, CI, S&S Pipes & Fittings etc.	Fittings size, dimension, unit weight, hairline crack	Verification	В	Random	IS:1729, Tech Specs andConst. Drawings	SR		
19.04		Proper fixing, joint cocking	Verification	В	Random	Tech Specs and Const. Drawings	SR		
19.05		Hydrostatic test/ Smoke Test	Verification	В	As Required	Tech Specs and Const. Drawings	SR		





20.00	20.00 WATER SUPPLY AND ALL TYPES OF FITTINGS										
20.01		Check for size and surface finish of all water supply, GI/ MS pipes and fittings, Photo Voltaic Control System etc. from Owner approved sources(Check MTC wherever applicable)	Physical / review of MTC	В	One from each type per Lot	IS:1239, DVC Spec, Const Dwg	MTC/SR		App roved Manuf acture r		
20.02		Acceptance of installations of all water supply, GI pipes and fittings	Acceptance	В	100%	IS:2065, DVC Spec, Const Dwg	SR				
20.03	CI, S&S Pipes & Fittings	material, Fittings size, dimension, unit weight, hairline crack	Review of MTC	В	100%	IS:778/DV C Spec	MTC/SR				
20.04		Hydrostatic test	Verification	В	As Required	Tech Specs and Const. Drawings	SR				
20.05											
20.06	Polyethylene Water Storage Tanks	Check for material of tanks from Owner approved sources	Physical / review of MTC	В	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR				
20.07		Acceptance for installation and fitting (IS 12701)	Acceptance	В	100%	Tech Specs and Const. Drawings	SR				





20.08	SW Pipes and RCC Pipes	Check for size and surface finish of Pipes from Owner approved sources	Physical	В	100%	Tech Specs and Const. Drawings, IS458, IS:1536	SR	V	
20.09		Testing of Joints, Proper Caulking	Physical	С	100%	Tech Specs and Const. Drawing	SR		
20.10		Acceptance of installations of Pipes	Acceptance	В	100%	Tech Specs and Const. Drawing	SR		
20.11	CI Pipes, Covers and Frames	Check for CI and SFRC covers and frames as per IS 1726 and IS 12592 from Owner approved sources (Check MTC wherever applicable)	Physical / review of MTC	В	Each Lot	Tech Specs and Const. Drawings, IS 1536, IS 12592	SR		
20.12		Acceptance of installations of CI Pipes, Covers and Frames	Acceptance	В	100%	Tech Specs and Const. Drawing	SR		
20.13	Manhole	Acceptance of RCC/HCI/CI manholes after completion	Acceptance	В	100%	IS:1726/IS:41 11, DVC Spec, Const Dwg	SR		
21.00	PILING WORKS (AS APPLI	CABLE)							
21.01	Boring Operation- Bentonite Slurry	Specific Gravity, Differential Free Swell, pH Value, Liquid Limit, Sand	Measurement	В	One sample from each Lot	Annex-D of IS:2911 (Part1/Sec2),	TR		





	Content, Marsh Cone Viscosity				Specification				
21.02 Pile Centering	Centering of pile at pile location	Measurement	В	Each Pile	IS:2911	DVC Spec, Const Dwg	SR	$\checkmark$	
21.03 Plumb	Verticality check by plumb	Visual/ Measurement	В	Each Pile	IS:2911, DVC Spec	SR			
21.04	Sp. Gravity of Bore water during boring/ drilling	Measurement	В	Each Bore	IS:2911, DVC Spec	SR			
21.05	Sp. Gravity of Bore just before concreting	Measurement	В	Each Bore	IS:2911, DVC Spec	SR			
21.06 Termination Level	Termination level of Pile before concerting	Measurement	В	Each Pile	DVC Spec, Const Dwg	SR			
21.07 Reinforcement	Dia of bar, lap length, spacing etc	Measurement	В	Each Pile	BBS, DVC Spec, Const Dwg	SR			
21.08 Pouring	Workability of concrete	Measurement	В	IS:456	DVC Spec, Const Dwg	TR	$\checkmark$		
21.09	Compressive Strength of cubes	Measurement	В	IS:456	DVC Spec, Const Dwg	TR			





21.10	Pile Load Test	Initial pile load test, Vertical (Compression), Lateral (horizontal) and pullout (tension).	Measurement	A	100% for 3 nos. for each type or as specified in BOQ / Tech. Spec.	IS:2911(P-4), DVC Spec	TR	$\checkmark$		
21.11		Routine pile tests, compression and horizontal	Measurement	A	100% for 0.5% of the total number of piles provided for each type of test/Tech. Spec.	IS:2911(P-4), DVC Spec	TR	V		
21.12		Integrity Tests	Measurement	A	100%	ASTM 14945/ IS:2911(P-4), DVC Spec	TR	$\checkmark$		
22.00	ROAD WORK					<u> </u>		·		
22.01	Embankment for Road	Borrowed Earth for embankment construction	Measurement	В	Per Change of Source	IRC 36, DVC Sp	pecification	TR	$\checkmark$	
22.02		Gradation/Particle Size Distribution	Measurement	В	Two test per 5000 cum	IS:2720 (P-1), IS:2720 (P-4), IS:1498, IRC:36	The soil should be classified as per PRA classificatio n or IS specificatio n (IS:1498).	TR	$\checkmark$	
22.03		Liquid Limit	Measurement	В	Two test per 5000 cum	IS:2720 (P-1), IS:2720 (P-5)	IS specification (IS:1498).	TR	V	t





22.04		Plastic Limit	Measurement	В	Two test per 5000 cum			TR	
22.05		Determination of Standard Proctors Density & Optimum Moisture content	Measurement	В	Two test per 5000 cum	IS: 2720(P-1), IS:2720 (P-7), IRC:36	DVC Specification	TR	
22.06		Moisture Content	Measurement	В	Two test per 5000 cum	IS:2720 (P-1), IS:2720(P-2)		TR	
22.07	Embankment Construction								
22.08	setting out	Centre Line & Reference Pegs, Side Slopes	Measurement	В	100%	DVC Specification, Const Dwg	SR		
22.09	Preliminary Operation	Clearing & compaction of sub- grade,	Measurement	В	One Test per 500Sqm/ Layer fill	DVC Specification	TR		
22.1	Placing of Fill	Placing of Soil in layers, Rolling, Moisture Content during Compaction	Measurement	В	One Test per 500Sqm/ Layer fill	DVC Specification	TR		
22.11	Density of Compaction	MDD	Measurement	В	One Test per 500Sqm/ Layer fill	IRC36, DVC Specification	TR		





22.12	WBM								
22.13	WBM-Coarse Aggregate	Cleanliness, Crushed or broken stone	Visual	В	100%	DVC Spec			
22.14		Grading	Measurement	В	One Test per 100cum	IRC19/ DVC Spec	TR		
22.15		Los Angeles Abrasion value	Measurement	В	One Test per change of source	IRC19/ DVC Spec	TR		
22.16		Aggregate Impact Value	Measurement	В	One Test per change of source	IRC19/ DVC Spec	TR		
22.17		Flakiness Index	Measurement	В	One Test per 100cum	IRC19/ DVC Spec	TR		
22.18	Screenings	Grading	Measurement	В	One Test per 100cum	IRC19/ DVC Spec	TR		
22.19	Binding Materials for WBM	Plasticity Index	Measurement	В	One Test per 100cum	IS:2720 (Part- 5)	DVC Specification	TR	$\checkmark$





22.20	Preparation of Sub- grade/ sub-base	Compacting sub- grade/ sub-base, mending of weak spot	Visual	С	100%	IRC19/ DVC Spec	SR			
22.21		Lateral Confinement of aggregate	Visual	С	100%	IRC19/ DVC Spec	SR			
22.22	Spreading of Coarse aggregate	Depth of spread, Dressing, Water sprinkling, Rolling	Visual	С	100%	IRC19/ DVC Spec	SR			
22.23	Screenings application	Uniform Spread, Rolling with Grooming, Sprinkling of water and grouting	Visual	С	100%	IRC19/ DVC Spec	SR			
22.24	Binder Application	Uniform Spread, application in layers followed by sprinkling, Rolling and sweeping slurry with broom	Visual	С	100%	IRC19/ DVC Spec	SR			
22.25	Setting & Drying	Leaving wet WBM undisturbed for drying, filling of hungry spot, checking evenness	Visual	С	100%	IRC19/ DVC Spec	SR			
22.26		Thickness of WBM	Measurement	В	Once per 500Sqm per Layer	IRC19/ DVC Spec	SR			
22.27	Premix Carpet	Bitumen Binder	Verification of MTC	A	Each Lot	IS:73/DVC Specification	MTC/TR	$\checkmark$	Procur e from Govt. Refinari es	





22.28		Testing	Measurement	В	One sample per Lot per Grade	IS:73/DVC Specification	TR			
22.29	Coarse Aggregate	Gradation	Measurement	В	One Test per 100cum	IS:2386 (Part- 1)	MORTH Table-500- 19/ IRC14/DVC Specificatio n	TR	$\checkmark$	
22.30		Aggregate Impact Value	Measurement	В	One Test per source change	IS:2386 (Part- 4)	MORTH/ IRC14/DVC Spec	TR	$\checkmark$	
22.31		Loss Angeles Abrasion Value	Measurement	В	One Test per source change	IS:2386 (Part- 4)	MORTH/ IRC14/DVC Spec	TR	$\checkmark$	
22.32		Soundness Test- Sodium Sulphate (5cycles)	Measurement	В	One Test per source change	IS:2386 (Part- 5)	MORTH/ IRC14/DVC Spec	TR		
22.33		Flakiness Index	Measurement	В	One Test per 100cum	IS:2386 (Part- 1)	MORTH/ IRC14/DVC Spec	TR		
22.34		Stripping Test	Measurement	В	One Test per source change	IS:6241	MORTH/ IRC14/DVC Spec	TR		
22.35		Water Absorption	Measurement	В	One Test per source change	IS:2386 (Part- 3)	MORTH/ IRC14/DVC Spec	TR	$\checkmark$	





22.36	Construction	Mending of underlying layer, free from dirt, dust and water	Visual	С	100%	MORTH/IRC14 / DVC Spec	SR		
22.37		Tack Coat ratio	Measurement	С	100%	MORTH/IRC14 / DVC Spec	SR		
22.38	Preparation of Premix	Preparation of Pre Mix, Transport and uniform spreading	Visual	С	100%	MORTH/IRC14 / DVC Spec	SR		
22.39	Rolling	Completion of Rolling before Min Rolling temperature	Visual	С	100%	MORTH/IRC14 / DVC Spec	SR		
22.40		Thickness, Bitumen Content	Measurement	В	One sample per 500Sqm	DVC Spec	TR		
22.41	RIGID PAVMENT (DLC/PQC)								
22.42	Rigid Pavement- Ingredient	Cement, Coarse & Fine Aggregate, Water		TR					
22.43		Fly Ash	Measurement	В	Once per change of Source	IS:3812 (Part- I), DVC Spec	TR		
22.44	TRIAL Mix	Proportioning of Mix, Moisture Content, 7Days compressive Strength	Measurement	В	As Required	MORTH/DVC Specification	Report		





22.45	TRIAL LENGTH	Workability, Proper Compaction, Segregation, underlying Honey Comb	Visual/ Verification	В	As Required	MORTH/ DVC Specification	Report		
22.46	Construction	Batching & Mixing, Placing in proper grade, thickness & camber, Rolling	Visual/ Measurement	С	100%	MORTH/ DVC Specification	SR		
22.47		Thickness	Measurement	В	Once per 500Sqm per Layer	DVC Specificati on	TR		
22.48	Joints	Joint bar, Spacing, Longitudinal Joint, Staggering of Transverse Joint, Bitumen Painting, expansion cap	Visual/ Veriication	В	100%	MORTH/DVC Speciication, Const Dwg	SR		
22.49		Curing	Visual	С	100%	DVC Specificati on	SR		
22.5	Precast Kerb Stone, Hume Pipe	Kerb Stone/ Hume Pipe MTC	Verification of MTC	В	Each Lot	IS:5758/ IS:458, DVC Specification, Const Dwg	MTC/TR	$\checkmark$	
22.51	Laying of Precast	Level, Line, mending of joint	Visual	С	100%	DVC Specification	SR		

## DATA, DRAWINGS AND DOCUMENT TO BE SUBMITTED

CHAPTER NO - 10





#### 10.00 DATA, DRAWINGS AND DOCUMENT TO BE SUBMITTED:

#### 10.01 **ALONG WITH OFFER:**

Scope of work with general description of the system and equipment offered specifying the important features. Bidder shall indicate clearly the work to be carried out in turbine, generator and all other auxiliaries with regard to modifications, additional accessories if required for completion of the job shall be supplied by the contractor without any extra charge, etc. to achieve the rated design capacity.

The description to be accompanied by single line diagrams, and equipment layout to enable the Purchaser to have a proper appreciation of the equipment offered and its operation.

- i. Filled in Technical Particulars as given in Chapter- 08
- ii. Detailed scope of work
- iii. Work schedule with bar chart indicating all activities (L-1 Schedule).
- iv. Main cross section drawing of proposed turbine and generator showing the various components/ parts/ assemblies of the turbine to the extent possible.
- v. Equipment Layout drawing of power house and unit-1 & 3 generator floor, turbine pit, transformers
- vi. The general arrangement and overall dimensions of the generators, exciters and bearings
- vii. Charts, Curves and Hill Curves showing performance and cavitation characteristics of the turbine.
- viii. Generator Characteristic Curve showing performance of generator
- ix. Curves showing areas and velocities at different section of the draft tube.
- x. Schematic Diagram and Block Diagram of bearing oil lubrication system, Cooling water System, Drainage /Dewatering system, Compressed Air System, Brake Air System, Fire Protection System
- xi. Detailed write up of servo system and interfacing with governor system.
- xii. List of commissioning spares and consumables included with the main offer.
- xiii. List of two (2) years operation spares, recommended by the Bidder equipment





wise, in addition to the Mandatory spares asked by the Purchaser.

- xiv. List of special tools and tackles, test jigs and special instruments required for operation and maintenance of turbine, generator, auxiliaries, generator static excitation, AVR, protection relays. For all other electro-mechanical equipment, individual list of special tools and accessories required is to be furnished for each item.
- xv. Proposal for training of Purchaser's personnel (equipment wise/mandays basis).
- xvi. Phase-wise requirements of power for construction, erection/testing and commissioning activities.
- xvii. List of performance tests proposed by the Bidder to demonstrate the guaranteed parameters for turbine, generator, electrical equipment and other auxiliaries in addition to tests/checks given in the specifications.
- xviii. Technical catalogues of equipment offered.
- xix. List of total aux. drives for unit and common system. for main plant with kW rating, enclosure class, class of insulation, cable size, frame size, duty cycle, places of control, rpm, type of drive (cage, slip ring etc.) starting method, technological interlocking etc. in a format.
- xx. List of annunciation considered in turbine panel, generator desk and in common aux. panels.
- xxi. P&I diagram for turbine, generator and auxiliary systems like cooling system, compressed air system, dewatering system, oil lubrication system, etc. indicating type of local and remote instruments recorders, gauges provided at local and remote places.
- xxii. Details of the CCVM system with cameras, NVR and capabilities along with Literature, Catalogues of offered model.
- xxiii. Ventilation fan & ducting details,
- xxiv. Details of Air filter unit and control and cleaning system, electrically operated damper, monorail with hoist facility, Instruments & Controls facilities.
- xxv. Process and instrumentation (P&I) diagrams for the unit with all





auxiliaries

- xxvi. Control schemes along with write-up for protection / interlock schemes for turbine and its auxiliaries and bill of materials.
- xxvii. Quality and quantity of electric power requirement for instrumentation and also instrument air requirement.

#### 10.02 AFTER PLACEMENT OF ORDER

The list of Data/Drawings/Documents to be submitted by Contractor for approval, information.(tentative list – shall be finalized during detailed engineering stage.)

- 1) Name of coordinators with address, telephone / FAX no. / E-mail of all sub contractors.
- 2) All information provided with tender in updated form. Technical literature/details catalogue and drawings of all equipment offered.
- 3) Basic calculation for selection of different equipment
- 4) Datasheet of all equipment, filters, valves and valve actuators etc.
- 5) P&IDs of all system like compressed air system, cooling water system,
- 6) L- 2 Schedule.
- 7) Operation and maintenance manual of equipment including trouble shooting and list of 'Dos' and Don'ts shall be supplied well in advance of shipment of the equipment
- 8) Other data and changes/documents as considered necessary for proper upkeep and operation of the plant and equipment and as may have been called for in the general conditions of the contract.
- 9) Assembly and sub-assembly drawings showing elevations, plans, sections for the entire turbine, turbine guide bearings, governor parts, generator, generator guide bearings, thrust bearing and generator parts, voltage regulator, exciter, control panels, lubrication etc., including all piping.
- 10) Detailed drawings of the turbine, generator. Control write-up and interlocking scheme
- 11) Layout plan of cooling water piping from tapping point to equipment and inter connections
- 12) Layout schematic drawing for static excitation equipment





- 13) Winding diagram for generator stator and dimensional drawings
- 14) Assembly and sub-assembly drawings for all components parts to be assembled at site.
- 15) Wiring and schematic diagram for control, instrumentation, protection and indication.
- 16) General layout of powerhouse with pipe work, cables, ducts.
- 17) GA Drgs. of each equipment / system.
- 18) Drawing indicating piping, supports and pipes & valves schedule with specification etc.
- 19) Bill of material of the total system
- 20) Test procedure for preliminary and final acceptance and guarantee test
- 21) Instruction manual for installation/erection, testing & commissioning, maintenance & operation instruction, drawings to facilitate dismantling and assembly of all equipment and system.
- 22) Technical literature catalogues and manufacturer's drawings for all bought out components & wearing parts with clear marking of tag nos.
- 23) Manufacturer's routine test and type test certificates for all equipment and cables.
- 24) Detailed technical catalogues for all the equipment.
- 25) Spare parts manual containing itemised inventory of equipment supplied.
- 26) Details of painting for all equipment.
- 27) Lubrication schedule and quantity and quality of lubricant for one year's normal operation.
- 28) Details of test results conducted at works for all equipments.
- 29) Details of test results conducted at site for all equipments.
- 30) Fixing details of all the equipments, supporting structures etc.
- 31) Conduit layout drawing indicating type, size, length and locations of conduits required to be placed in RCC wall/floor, brick wall, if any.
- 33) Data sheets, characteristic curves and technical details of all the equipments, valves and piping.
- 34) Quality Assurance Plan
- 35) Welding procedure





- 36) Any other drawing/ documents as required by the Purchaser.
- 37) CCVM System Configuration / Schematic diagram
- 38) Datasheets with catalogues and Bill of Material for CCTV System, Guarantee / Warrantee certificates.
- 39) Control & Instrument system- details mentioned in Volume-III

Note : The Indian subsidiary company will get the design, basic and detailed engineering drawing and quality of material of turbine generator to be delivered approved by the Parent/Holding /any other subsidiary company of its Parent/Holding Company.

## **PROJECT IMPLEMENTATION SCHEDULE**

CHAPTER NO - 11



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



#### 11.0 ROJECT IMPLEMENTATION SCHEDULE

#### 11.01 General

The project envisages Renovation & Modernisation (R&M) of Unit # 1 & 3 of Maithon Hydel Station under Damodar Valley Corporation (DVC).

The following equipment and systems will be covered under this project.

- Main generating unit
- Electrics
- Hydro-mechanical equipment
- Common Auxiliaries like compressed air system, cooling water system, ventilation system, fire fighting system, drainage & dewatering system, etc.

The "Zero-Date" of the project is reckoned as the date of "Award of Contract on EPC Contractor".

The overall time for the R&M project is estimated to be 24 months and 40 months for unit #1 and #3 respectively from "Zero-Date". The basic modus operandi for implementation of the project is to entrust the entire work on EPC (Engineering Procurement and Construction) basis to a single party.

The implementation phase will involve all the activities by the EPC contractor like design, engineering, manufacture, procurement, inspection, dismantling, erection, transportation to site, storing, testing and commissioning including performance guarantee test of the unit. The R&M work will be carried out in consultation with DVC and according to DVC's guidelines. The work at site will be monitored and controlled by DVC / its Consultant in order to ensure proper and timely completion of the R&M activities.

#### **10.02 Schedule of Major Activities**

The major activities and suggested sequence of implementation for R&M of Unit # 1 & 3 are given below:-

• Award of contract to successful bidder i.e Zero Date of the project.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3





- Dismantling, refurbishment, erection / re-erection, testing and commissioning of the units considering minimum period of complete shutdown of the powerhouse.
- Refurbishment / replacement of station auxiliary systems like cooling water system, drainage water system, compressed air system, LT and control panel etc.

#### **10.03 Implementation Schedule**

The implementation schedule for the project is given in the form of bar-chart in Drg. No. MEC/11/S3/Q7K6/R&M/ Schedule/DVC-Maithon /01.

A brief description of the implementation plan is given below for reference.

#### 10.04 Implementation Plan

#### For R&M Work of Unit # 1 & 3:

#### For R&M Work of first unit:(either Unit # 1 or 3)

#### • Design & Engineering:

After "Award of Contract (Zero-Date)", the contractor shall take up the detailed design, engineering and procurement activities. The new components to be installed are already identified, so that design & engineering of these items can be completed within 10 months from "Zero Date" for both units.

#### • Procurement Activities:

Procurement activities for first unit (either Unit # 1 or 3) shall be completed within 9 to 12 months from Zero Date.

#### • Shutdown of first unit:

It shall start from the 9<sup>th</sup> month from "Zero Date". Therefore, site mobilization must be completed by the contractor by the 8<sup>th</sup> month. After shut-down and before starting of R&M work, isolation and dewatering of the unit shall be completed by contractor.

#### • Dismantling, Refurbishment/ Replacement activities:

To complete the project within the stipulated time, the R&M work shall be carried out simultaneously in all the areas, as indicated in the schedule. The turbo-generator shall be dismantled within 3 months after shut-down. After dismantling of the main equipment,



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



replacement of the turbine runner, cone generator shaft, refurbishment of generator stator and associated equipment shall be taken up, which will continue for another 6 months. Renovation of the under-water parts shall also be completed during this period. After completion of renovation and refurbishment of the parts, re-assembly of the various parts and equipment erection will be completed in 6 months time.

#### • Shutdown of the powerhouse:

Complete shutdown of the power house is required to execute all civil works related with open channel. Approximate 4-5 months shutdown is required to complete the works.

#### • Reassembly & Erection:

Reassembly & Erection of various parts shall be completed by 21<sup>st</sup> months from Zero date.

#### • Commissioning of first unit:

It shall be taken up on the 22nd & 23rd month from "Zero – Date" followed by trial run in the 24<sup>th</sup> month when commercial generation from the first renovated unit will be resumed.

#### a) For R&M Work of second unit:

#### • Design & Engineering:

Detailed design & engineering activities for both Unit # 1 & 3 shall be completed within 10 months from "Zero Date" for both units.

#### • Procurement Activities:

Procurement activities for second unit shall be completed within 28<sup>th</sup> months from Zero Date.

#### • Shutdown of second unit:

After successful commissioning of first unit within schedule time of 24 months, second unit to be handed over to contractor in 25<sup>th</sup> month "Zero Date". After shut-down and before starting of R&M work, Isolation & dewatering of the unit shall be completed by contractor

#### • Dismantling, Refurbishment/ Replacement activities:

To complete the project within the stipulated time, the R&M work shall be carried out simultaneously in all the areas, as indicated in the schedule. The turbo-generator shall be



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



dismantled within 3 months after shut-down. After dismantling of the main equipment, replacement of the turbine runner, cone generator shaft, refurbishment of generator stator and associated equipment shall be taken up, which will continue for another 6 months. Renovation of the under-water parts shall also be completed during this period. After completion of renovation and refurbishment of the parts, re-assembly of the various parts and equipment erection will be completed in six (6) months time.

#### • Shutdown of the powerhouse:

Complete shutdown of the power house is not envisaged. However complete shutdown, if necessary, shall be taken temporarily.

#### Reassembly & Erection:

Reassembly & Erection of various parts shall be completed by 37<sup>st</sup> months from Zero date.

#### • Commissioning of second unit:

It shall be taken up on the 38th & 39th month from "Zero – Date" followed by trial run in the 40<sup>th</sup> month when commercial generation from the first renovated unit will be resumed.

#### 10.05 Implementation Strategy

The proposed implementation schedule and planning has been based on the assumption that project will be executed according to DVC's guidelines / policies on R&M works.

As the work involved is very complicated and the time schedule is quite tight, it will be necessary to ensure selection of a capable and reputed construction / erection agency, having sufficient expertise and knowledge of modern construction techniques and methods. Moreover, mobilization of adequate resources of men, materials and construction machinery has to be made by the contractor, in order to meet the schedule.

#### 10.06 Facilities provide by Client:

- Appointment of Owner engineers/consultant before "Zero Date" of the project for drawing/documents approval, inspection, site supervision and assistance during commissioning.
- Approval of drawings and documents inspection, site supervision and assistance during commissioning from own resources.



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



- ACCI CONTRA
- On site facilities to be provided to the EPC contractor for preparation of stores, offices, labour camps, etc at site.
- Providing EOT crane (inside the power house- without operator) during R&M work, EPC Contractor shall arrange crane for any activity outside the power house.
- Inspection of equipment.

#### IMPLEMENTATION SCHEDULE FOR R&M OF UNITI # 1 & 3 OF MAITHON HYDEL STATION OF "DVC"

SI No	ITEM OF WORK/ACTIVITIES	MONTH WISE PROGRAM																																					
0		1	2	2	3	4	5	6	7	8	9	10	11	I 12	2	13 14	15	16	17	18	3 1	9	20 2	1 2	2 23	24	25	26	27 28	29 3	0 31	32	33	34	35	36	37	38	39 40
	POST AWARD ACTIVITIES																																						
	ZERO DATE	30	0.12.2	2022																																			
1	Design & Engineering for both Unit # 1 & 3.																																						
2	Procurement activities for Unit # 1													-																									
3	Site Deployment by EPC Contractor																																						
4	Shut Down of Unit # 1									<	>																												
5	Dismantling of the Unit # 1												-																										
6	Refurbishment, Replacement of Turbine, Generator,their Auxiliaries and Common Facilities of the Unit # 1												_																										
7	Re-assembly of the various parts and equipment Erection																				-																		
8	Commissioning of the Unit # 1																																						
9	Procurement activities for Unit # 3														•																								
10	Shut Down of Unit # 3																									<													
11	Dismantling of the Unit # 3																									-													
12	Refurbishment, Replacement of Turbine, Generator, their Auxiliaries and Common Facilities of the Unit # 3.																																						
13	Re-assembly of the various parts and equipment Erection																																		1				
14	Commissioning of the Unit # 3																																						

Drg. No: MEC/11/S3/Q7K6/R&M Schedule/DVC-Maithon/01

## LIST OF MANDATORY SPARES

CHAPTER NO - 12





#### 12.00 LIST OF MANDATORY SPARES

12.01	Turk	pine and Associated Equipment	
	1.	Runner blade packings	-10% of total installation (each type)
	2.	Oil head packings	- 10% of total installation (each type)
	3.	Guide vane, self lubricating bushes	- 10% of total installation (each type)
	4.	Guide vane stem seals	-10% of total installation (each type)
	5.	Guide vanes	- Four (4) nos.
	6.	Linkages/Levers self lubricating bushes	-10% of total installation (each type)
	7.	Regulating ring bushes	- 10% of total installation (each type)
	8.	Facing plate for head cover and bottom ring	- one (1) set assembly
	9.	Servo pin bushes	- 10% of total installation (each type)
	10.	Shear pin/breaking pin	-10% of total installation (each type)
	11.	Piston rings for GV servo motor cylinders	- Two (2) nos.
	12.	Piston rings for RB servo motor cylinders	- Two (2) nos.
	13.	Servo motor seals and packings of each type	- Two (2) sets
	14. 15.	Thrust pad Guide pad	- Two (2) nos. - One (1) nos.
	16.	Packing and sealing for spiral casing and draft tube man hole	- Two (2) sets
	17.	All types of packing and sealing including gaskets for machine and piping.	-10% of total installation (each type).
	18.	Turbine Guide Bearing Shell	- One (1) set assembly
	19.	Regulating pins	- 10% of total installation (each type)
	20.	Connecting pins of guide apparatus	- 10% of total installation
	21.	Necessary nuts, bolts, washers etc.:	<ul> <li>10% of all nut, bolts washer of each size &amp; type.</li> </ul>
	22.	Valves	- 10% of total valve of all sizes and rating
	23.	Dial thermometer	- One (1) nos. each type.
	24.	Bearing Oil cooler	- One (1) set





One (1) set assembly

One (1) set of each type

One (1) set of each type.

One (1) set assembly

Two (2) set assembly

Two (2) set assembly.

Two (2) set assembly

Two (2) set assembly

Two (2) set assembly

One (1) set assembly

Four (4) nos.

10% of installation

Four (4) coils

Two (2) nos.

\_

#### 12.04 a. Generator and Associated Equipment

- i. Stator Air Coolers
- ii. Stator bars of each type
- iii. Field coil with insulation
- iv. Guide pad
- v. Bearing shell
- vi. Bearing oil cooler
- vii. Collector ring
- viii. Brush holder
- ix. Carbon brush
- x. Brake shoe
- xi. RTDs for bearings
- xii. Dial type thermometer Four (4) nos.
- xiii. Speed sensor probes One (1) set assembly
- xiv. Brake liner
- xv. Filter element of oil
- xvi. Solenoid coils
- xvii. Level gauge
- xviii. Pressure switch
- xix. Pressure gauge
- xx. Contact springs & coils for each one ( type of relay contactor
   xxi. Seal packing (all type) - Two (
- Four (4) nos.

Two (2) nos.

Four (4) nos.

- one (1) complete set
- Two (2) set assembly of each type

#### b. Generator Fire fighting system

i.	Diverter Valve	-	one (1	) no.				
ii	Discharge Nozzle	-	10%	or	01	no.	for	each



#### DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



whichever is

Type/Model/Rating,

higher. iii. **Check Valve** 10% 01 or no. for each Type/Model/Rating, whichever is higher. **Pneumatic Actuator** 10% iv or 01 no. for each Type/Model/Rating whichever is higher. **Pressure Relief Valve** Two (2) for each Type/Model/Rating ٧. \_ Release Unit Solenoid Valve with Coil vi. Two (2) for each Type/Model/Rating vii. Detectors 10% of population for each \_ Type/Model/Rating. Other Solenoid Valve with Coil 10% viii or 01 no. for each Type/Model/Rating, whichever is higher. All other Field Instruments 10% or ix. 01 no. for each Type/Model/Rating, whichever is higher. One (1) for each Type/Model/Rating. х. Buzzer/Hooter Spares for Hardware Annunciation System - One (1) set xi.

#### c. UPS (Uninterruptible Power Supply System)

i	Fuses	-	Two(2) times of total quantity of each					
			type/rating of fuses used in the					
			system					
ii	MCBs of ACDB	-	10% or 01 no. for each					
			Type/Model/Rating whichever is					
			more.					
iii	Cooling Fan	-	02 nos.					
iv	SCR	-	10% of total quantity of each type					
			used in the system or minimum					
			1(one) no whichever is more.					
v	Diode	-	10% of total quantity of each type					
			used in the system or minimum					



#### DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



				1(one) no	o. whichever is more.
	vi	IGBT	-	2 (two) no	DS.
	vii	Electronic Module/ PCB	-	1 (one) n	o. or 10% of each type of
				Electroni	c Card/PCB/Modules used
				in the to	otal system whichever is
				more.	
	viii.	Electronic Cards (Each Type	e) -	One (1) N	lo.
	ix.	Meters (Each Type)	-	One (1) N	lo.
	х	Aux. Relays / Contacto (Each type)	or -	One (1) N	los.
	xi.	Switch / Push Buttons (Eac	h -	Two (2) N	los.
		Туре)			
	xii.	Indication Lamps	-	Twenty (2	2)0 Nos.
12.05	Excita	tion System & AVR			
	1.	Thyristor with fuse		-	One (1) no.
	2.	Fuses		-	Ten(10) nos. of each type
	3.	Digital/Electronic cards used in	(AVR et	tc.) -	one (1) of each tube
	4.	Bushings of Excitation transfo	rmer	-	two (2) nos. of each type
	5.	Field breaker coils		-	One (1) set assembly
	6.	Field breaker aux. contacts		-	One (1) set assembly
	7.	Power supply DC/DC converter		-	One (1) set assembly
	8.	Gate pulse transformer unit		-	One (1) set assembly
12.06	Coolir	ng water system			
	1.	Filter element	-	One (	(1) set
	2.	Pressure gauge	-	One (	(1) no. each size
	3.	Valves	-	One (	(1) no. each size
	4.	NRV	-	One (	(1) no. each size
	5.	Flow meter	-	One (	(1) no. each size



(MECHANICAL & CIVIL)



12.07	Dew	vatering/ Drainage system			
	1.	Ball bearing of motor	-	One (1) set c	of each size
	2.	Pressure gauge	-	One (1) no.	of each size
12.08	Con	npressed Air System			
	1.	Piston ring	-	One (1) set	
	2.	Oil filters set	-	Two (2) nos.	
12.09	Gen	erator LAVT			
	1.	Lightning arrestor with complete assembly	-	One (1) set	
	2.	PT assembly	-	One (1) set	
	3.	PT primary HT fuse	-	Five (5) nos.	
	4.	MCB	-	Ten (10) nos	
	5.	Fuse	-	Twenty (20)	Nos.
12.10	Genera	ator CT			
	1.	Phase CT of each class & type	-	One (1) no.	each type
12.11	Genera	ator Transformer			
	1.	H.V. side bushing.		-	One (1) No.
	2.	L.V. side bushing.		-	One (1) No.
	3.	H.V. neutral bushing.		-	One (1) No.
	4.	Buchholz relay (with alarm/trip cont	acts).	-	One (1) No.
	5.	Oil surge relay (with alarm/trip conta	acts).	-	One (1) No.
	6.	Magnetic oil level gauge (with alarm	n/trip co	ntact)	One (1) No.
	7.	Current Transformer of WTI.		-	One (1) No.
	8.	Dial type oil temp. indicator with ala	rm/trip c	contact -	One (1) No.
	9.	Winding temperature indicator with	alarm/tr	rip contacts	One (1) No.
	10.	Silicagel breather with silicagel cha	rger.	-	One (1) No.



#### DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

	*******	(MECHANICAL & CIVIL)			SUD1 Colline
	11.	Set of Gaskets for bushings.		-	One (1) No.
	12.	Differential Pressure gauge of each type		-	One (1) Set
	13.	Pressure gauge of each type		-	One (1) Set
12.12	Neutr	al Grounding Cubical			
	01.	Supporting insulators		-	five (5) nos.
	02.	Resistor unit		-	Two (2) sets of banks
12.13	Contr	ol Relay Panel / Desk			
	01.	Indication Lamps		-	Fifty (50) Nos.
	02.	Semaphor Indicator		-	Four (4) Nos.
	03.	Control Fuse		-	Fifty (50) Nos
	04.	Control Switches / Selector Switches (Each Type)		-	Two (2) Nos.
	05.	Meters (Indication Only) (Each Type)		-	One (1) No.
	06.	PLC Card		-	One(1) each type
	07.	Relays (Protective and Aux.) (Each Type)		-	One (1) No.
	08.	Power Supply Card / units for relays (Each Type)		-	Two (2) Nos.
		(If applicable)			
	09.	Hooter / bell etc		-	Two (2) each type
	10.	Isolating switch			
		a) AC supply	-	One (′	1) no. of each type
		b) DC supply	-	One (′	<ol> <li>no. of each type</li> </ol>
	11. 12	Terminal blocks	-	Three	(3) sets of assembly
	12.	Timers of each range	-	1 WO (2	2) 1105.
12.14	LT Sw	itchboard			
	01.	Breaker Closing coil & Trip Coil	-	One (´	1) each type
	02.	Spring charge Motor	-	One (′	1) No.
	03.	ACB Contacts	-	One (′	1) Set
	04.	Current Transformer of each type	-	One (′	1) Set each
	05.	Potential Transformer (Each Type)	-	One (´	1) Set
	06.	Fuses	-	Fifty (5	50) Nos.
	07.	ACB Arc Chutes	-	One (′	I) Set



12.15

#### DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



MCCB / MPCB (Each Type)	-	Five (5) Nos.						
Aux. Relays / Contactor (Each type)	-	Two (2) Nos.						
Push Buttons and selector Switch	-	One (1) . each type						
Indication Lamps	-	Fifty (50) Nos.						
Contactors Complete (each Type)	-	Three (3) Nos.						
Aux. Contacts of Contactors (each Type)	-	Five (5) Nos.						
Close Coil of Contactors (each Type)	-	Five (5) Nos.						
Transducers (Each Type)	-	One (1) No.						
O/L Relay (each Type)	-	Thee (3) Nos.						
Meters (each Type)	-	One (1) No.						
AC Motors								
	MCCB / MPCB (Each Type) Aux. Relays / Contactor (Each type) Push Buttons and selector Switch Indication Lamps Contactors Complete (each Type) Aux. Contacts of Contactors (each Type) Close Coil of Contactors (each Type) Close Coil of Contactors (each Type) Transducers (Each Type) O/L Relay (each Type) Meters (each Type)	MCCB / MPCB (Each Type)-Aux. Relays / Contactor (Each type)-Push Buttons and selector Switch-Indication Lamps-Contactors Complete (each Type)-Aux. Contacts of Contactors (each Type)-Close Coil of Contactors (each Type)-Close Coil of Contactors (each Type)-Transducers (Each Type)-O/L Relay (each Type)-Meters (each Type)-Stors-						

# 1. Valve drive-One (1) of each type2. Bearings-Three (3) set of each type3. Fans-Three (3) nos. each type

#### 12.16 MAINTENANCE TOOLS & TACKLES

01.	MCC tray racking handle	-	Three (3) nos. of each board
02.	Panel keys	-	Five (5) nos. for each board
03.	Test cabinet with coupling cables for testing breaker in withdrawn position	-	Two (2) nos. for each board
04.	Indication lamp extractor	-	Two (2) nos. for each board
05.	Programming device for programming and changing setting of relays for numeric relay	-	One (1) set





#### 12.17 LIST OF MANDATORY SPARES (Control & Instrumentation)

#### a) Measuring Instruments/Field instruments.

- i) 10% of total Temperature & Pressure gauges of each type & model or a minimum of one of each type and model whichever is more.
- ii) 10% of total temperature elements with thermowells for RTD/TC or a minimum of one of each range & model whichever is more

#### c.) Electronic smart transmitters

i) 10% of total electronic transmitters of each type range and model or minimum of one number of each type, range & model whichever is more.

#### d) Vibration Monitoring System

- i) One no. of velocity coil type, accelerometer type and proximity type vibration transducer.
- ii) One no. of power supply module.

#### e) Process Actuated switch devices

10% of total pressure switches, limit switches, differential switches, temperature switches, flow switches of each type & model or minimum of one number of each type & model whichever is more.

#### f) Local Instrument

- i) 10 % of each type of Push buttons, indicating lamps, colour caps & control station for each type.
- ii) 10% or minimum 1 nos of each instrument not covered in the list but used in the system.

#### g) Alarm Annunciator

 i) 10% of total electronic cards (if applicable) of each type & model or minimum of 2 nos of each type & model. This shall include all types of cards.

#### h) Cable

 i) 100% of total quantity of each type,size and rating used in the system or maximum 500m. whichever is less.





#### 12.18 MAINTENANCE TOOLS & TACKLES

i	MCC tray racking handle	-	Three (3) nos. of each board
ii.	Panel keys	-	Five (5) nos. for each board
iii.	Test cabinet with coupling cables for testing breaker in withdrawn position	-	Two (2) nos. for each board
iv.	Indication lamp extractor	-	Two (2) nos. for each board
v.	Programming device for programming and changing setting of relays for numeric	One (1) set	

#### Note:

- 1. Wherever" set" is indicated it shall mean that complete replacement for one main equipment.
- 2. If percentage comes at fraction next higher integer should be considered for the purpose of quantity required.
- 3. The bidder shall furnish item wise list of recommended spare parts that will be required for two (2) years operation along with the unit with price as called in bid proposal sheet.DVC shall have option to placing the order separately later on.
- 4. Whether included in bidder's recommendations or not, prices of the mandatory spares as par the list above shall be quoted which shall be considered in evaluation.

## LIST OF INDICATIVE MAKES

CHAPTER NO - 13
#### **Disclaimer for Indicative Vendor List/ Makes**

- A) Reasonable efforts have been made to collate the sub-vendors proposed by the various Main Contractors/ Consultants from time to time against different Projects/Packages and accepted by DVC for various items/ systems. However, in case of error/omission, if any, and represented by the successful bidder this will be addressed during the execution of the contract based on the material evidence available with DVC / Main Contractor.
- B) The approved/indicative sub-vendor list drawn is not based on DVC driven enlistment process but based on the sub- vendors proposed by various Main Contractors/ Consultants. As such, it is possible that some of the Suppliers/Manufacturers who may be involved in similar work/ process may not be appearing in the list as such sub-vendors may not have been proposed by Main Contractors/ / Consultants against DVC Contracts.
- C) In case the successful bidder chooses to propose additional sub-vendors with relevant experience after the award of the contract such sub-vendors will be considered in terms of Relevant Clause of GCC/ NIT, provided the proposals are received sufficiently in time: 90 days prior to ordering date of a Bought-Out Items/Start of Manufacturing so as not to impede the progress of the contract.
- D) Sub-vendors have been grouped under different categories of items. It is possible that an item characterized by certain specific features such as range and type required as per Main Contractor's design requirements may not be in the range of the listed sub-vendor's manufacturing process/capability. As such the main contractor to ascertain the vendor's capability to meet his specific requirements before considering a sub-vendor.
- E) It is to be noted by the bidders that any shortfall in contract performance attributable to the sub-vendor listed will not absolve the contractor from his contractual obligations in any manner.
- F) The approval was granted based on the evaluation of relevant capabilities and facilities possessed by the sub-vendor at the time of evaluation. Also, some of the sub-vendors may not be active. As such, the successful bidder is to carry out his own due diligence before considering the listed sub-vendor for subletting: the current status of the sub-vendor, the continued availability of productive resources including Human Resources.
- G) The list of sub-vendors is periodically revised to include new sub-vendors. Such a revision may also see a deletion of certain sub-vendors who may have been disqualified on grounds of inadequate performance or banned in line with DVC's banning policy. The then current list will be shared with the successful bidder immediately on award.

#### H) Brand Name

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

 For all items of DVC Packages/ Projects, the Bidder has to comply with the standing and subsequent Orders, OMs, Corrigendum, Clarifications etc.\* of MoP, GOI regarding selection of vendors/contractors, testing and other conditions detailed in the order (s).

\*like restrictions on procurement from a bidder of a country which shares a land border with India, DPIIT Registration, testing of imported items in India, Atmanirbhar Bharat' and 'Make in India' through phased Indigenization in Power Sector", Procurement only from the local suppliers for the items etc.

If any sub-vendor (s), appearing in the sub-vendor list which is not complying with the above, will be considered as 'Not Approved/ Not-Accepted' by DVC.



# **13.00 LIST OF INDICATIVE MAKES**

A tentative vendor list is appended. However, other reputed vendors of item may be acceptable subject to approval of owner.

## a. Mechanical

SI. No.	EQUIPMENT	Indicative Makes
1.	Horizontal Centrifugal Pumps	KBL, KSB, WPIL, Mather & Platt, SAM TURBO , Beacon Weir
2.	Vertical Turbine Pumps	KBL, KSB, WPIL, Mather & Platt, SAM TURBO, Beacon Weir
3.	Vertical Wet Pit Type Pumps	KBL, WPIL KSB ,Mather & Platt,
4.	Submersible Pumps	KSB, SU Motors, Kirloskar Brothers, Kishore Pumps, WPIL, Beacon Weir
5.	Slurry Pump	Sam Engg, KSB Pumps, WARMAN.
6.	Dosing Pump	Shapo Tools, Swellore Engg., V.K. Pumps, Milton Roy India, Asia LMI, Miralmi
7.	Package type FRP Cooling Tower	PCTPL, BDT, GEA, Himgiri, Mihir Engineers Pvt Limited



SI. No.	EQUIPMENT	Indicative Makes
8.	Pressure Filters	Thermax, Ion-Exchange, Resin India, Driplex, VA Tech Wabag
9.	Fire Hydrants	New Age Industries, Sukhan, Shah Bhogilal
10.	Strainers	GRANDPIX, MULTITEX, GUJRAT OTOFILT, OTOKLIN FILTERS INDIA
11.	Sluice Gates	Jash Engineering, H. Sarkar
12.	Diesel Engine	Jackson/ Supernova/ Sterling Generator Pvt ltd, Powerica
13.	Softening & DM Plant	Thermax / VA Tech / Ion Exchange
14.	Electric Actuators	Limitorque, Rotork, Auma, PBL
15.	Rotory Pneumatic Actuators	AL Saunders, Xomox, EL-O-Matic, Virgo, L&T, Flocon, Precision Processing Equipt. Co.
16.	Thermal insulations	Lloyd insulations (india) limited, Polybond insulation pvt ltd ,Dhanbad rockwool in sulation pvt ltd , Hyderapad Industries, Rockwool, Thermax Heat Tracers, U.P. Twiga Fibreglass.
17.	C.I. Valves Gate, Globe,	G.M.Dalui & Sons, H.Sarker & Company, Leader
	Valve	Valves Ltd., Micon Valves (India) Pvt.Ltd
18.	CS Valves (gate, NRV)	Audco, Fouress, BHEL, KSB, , BDK, Kirloskar
19.	Duplex filter	GRANDPIX,MULTITEX, GUJRAT OTOFILT, OTOKLIN FILTERS INDIA
20.	Plug valves	Audco- L&T, Vass Ind., Xomox, Fischer Sanmar, BDK, Leader Engg., Fouress
21.	Ball Valves	AUDCO, AKAY, LEADER, FLOWCHEM, BDK VALVES, A.V. VALVES, MICROFINISH, FISCHER SANMAR LTD. VIGRO ENGINEERS, LEADER
22.	GM Valves	Leader, SANT Valves
23.	Butterfly Valves (Manually & electrically operated)	IL, AUDCO, INTERVALVE, TYCO VALVES, BDK, FOURESS ENGG, KIRLOSKER, CRANE PROCESS FLOW, Audco, MICON ENGINEERING, ADVANCE VALVES
24.	Diaphragm Valves	WEIR BDK , CRANE PROCESS, PROCON ENGINEERS , L&T LTD., CRANE (SAUNDERS), A.V. Valves
25.	Control Valve	BHEL, L&T, Fouress, IL, MIL Controls, NECO Scharbet, Darling pumps
26.	Knife Gate Valves	Jash Engineering, Fouress,



# DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

SI. No.	EQUIPMENT	Indicative Makes
27.	Pressure Reducing Valve	L&T, Fouress, , Forbes Marshal
28.	Safety Relief Valve (Pressure relief Valves)	BHEL, L&T (Audco Div.), Leader, A.V. Engg. Works, Spirax Marshal
29.	Hoses	BIS Approved Sources with Valid License
30.	MS ERW BLACK Pipes	SURYA ROSHNI, JINDAL, SAIL, TISCO, Welpsun, Ratnamani, MSL
31.	MS PIPES (SAW)	PSL Limited for SPIRAL WELDED SAW MUKUT PIPES, LONG WELDED SAW (SINGLE WELD) MANN IND, SPIRAL WELDED SAW SAW PIPES, SPIRAL WELDED SAW MUKUT TANKS & VESSELS for LONG(SINGLE WELD) & SPIRAL WELDED SAW SURENDRA ENGG, UPTO 500 NB, SPIRAL WELDED SAW, Ratanamani, SPIRAL WELDED SAW, SAIL, WELSPUN, SPIRAL WELDED SAW
32.	Seamless MS/CS Pipes	ISMT, BHEL, MAHARASHTRA SEAMLESS, Upto 300 NB, ISMT, Upto 150 NB
33.	SS Pipes / fittings	Heavy Metal Tubes, Nobel Tubes, Rajendra Mech. Ind., Sterling Supply Agency, Vitrag, Poonam Enterprises, N.L.Hazra, M.S.Fittings, Jindal Saw Itd., Ratnamani Metals, Reliable steel
34.	MS/CS Pipe Fittings	GUJRAT INFRA, SHYAM ENGINEERING, ABASI ENGINEERING WORKS, INTERTECH FITTINGS, MS FITTINGS TUBE PRODUCTS ,TEEKAY TUBES ,EBY INDUSTRIES, ALLIANCE PIPES & FITTINGS, Electrosteel
35.	HDPE / PVC Valves, Pipes, Flanges & Fittings	ASTRAL, GLYNWED, GEORGE FISCHER
36.	Compressor	Ingersoll Rand, Atlas Copco, Kirloskar Pneumatic, KPC
37.	Air Drying Unit	Melcon, Delhi, Indcon Projects, Delhi, Delair (I) Pvt Ltd. New Delhi, Summit, Coimbatore
38.	Pressure Vessel & Tanks	EPC Approved Sources
39.	Control valve (Globe/Ball/V- Notch/Angle)	Fisher, Instrumentation Ltd, Masoneilan (Dresser Industries), Flowserve (Valtek), Samson Controls, Arca (Forbes Marshall), MIL Controls, Introl (RK Controls), Metso, Virgo (only ball type), Elomatic, Uniflow Control Instruments Pvt. Ltd., Severn Glucon (India)



SI. No.	EQUIPMENT	Indicative Makes
40.	Control valve (Butterfly)	Fisher (Emerson), Instrumentation Ltd, Flowserve (Valtek), Masoneilan (Dresser Industries), Dembla (Except for power cyllinder actuators), Fouress, Introl (RK Controls), Metso, , Samson Controls, Pentair, Uniflow Control Instruments Pvt. Ltd., Severn Glucon (India)

## b. Electrical.

SI. No.	EQUIPMENT	Indicative Makes
1.	HV Busduct	STAR DRIVE NOW KGS ENGINEERING LIMITED
		(CHENNAI)/ BEST & CROMPTON/ / CONTROL &
		SWITCHGEAR/ SPACEAGE
2.	POTENTIAL	AE /ABB/ KAPPA / INDCOIL/ PRAGATI/ LAXMI/
	TRANSFORMER	SILKAANA/ PRAYOG
3.	415V SWITCHGEAR &	L&T / SIEMENS / CONTROL & SWITCHGEAR
	MCC	/GE (ALSTHOM) / SCHNEIDER/ ELECMECH/
		UNILEC SWITCHGEAR
4.	LT CIRCUIT BREAKER	SIEMENS/ GE(ALSTHOM) /L&T/ C&S/
		SCHNEIDER
5.	UPS	SIEMENS/HIREL/GE
6.	AUXILIARY RELAYS	AREVA/ EASUN/ ABB/GE/ SCHNEIDER/ SIEMENS/ OEN/ JYOTI.
7.	AMMETER/VOLTMETER/ VARMETER/WATTMETER	IMP/ MECO AE/L&T/ RISABH/ WATTMETER/ VAR-METER
8.	VOLTAGE/ POWER/ CURRENT/ FREQUENCY/ ENERGY TRANSDUCER	ABB/ AE/RISHAV, NASIK/ SOUTHERN TRANSDUCER
9.	LOCAL PUSH BUTTONNS	SIEMENS/ L&T/ BCH/ GE/ TEKNIK
10.	MCCB/MCB	L&T/ SIEMENS/ GE POWER CONTROL / HAVELLS /MDS(LEGRAND)
11.	INSTRUMENTATION CABLE	DELTON, UNIVERSAL CABLES, KEI INDUSTRIES, PARAMOUNT CABLES, CORDS CABLES, FORT GLOSTER, POLYCAB,



MAITHON HYDEL STATION

## TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

SI. No.	EQUIPMENT	Indicative Makes
	(Screened, Paired, Triad- Signal, Control, Power etc.)	RELIANCE CABLES
12.	Generator Transformer	CGL/BHEL / TR / ALSTOM/AREVA /ABB
13.	33 kV SF <sub>6</sub> Circuit Breaker	ABB / CGL / SIEMENS
14.	33 kV ISOLATOR	S&S, GR POWER, HYDERABAD/ TRANS ELECTRICALS, KOLKATA/ ALLIANCE ENGINEERS PVT LTD,/ P. R. ENGINEERING WORKS/ PROJECT ELECTRICALS/ SIEMENS
15.	EHT / HT Current TRANSFORMER	ABB / AREVA / CGL / EPECO/ BHEL/ TELK/ MEHRU
16.	ISOLATING SWITCH	A BOND STRAND / PANNIKAR SWITCHGEAR
17.	LT TRANSFORMER	BBL/CGL/ALSTOM/ KEC/EMCO/ VOLTAMP/TR
18.	CURRENT TRANSFORMER	AE /ABB/ KAPPA / INDCOIL/ PRAGATI/ LAXMI/ SILKAANA/ EPECO/GE
19.	LIGHTNING ARRESTOR	ELPRO / OBLUM INDUSTRIES LTD / SCHNEIDER (AREVA).
20.	BATTERY	EXIDE (FOR LEAD ACID PLANTE TYPE ONLY). HBL POWER SYSTEM (FOR NI-CD TYPE ONLY) AMCOSAFT (FOR NI-CD TYPE ONLY)
21.	BATTERY CHARGER	HBL-NIFE(SABNIFE)/ CHHABI ELECTRICALS/ CALDYNE / AMAR RAJA
22.	SOLID STATE ANNUNCIATOR	ELECMECH/PROCON/MINILEC/ PECON/ IIC/ SEMUDA
23.	NUMERICAL PROTECTION RELAYS FOR LT SYSTEM	SIEMENS/ ABB/ AREVA/ SCHNEIDER/SEL.
24.	NUMERICAL PROTECTION RELAYS FOR HT SYSTEM	AREVA / SIEMENS / ABB/SEL.
25.	AUXILIARY RELAYS	AREVA/ EASUN/ ABB/ GE/ SCHNEIDER/ SIEMENS
26.	VOLTAGE/ POWER/ CURRENT/ FREQUENCY/ ENERGY TRANSDUCER	ABB/ AE/RISHAV, NASIK/ SOUTHERN TRANSDUCER
27.	INDICATING LAMP	SIEMENS/ VAISHNO/ TECHNIK/ (CLUSTER LED TYPE) BINAY/ RASS/L&T,BCH/ VAISHNOV/GE/BINAY/ OPTO/ TECNIK/ SIEMENS



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TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

SI. No.	EQUIPMENT	Indicative Makes
28.	HOOTER/ BUZZER/ BELL	ANCHOR/MK/ABB/LEGREND
29.	1.1 KV CONTROL CABLE	UNIVERSAL CABLELTD. NICCO, INCAB, POLYCAB WIRESPVT. LTD, HINDUSTAN VIDYUT PRODUCTS LTD ,KEI INDUSTRIES, DELTON CABLE LTD, PARAMOUNT CABLE, GEMSCABS INDUSTRIES, CORDS CABLES, SPM CABLES, ELKAY TELELINK, HAVELLS INDIA LTD., R. R. KABEL, THERMOCABLES, FINOLEX, SB EE CABLES, SUYOG CABLES, SCOT INNOVATION WIRES & CABLES, INDO ALUSYS, RADIANT CABLES
30.	1.1 KV AC/DC POWER CABLE (PVC & XLPE)	UNIVERSAL CABLE LTD.NICCO, INCAB, HINDUSTAN VIDYUT PRODUCTS ,KEI INDUSTRIES,DELTON CABLE LTD,PARAMOUNT CABLE,POLYCAB WIRES PVT. LTD,GEMSCABS INDUSTRIES,CORDS CABLES,HAVELLS INDIA LTD.,SRI RAM CABLES,THERMOCABLES,SBEE CABLES,SUYOG CABLES,FINOLEX,SCOT INNOVATION WIRES AND CABLES,INDO ALUSYS,RADIANT CABLES
31.	H.T. CABLE GRADE- UPTO 33KV	APARINDUSTRIES, FINOLEX, GEMSCAB, GUPTA POWER, HAVELLS INDIA LTD. INCAB (UPTO 11KV ONLY) KEC INTERNATIONAL, KEI INDUSTRIES, KRISHNA ELECTRICAL INDUSTRIES LTD (UPTO 11KV ONLY), NICCO (UPTO 11KV ONLY), PARAMOUNT, POLYCAB WIRES PVT. LTD, SRI RAM CABLES (UPTO 11KV ONLY), STERLITE, TIRUPATI PLASTOMATICS, TORRENT CABLE LTD (UPTO 11KV ONLY), UNIVERSAL CABLE LTD.
32.	LOCAL PUSH BUTTON STATIONS	SIEMENS/ L&T/ BCH/ C&S/ GE/TEKNIK
33.	LIGHTING FITTINGS (SV/MV/MH/FLUROESCE NT/CFL)	PHILIPS/ BAJAJ/ CGL
34.	HT CABLE JOINTING KITS & TERMINATION KITS	RAYCHEM / 3M / MECP
35.	CONTACTORS	SIEMENS / GE/L&T / CGL / ABB/ TELEMECHANIQUE
36.	HT HRC FUSES	COPPER BUSSMAN/ SIEMENS/ L&T/ GE
37.	LT FUSE	SIEMENS / ABB / GE POWER



MAITHON HYDEL STATION

## TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

SI. No.	EQUIPMENT	Indicative Makes
38.	TEMPERATURE SCANNER	MASIBUS/ PROCON / PYROTECH/
39.	МССВ	L&T/ SIEMENS/ GE POWER CONTROL / /MDS (LEGRAND)/ HAVELLS
40.	MINIATURE CIRCUIT BREAKER	SIEMENS/ L&T/ GE POWER CONTROL/ HAVELLS/ MDS (LEGRAND)
41.	LT SQUIRREL CAGE MOTOR	ABB/ BHARAT BIJLEE/ CGL/ KEC MARATHON/ SIEMENS.
42.	TERMINAL BLOCK	ELMEX/ PHOENIX CONTACT/ CONNECT WELL/ WAGO.
43.	CONTROL SWITCH	SIEMENS / KAYCEE / GE/ SALZAR
44.	LIMIT SWITCH	AG SYSTEMS/JAY BALAJI/ TECHNOCRATS / KAYCEE, SIEMENS, ESSEN DEINKI, LENCAS, L&T, HONEYWELL, BCH
45.	MIMIC PANELS & ANNUNCIATION PANELS	L&T / GE POWER CONTROL/ BHEL/ BCH/ MINLEC/ CONTROL DEVICES.
46.	Electrical Actuator	LIMITORQUE, ROTORK, AUMA, PBL.
47.	EARTH STRIP	INDUSTRIAL PERFORATION (INDIA) PVT. LTD. MJ ENGG, KR TRANSMISSION TOWER, URJA ENGINEERS, BM ENGG IND. LTD.
48.	CABLE TRAY	INAR PROFILES LTD, VATCO, INDIANA CABLE TRAYS, INDUSTRIAL PERFORATION, RATAN PROJECTS, INDIA ELECTRIC SYNDICATE, STEELITE ENGG., PREMIER POWER PRODUCTS, INDIANA GRATINGS, M.J. ENGINEERING, T.R.G, AMTECH, RUKMANI, PASSIVE INFRA, UNITECH FABRICATORS & ENGINEERS, PATNY SYSTEM, RABI ENGG, INDMARKFORM TECH PVT LTD, JAMNA METAL
49.	WELDING RECEPTACLES	SCHEINDER, AJMERA, BEST & CROPMPTON, BCH
50.	ELEVATOR	ECE, TECHNO, OTIS, KONE, OMEGA
51.	LT BUSDUCT	KGS ENGG, SPACEAGE, C&S, BHEL, NITYA ELECTRO CONTROLS, UNILEC, REEP
52.	CRD	BENGAL TECHNOCRATS PVT LTD. ELCTROZAVOD, ELECON



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TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(MECHANICAL & CIVIL)

SI. No.	EQUIPMENT	Indicative Makes
53.	LIGHTING WIRES / GI CONDUIT	BIS LICENCEE WITH VALID CML NO
54.	LIGHTING POLE	BIS APPROVED VENDORS AS PER IS-2713
55.	CONTROL PANEL/DISTRIBUTION BOARD	CONTROL & SCHEMATICS LTD., ELECTROMECHANICAL INDIA, SWITCHING CIRCUIT - KOLKATA, RITTAL, BANGALORE, ECS, FARIDABAD, POSITRONICS, ELECMECH CORPORATION, AHMEDABAD, CONTROL & SWITCHGEAR, PYROTECH, L&T, SIEMENS, SCHENIDER ELECTRIC.
56.	EMERGENCY LIGHT, TREFOIL CLAMPS, CEILING FANS M.S. ROD, G.I. FLAT, G.I. WIRE, EARTH WIRE	MAIN CONTRACTOR APPROVED SOURCES
57.	CABLE SOCKET & LUGS	DOWELLS, CHETNA,3D, ADDITIONALLY, ANY MAKE WITH VDE OR CE OR UL OR CSA MARKING OR BIS APPROVED WITH VALID CML NUMBER IS ACCEPTABLE
58.	CABLE GLAND	ANY MAKE WITH VDE OR CE OR UL OR CSA MARKING, OR BIS APPROVED WITH VALID CML NUMBER.IS ACCEPTABLE

# c. Control & Instrumentation. (C&I)

SI. No.	Equipment	Indicative Makes
1.	Pressure Gauge Differential Pressure gauge	WIKA, Forbes Marshall, Gauges Bourdon, Manometer India, A.N. Instruments, H Guru, Waree
2.	Pressure / Differential Pressure switches (Mech. Type).	Switzer, Indfoss, Gauges Bourdon (GIC), Ashcroft (Precision Industries), Vasu Tech, Trafag
3.	Pressure / Differential Pressure switches (Electronic Type).	Switzer, Indfoss, Gauges Bourdon (GIC), Ashcroft (Precision Industries), Vasu Tech, Trafag



MAITHON HYDEL STATION

## TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

SI. No.	Equipment	Indicative Makes
4.	Pressure / Differential Pressure/ Flow (DP type)/ Level (DP type)/ Temperature Transmitters	Emerson, Fuji, Honeywell, Yokogawa, ABB, Siemens, E&H
5.	Temperature gauges	WIKA, Gauges Bourdon, Baumer, Manometer India, A. N. Instruments, Thermostatic, Bells Control
6.	Thermocouple & RTD / thermowell	Gauges Bourdon, Tempsens, Pyro-electric Instruments, Industrial Instrumentation, Baumer
7.	Temperature Switch	General Instruments, Indfoss, Switzer, Vasu Tech
8.	Rotameters	Trac, Eureka instruments, Placka, IEPL, Scientific Devices
9.	Orifice Plate & flanges Assembly/ Venturi, Flow nozzle, Wedge flow element	Engineering Specialities, Micro-precision, Instrumentation Itd, Chemtrols-Samil, Minco Flow, Minco India, Unicontrol, Placka, Eureca
10.	Flow Switch (Mech. Type)	Krohne-Marshall, Switzer, Levcon, Trac, Scientific Devices
11.	Flow switch (Electronic Type).	Krohne Marshal, Switzer, Levcon, Trac, Scientific Devices
12.	Electromagnetic flowmeter	Yokogawa, Emerson, ABB, Siemens, Endress & Hauser
13.	Vortex Flow meter	Emerson, Yokogawa, Honeywell, Endress & Hauser, Siemens, ABB
14.	Mass (coriolis) flow meter	Emerson, Yokogawa, Endress & Hauser, ABB, Krohne Marshall, Rockwin
15.	PD/Turbine Flow meters	Daniel (Emerson), Bopp & Reuther (Toshniwal), Smith, Liquid Controls, Barton, Rockwin, ABB, SWITZER
16.	Level gauge (tubular, magnetic, reflex type)	Chemtrol, Levcon Instruments, Magnetrol, V-Automat, Sigma, SBEM, E&H, Krohne Marshall
17.	Level Switch (Conductivity type)	Endress & Hauser, Vega, SB Electro- mechanical, Techtrol, Level-Tech, Nivo Controls, EIP, Truck, Sapcon, VAUTOMAT



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

SI. No.	Equipment	Indicative Makes
18.	Level Switch (Capacitance/RF type)	Endress & Hauser, SB Electro-mechanical, Nivo Controls (For RF type only), Pune Techtrol (Far Cap. Type), EIP Enviro Controls (For RF Type only), Levcon (For Cap. Type only)
19.	Level Switch (Tuning	Vega, Endress & Hauser, Nivo Controls,
	fork/ Rod type)	S.B. Electro-mechanical, K-TEK
20.	Level Switch (Float type)	Chemtrols, Levcon Instruments, Sigma, E&H, SBEM, Trac
21.	Level Switch/ Transmitter (Displacer type)	Emerson, Kronne Marshall, E&H, Magnetrol, Yokogawa,, Kistler Morse
22.	Level Switch/ Transmitter (Ultrasonic type)	Endress & Hauser, Magnetrol, Emerson, Yokogawa,, Kistler Morse
23.	Level Switch/ Transmitter (Radar type	Endress & Hauser, Emerson (Rosemount), Siemens, Forbes- Marshall
24.	Level Switch/ Transmitter (Nucleonic type)	Dr. Berthold (Concord International),Emerson (Kay Ray), E+H, ECIL, OHMART-Vega
25.	Level switch (Electro- mech type)	Endress & Hauser, S.B. Electromechanicals, TRAC, LEVCON, VAUTOMAT
26.	Flow Switch (Mech. Type).	Krohne-Marshall, Switzer, Levcon, Trac, Scientific Devices
27.	Flow switch (Electronic Type).	Krohne Marshal, Switzer, Levcon, Trac, Scientific Devices
28.	Electromagnetic flow meter	Yokogawa, Emerson, ABB, Siemens, Endress & Hauser.
29.	Vortex Flow meter	Emerson, Yokogawa, Honeywell, Endress & Hauser, Siemens, ABB,
30.	Mass (coriolis) flow meter	Emerson, Yokogawa, Endress & Hauser, , ABB, Krohne Marshall, Rockwin
31.	PD/Turbine Flow meters	Daniel (Emerson), Bopp & Reuther (Toshniwal), Smith, Liquid Controls, Barton, Rockwin, ABB, SWITZER



MAITHON HYDEL STATION

## TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

SI. No.	Equipment	Indicative Makes
32.	Level gauge (tubular, magnetic, reflex type)	Chemtrol, Levcon Instruments, Magnetrol, V- Automat, Sigma, SBEM, E&H, Magnetrol, Krohne Marshal
33.	Level Switch (Conductivity type)	Endress & Hauser, Vega, Switzer, SB Electro- mechanical, Techtrol, Level-Tech, Nivo Controls, EIP, Truck, Sapcon,VAUTOMAT
34.	Level Switch (Capacitance/RF type)	Endress & Hauser, SB Electro-mechanical, Nivo for RF type Controls, Pune Techtrol (Far Cap. Type), EIP Enviro Controls (For RF Type), Levcon (Foe Cap. Type).
35.	Level Switch (Tuning fork/ Rod type)	Vega, Endress & Hauser, Nivo Controls, S.B. Electro-mechanical, K-TEK
36.	Level Switch (Float type)	Levcon Instruments, Sigma, E&H, SBEM, Trac
37.	Level Switch/ Transmitter (Displacer type)	Emerson, VAUTOMAT, Krhone, E&H, Magnetrol
38.	Level Switch/ Transmitter (Ultrasonic type)	Endress & Hauser, Siemens, Magnetrol, Emerson, Yokogawa,, Kistler Morse
39.	Level Switch/ Transmitter (Radar type)	Endress & Hauser, Emerson (Rosemount), Yokogawa,, Kistler Morse.
40.	Level Switch/ Transmitter (Nucleonic type)	Dr. Berthold (Concord International), Emerson (Kay Ray), E+H, ECIL, OHMART-Vega
41.	Level switch (Electro- mech type)	Endress & Hauser, S.B. Electro-mechanicals, TRAC, LEVCON, VAUTOMAT
42.	Control valve (Globe/Ball/VNotch/ Angle/Butterfly)	Instrumentation Limited, MIL Control Limitrd, Fischer Sanmar Limited, CCI Valve Technology Gmbh, Dresser Products Industries
43.	Fittings (compression & pipe) & valves	Swagelock, Parker, Hylok, Baldota, D K Lok, Fluid Control, Excel-Hydropneumatics,
44.	SS Tubes, Impulse pipes	ISMT, BHEL-Trichy, Ratnamoni
45.	Junction box	Rittal, Pyrotech, Sajas, KSI, Electro- Mechanical, Manisha Enterprise
46.	IS Interface/Zenner Barrier	Pepperl & Fuchs, MTL, Stahl, DEHN



# DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

SI. No.	Equipment	Indicative Makes
47.	Signal isolators	Pepperl & Fuchs, MTL, Stahl, Yokogawa, Protech (Forbes Marshall), Phoenix
48.	Annunciation system	IIC, Procon, ECIL
49.	Instrument Panels/ Cabinets/ Control Desk	Rittal, Pyrotech, IL, C&S, Siemens, Schneider, L&T.
50.	Thermocouple Compensating Cable	Paramount Cables, Delton, Cords cables, Brooks, Lapp cables, Elkay Telelinks, Crystal Cable, Universal Cable, KEI
51.	Instrumentation Cable (Screened, paired, triad- signal, control, power etc.)	Delton, Universal Cables, Thermopads, KEI, industries, Paramount Cables, Cords cables, Fort Gloster, Polycab, RELIANCE CABLES, Crystal Cable
52.	Analytical / Special Instruments	
53.	Vibration sensors & monitors	GE Bentley Nevada, SKF, Shinkawa (Forbes- Marshall), Rockwell Automation, Sensonic
54.	Density meter (Nucleonic)	Dr. Berthold, Rosemount (K-Ray), Thermo Fisher Scientific, Endress & Hauser, ECIL, OHMART- Vega, RONAN,
55.	Solenoid Valve	Asco, Heroin, Rotex, Nucon Industries, Veljan Hydrair, IMI Norgen Pvt. Ltd., Jefferson



# d. Fire Fighting:

SI. No.	Equipment	Indicative Makes
1.	CS Valves (gate, NRV)	As per list above
2.	Plug Valves	As per list above
3.	Ball Valves	As per list above
4.	Air Release Valve	LEADER VALVE , JALANDHAR, H.SARKAR , HOWRAH, INDIAN VALVE , NASHIK
5.	Pipe- MS/GI	SAIL, TATA, Jindal, Welspun, MSL,
6.	Pipe Fittings	As per list above
7.	Fire Hydrants	NEWAGE INDUSTRIES, SURENDRA NAGAR SUKHAN, AHMEDABAD SHAH BHOGILAL, AHMEDABAD
8.	Pressure Switch	As per Control & Instrumentation Sub vendor list
9.	Pressure Gauge	As per Control & Instrumentation Sub vendor list
10.	Solenoid valves	As per Control & Instrumentation Sub vendor list
11.	Strainer	As per list above
12.	Deluge Valves	TYCO, UK/USA, KIDDE INDIA, NAVI MUMBAI M&P,PUNE, HD FIRE, THANE/JALGAON
13.	Water Spray Nozzles	Kidde India, Navi Mumbai Tyco, UK/USA Hd Fire, Thane
14.	Foam Sprinkler	Kidde India, Navi Mumbai Tyco, UK/USA Hd Fire, Thane
15.	Q.B. Detector	Automatic Sprinkler, Usa Hd Fire, Thane Tyco (Grinell), UK/USA
16.	Steel Pipes (MS)	Asper list above
17.	Steel Pipes (GI)	SAIL, TATA, MSL, Jindal
18.	Portable fire extinguishers	Steel Age Industries, VFPS, Deflame(India),



## e. Ventilation, Air Conditioning Equipment.

SI. No.	Equipment	Indicative Makes
1.	Centrifugal fans for Ventilation	CBDOCTOR, , FLAKTWOOD, , F. HARLE , PATEL AIRFLOW, ALMONARD, SUBURBAN INDUSTRIAL WORKS <i>For AHU Fans</i> :, KRUGER, COMFERÉ
2.	Tube axial fans / Propeller Fans	CBDOCTOR, , FLAKTWOOD, , F. HARLE , PATEL AIRFLOW, ALMONARD, SUBURBAN INDUSTRIAL WORKS
3.	Main coolers	VOLTAS, BLUE STAR, CARRIER AIRCON, LG, HITACHI
4.	Window air conditioners	VOLTAS, BLUE STAR, CARRIER AIRCON, LG, HITACHI
5.	Packaged air conditioners	VOLTAS, BLUE STAR, CARRIER AIRCON, LG, HITACHI
6.	Packaged chillers	VOLTAS, BLUE STAR, CARRIER AIRCON, LG, HITACHI
7.	Air handling units / Fan coil units:	VOLTAS, BLUE STAR, CARRIER AIRCON, LG, HITACHI
8.	Cooling towers	PAHARPUR, MIHIR, ADVANCE, GAMMON INDIA,
9.	Refrigerant compressors	VOLTAS, BLUE STAR, ATLAS COPCO, KIRLOSKAR, HITACHI, , CARRIER,
10.	Duct Insulation	U.P.TWIGA, LLOYDS, BAKELITE HYLAM,
11.	Vibration isolators	GERB
12	3 / 2 way Control Valve	HONEYWELL, JOHNSON CONTROLS, SIEMENS
13	Fabricated Duct	ZECO, RADIANT, NUTECH, SPIRO
14	Strip Heater / Pan Humidifier	KEPL, DAS PASS, RAPID CONTROL
15	Balancing Valve	ADVANCE, CASTLE, FLOWCON
16	Actuators	SIEMENS, BELIMO, HONEYWELL, JOHNSON CONTROLS
17	Cyclones & Multiclones:	THERMAX, ALSTOM, C.DOCTOR, F.HARLEY, EFE, BATLIBOI, F.L.SMIDTH,



## f. Water System

SI No.	Item Description	Manufactures
1.	CS Valves (gate, NRV)	As per list above
2.	Plug Valves	As per list above
3.	Ball Valves	As per list above
4.	Air Release Valve	As per list above
5.	Pipe- MS/GI	As per list above
6.	MS/GI Pipe Fittings	As per list above
7.	Sluice Gates	As per list above
8.	Fire Hydrants	As per list above

# g. Closed Circuit Video Monitoring System

SI no	Equipment / Item	Indicative Makes
1.	CAMERA	PELCO/ HONEYWELL/ BOSCH / SONY
2.	NETWORK VIDEO RECORDER (NVR)	PELCO/ HONEYWELL/ BOSCH/ SONY
3.	ETHERNET SWITCH	CISCO/ NORTEL/ALLIED TELESYS/ NETGEAR/ D-LINK/ EXTREME
4.	DISPLAY MONITOR	LG/ SAMSUNG/ SONY
5.	POWER CABLE	FINOLEX/ POLYCAB/ HAVELLS
6.	CAT6 CABLE	D-LINK/ FINOLEX/ POLYCAB/ HAVELLS
7.	OFC CABLE	MOLEX / FINOLEX / ERICSON / STERLITE / HFCL / OPTEL

### h. Other Items

SI no	Equipment / Item	Indicative Makes
1.		GRASIM
		BIRLA COPORATAION
	CEMENT	AMBUJA
		ULTRATECH
		LAFARGE (NUVOKO VISTAS)
		ACC LIMITED
		CENTURY CEMENT (BIRLA GROUP)
		JAYPEE
2.	CONSTRUCTION	FOSROC,



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	CHEMICALS:	STP,
		SIKA,
		PIDILITE,
		CICO,
		MC BAUCHEMIE
		BECK.
		BASF
		FOSROC
3.	COLOUR COATED SHEET	TATA BLUESCOPE
	(FOR COIL)	LLOYD INSULATION (INDIA) LTD.
		JSW STEEL
4.	PROFILERS FOR DECKING/	APPROVED PROFILER OF RESPECTIVE MANUFACTURER
5.		INDIANA GRATINGS PVT LTD
	GRATING	BHOLARAM GRATINGS
		PINAX STEEL INDUSTRIES PVT LTD
		RATAN PROJECTS & ENGG. Co. LTD.
		KANADE ANAND UDYOG PVT. LTD.
6.	PAINT AND PAINTING	BERGER PAINTS
	SYSTEM	ICI DULUX
		ASIAN PAINTS
		JOHNSON & NICHOLSON
		NEROLAC
7.	PU PAINT	MRF,
		BERGER
		ICI DULUX
		ASIAN PAINTS
8.	GI PIPES	ΤΑΤΑ
		JINDAL
		APL Apollo
		UTKARSH
9.	INSULATION WOOL	LLOYD INSULATION (INDIA) LTD.
		ROCKWOOL
10.	PVC WATER STOP	SOFTEX INDUSTRIES
		D.M. POLYMER
		MARUTI RUBBER



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		KANTA RUBBER
		GREENSTREAK
		DURON
11.	PLASTIC/ PVC PIPES	FINOLEX
		ORIPLAST
		SUPREME
12.	FLOOR TILES	KAJARIA
		JOHNSON
		NITCO
		SOMANY
13.	FIREPROOF DOORS	GODREJ
		SHAKTI HORMANN PVT. LTD.
14.	ROOF WATER PROOFING	STP,
		SIKA,
		LLOYD INSULATION (INDIA) LTD.
		CICO,
		PIDLITE
		FOSROC
15.	RCC PIPES	BIS APPROVED MANUFACTURER
16.	FALSE CEILING - GLASS	ARMSTRONG
	REINFORCED GYPSUM	HUNTER DOUGLAS
		FUNDERMAX
17.	7. BITUMEN ASPHAULT	IOCL,
		HP,
		SHELL,
		ALL GOI REFINERIES
18.	BITUMEN IMPREGNATED FIBER BOARD JOINT	SHALITEX
		SIKA
		BASF
		JOLLY BOARD
		STP
19.	SANITARY ITEMS (CI PIPES & FITTINS)	BIS APPROVED MANUFACTURER
20.		CERA
	CP BRASS TAP AND OTHER SANITARY FITTINGS	HINDWARE
		JAQUAR
		PARRYWARE



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21.	POLYTHENE WATER STORAGE TANKS - IS 12701	SYNTAX
		SINTEX INDUSTRIES LTD.
		PATTON
		NILKAMAL
		SUPREME INDUSTRIES LTD.
22.	REINFORCEMENT STEEL	SAIL,
		RINL,
		TISCO,
		JSPL
23.	STRUCTURAL STEEL	SAIL,
		IISCO,
		RINL,
		TISCO,
		JSPL,
		JSW,
		ESSAR (Flat/ Steel Plates)
		LLOYD STEEL (UTTAM VALUE STEEL) (FLAT/STEEL PLATES)
24.	STEEL HOLLOW SECTION	TATA STRUCTURA
		JINDAL
		APL APOLLO TUBES LIMITED
		MAHARASHTRA SEAMLESS
		WELSPUN CORP
25.	25. STAINLESS STEEL RAILING	SALEM STEEL
		JINDAL STAINLESS STEEL
		ENTARCHCON INFRATECH PVT. LTD.
26.	HEAVY DUTY ANCHOR FASTENER	HILTY,
		FISCHER
		BAUCH
27.	HSFG/ HT BOLTS	ASP Pvt. Ltd,
		GKW,
		DEEPAK FASTENERS
		NEXO
		PRECISION FASTENERS
		PIONEER NUTS & BOLTS PVT. LTD.
		SUNDARAM FASTENERS
		BOLT MASTER



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		KARAMTARA FASTENERS
		SREE PAVITRA INDUSTRIES
		PANCHSHEEL FASTENERS
28.	WELDING ELECTRODES	ESAB
		ADOR WELDING LTD.
		D&H SECHORON ELECTRODES (P) LTD
		General Electrodes (P) Ltd.
		Fusion Engg Products.
		Voltarc Electrode Pvt. Ltd.
		Honavar Electrode Pvt. Ltd.
		Gee Ltd
		Maruti Weld Ltd., Gurgaon
		Robler Wolding Group
		Kobe Steel I td
		Metrode Products Limited
		Royal Arc Electrodes Pvt. Ltd.
		ADVANI- ORLIKON WELD ALLOY
		MODI ARC ELECTRODE
		L&T EUTACTIC
29.	VIBRATION INSULATION SYSTEM	GERB
30.	ALUMINIUM SECTION	Hindustan Aluminium,
		ZINDAL
		NALCO,
		BALCO
31.	GLASS (FLOAT/	FLOAT GLASS INDIA LTD
	TOUGHENED/ INSULATING)	MODIGUARD
		SAINT GOBAIN
		BELGIUM GLASS LTD

**SECTION "B":** 

**TECHNICAL SPECIFICATION** 

(CIVIL)



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



### 1.0 CIVIL WORKS

#### 1.1 General

- 1.1.1 The Civil Works for the project primarily comprises of Renovation & Retrofitting Works for Civil Structures for Unit # 1 and Unit # 3 of Power House. All the Civil Renovation & Retrofitting works shall match to the existing structures. Utmost care shall be taken while carrying out dismantling works to ensure that no damage is done to the existing structures. Also, safety & stability of the existing structure shall be taken care during execution of the works.
- **1.1.2** The Bidder shall visit and carefully examine the site and surroundings to satisfy himself about the nature of all existing structure, existing underground services, general site condition, extent of dismantling works & renovation works required, the site for disposal of surplus materials, debris etc. and all other factors affecting the works. Claim and objection due to ignorance of site condition shall not be considered after submission of tender.

### 2.1 Scope of work

Renovation & Retrofitting Works of existing Civil Structures & Facilities are under the Scope of works of the Bidder. Bidder's scope shall include complete engineering, construction and execution of Civil Engineering Works on Turn-Key basis including Basic Engineering, Detail Design, Detailed Engineering, Supply of all materials, Construction, Execution, Testing for all structures & facilities required for completion of the Civil Engineering Works for Unit No. 1 & 3 of Power House.

#### 2.1.1 Renovation & Retrofitting Works

Civil Engg Renovation & Retrofitting Works pertaining to Civil Structures of the following existing units & facilities shall be under the Scope of Works of the Bidder:

- (a) Turbine & associated equipment.
- (b) Generator & associated equipments.
- (c) Power House Building.
- (d) Transformer and Electrics.
- (e) Access Tunnel
- (f) Tail Tunnel



#### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



- (g) Tail channel
- (h) Emergency Exit
- (i) RCC portion of Draft tube
- (j) Other Misc. Equipment

The Renovation & Retrofitting Works involve:

- Repair of Cracks by making "V"-groove and filling with epoxy grouts wherever cracks are visible.
- The cracks developed in the plastered surface at the external surfaces of the building are to be repaired with new plastering. Moss and vegetation growth from the surfaces shall be completely removed.
- Non-shrink polymeric water-proof grouting compound admixed with cement slurry through the nozzles at locations where water seepage is observed and at weak or honey-combed concrete locations.
- Wherever concrete spalling has taken place, shotcreting/gunniting shall be carried out.
- Carbon Fibre Wrapping shall be provided for enhancing the structural strength of concrete member (wherever necessary).
- Modification/retrofitting/strengthening of existing equipment foundation to suit the requirements of new equipment.
- Cleaning of deposit behind RCC Wall in Access Tunnel.
- Additionally, Steel Liner Encloser Plate shall be provided all around on Emergency Exit near to unit # 3.
- Moss and vegetation growth from the surfaces shall be completely removed. The rough surface in the rock tunnel wall at the internal surfaces of the tunnel shall be rendered with 1:6 cement mortars to achieve a smooth surface.
- Filling with RCC of unused block/cuts/openings after removal of old equipment.
- Anchoring of guides including the required waterproofing works
- Dismantling of existing structures for installation of new equipment wherever required.





- Removal of dismantled structures, materials, cables etc. to place identified by the purchaser.
- Construction of temporary structures with concrete/ masonry to facilitate the main construction work, including dewatering etc as required. These temporary structures shall be dismantled and materials/debris shall be removed from site after completion of work.
- All other minor civil engineering works that will be necessary to complete the works in all respect.
- The external surfaces of the building shall be painted with cement based paint.
- The internal surface of the building shall be provided with white wash or colour wash as per requirement.
- Expansion joints shall be treated by filling of gap with Polysulphide joint sealant wherever necessary, followed by covering the same with GI sheet all along external and internal exposed surfaces.
- Rainwater Pipes wherever required shall be provided and the choked/damaged Rainwater Pipes are to be replaced.
- Assessing the present quality of concrete, reinforcement, structural steel, bolt etc. shall be done by Bidder & the report verified/approved by competent/DVC.
- Replacement of man door at the entrance to the power house and repair of door and window at ventilation fan house.

# • Tail channel:

- a. The Tailrace Channel shall be dredged off to maintain its designed bottom level and cross section.
- b. The foreign hinderances like loose boulder chunks etc shall be removed from the channel.
- c. The vegitations and tree branches shall be cut and removed from the channels.
- d. The sharp stone edges at the entry locations of each tunnel in surge chamber area shall be cut to achieve a smooth bell mouth shaped entry into the each tunnel.



### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



e. To maintain a smooth flow, it is recommended that the entire stretch of the both sides of open channel shall be lined with 250 mm thick RCC approx 12ft from the bed level of the channel. The approx quantity of RCC work is about 650m3(Grade M30) {For bidding purpose bidder may quote as per mentioned quantity}. However, the exact quantity (final quantity) of RCC may vary as per site requirement and site condition.

Payment shall be on the basis of quantum of work actually carried out. RCC consumption of +/- 10% shall be within scope of bidder. If RCC consumption during execution is more/ less than +/- 10% over specified quantity, employer shall pay/ deduct to/ from bidder price.

**Note:** Additional RCC quantity shall be reimbursed by DVC actual basis as per prevailing DSR rate. Deduction also being carried out as per prevailing DSR rate.

# • Emergency Exit :

The evacuation emergency shaft roof shall be made completely water proofed. For this the top roof surfaces and side surfaces shall be made waterproof by non-shrink polymer pressure grout.

# Draft tube

Existing damage surface to be removed and filled with new concrete along with providing mesh reinforcement (approx 250mm)

# 2.1.2 Plastering

All plastering work shall conform to IS: 1661. External (rough) surface of walls shall be plastered with 18 mm thick cement plaster, consisting first (base) layer of 12 mm thick plaster in cement sand mortar (1:6) and second (finishing) layer of 6 mm thick plaster in cement sand mortar (1:4). The internal (smooth) surface of walls shall have 12 mm thick plaster in cement sand mortar (1:6).

All exposed faces of R.C.C. walls of structures as well as external / internal RCC surfaces including RCC parapet walls shall be provided with minimum 12mm thick plaster in cement sand mortar (1:4) except walls of underground structures like cable trenches / valve pits etc.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



All RCC ceilings (except areas provided with false ceilings and cable vault ceiling) shall be provided with 6 mm thick cement sand plaster 1:4.

## 2.1.3 Painting

All painting on masonry or concrete surface shall preferably be applied by roller. If applied by brush, then same shall be finished off with roller. All paints shall be of approved make including chemical resistant chlorinated rubber paint. Minimum two finishing coats of paint shall be applied over a coat of primer. The paint shall be of approved colour shade and make & shall be applied after proper surface preparation. The paint thickness (DFT) shall be as specified in the relevant IS codes. Special protection shall be required in respect of painting of steel surfaces embedded in concrete. The following IS codes shall be followed for painting:

- IS: 2395 : concrete, masonry and plastered surface
- IS : 1477 : steel work and ferrous metals.
- IS : 162 : Fire resistant transparent paint on all wood works etc.

All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be as per latest Indian Standard for galvanised Structures and shall comply with IS: 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS: 2629.

## Internal wall Finish

All Air conditioned areas shall have 2mm of polymer based water resistant putty (wall putty) to give an even and smooth surface. Air - conditioned areas shall be applied with minimum two (2) coats of acrylic emulsion paint as per IS: 5411 (Part - 1). All other areas shall be applied with minimum two (2) coats of Acrylic distemper as per IS: 428.

Toilet, Pantry / Kitchen areas shall have dado with Designer ceramic tiles, 300x450mm up to 2.2 m height and shall match with floor finish. Acrylic distemper paint shall be applied above the dado.

Areas coming in contact with chlorine fumes or acid / alkali shall have two coats of acid / alkali resistant chlorinated rubber paint over suitable primer on walls above dado & ceiling.



### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



## **External Wall Finish**

Acrylic Smooth Exterior Paint with silicone additives (minimum two coats) of approved colour shade and make shall be applied over suitable primer of approved colour and shade as per manufacturer's specifications for all types of plastered and / or exposed concrete surface, in all kinds of works, at all levels, including preparation of surface, labour, material, equipment, handling, transportation, mixing, laying, applying finishing, testing, curing, making grooves, scaffolding, staging, etc.

## **Ceiling Finish**

Ceiling shall have minimum two (2) coats of Acrylic distemper paint .

2.1.4 **Steel doors, windows and ventilators:** Steel doors, windows, ventilators and their fittings for residential and office buildings shall conform to IS:1038.

Steel windows for industrial buildings shall conform to IS:1361.

External doors shall be provided with threshold as shown in IS:1081 and the doors required for internal use shall be provided with an approved size base tie-bar in lieu of threshold.

Unless otherwise specified, coupling sections shall be of mild steel and handles, peg stays and pivots of centre hung ventilators shall be of lead-tin-bronze alloy (gun metal). Hinges for side hung shutter shall be projecting non-friction type. Weather bars shall be provided as per requirement. The type, size, number and position of fixing lugs shall conform to IS:1038. The steel doors shall be painted with one coat of zinc chromate primer conforming to IS:2074 before they are supplied. Final painting shall be done with two coats of ready mixed approved synthetic enamel paint of approved colour. Glazing clips shall be provided where panel sizes exceed 600 x 300 mm and shall be of shape as shown in IS:1038.

2.1.5 Rain water from the roof will be taken into G.I. rainwater pipes of adequate sizes at suitable intervals/locations and discharged into the plant storm water drainage system through surface drain. G.I. pipe sleeves for draining out rainwater from chajja and canopy will be provided at suitable locations

## 2.1.6 Dismantling

Dismantling area to be identified by the Engineer. Dismantling of all weak and dilapidated reinforced cement concrete, removal of rust layers shall be done manually mechanically all as per instructions of the Engineer.





MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)

No debris shall be left over during the repair works under each item. An area for 'Debris bins' will be identified within 50 M lead on the request of contractor for collection of debris generated on day to day basis. The contractor must maintain adequate number of wheel barrows all the time for shifting the debris to Debris bin within 50m lead, from work place.

2.1.7 Sufficient nos. of 12mm dia MS/PVC nozzles of suitable length all over the inside surfaces of raft/wall/roof slab, joints, cracks etc from where seepage is seen or envisaged, for providing water-proofing system to reinforced concrete existing structures to make water tight ( including using water proofing compounds of reputed manufactures like FOSROC/ BASF/ CHRYSO or equivalent) at all locations, depths and heights, and finally pressure injecting non-shrink polymeric water proof grouting compound admixed with cement milk through the nozzles and sealing the nozzles with approved sealant after grouting.

## 2.1.8 EPOXY injection grouting into concrete cracks/damages

- 2.1.8.1 Excavate below ground level (as required and directed by the Engineer) around the columns and structures for the repair jobs for either strengthening or repairing. The excavated area shall be backfilled after repair work.
- 2.1.8.2 Identify the cracks/damages on the surface and carefully chip the existing loose concrete on both sides of the crack openings/damages along the length of the cracks/damages. Remove damaged cracked plaster/concrete using chisel and hammer or by mechanical means. Remove the debris.
- 2.1.8.3 Clean the surface by wire brush and water jet after chipping and ensure that all loose, dust particles are washed off completely. Groove cutting shall be done along the crack/damage up to 50 mm depth. Beyond 50 mm, any cutting shall be done with the approval of Engineer.
- 2.1.8.4 Drill a hole of suitable dia up to 75 to 100 mm depth for fixing 12mm MS nozzles along the length of the crack/damage for pressure grouting with approved make Epoxy mortar at 450 mm spacing on cracked/damaged concrete structure. Seal outer crack openings with approved make Epoxy mortar or putty as per manufacturer's specification.
- 2.1.8.5 Pressure grouting shall be done using approved make Epoxy injection Resin Grout as per manufacturer's specification, through nozzles with a suitable pressure grouting machine.
- 2.1.8.6 Pressure grouting shall start from the nozzles fixed at the bottom & gradually moving up.



### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



Once the nozzle shows refusal of epoxy grout intake, nozzles shall be sealed & grouting for the next nozzle shall start. Locations shall be informed in advance to Engineer before epoxy injection.

2.1.8.7 Once the pressure grouting has been done, nozzles shall be cut using appropriate tools and sealed using approved make Epoxy mortar or putty as per manufacturer's specification.

## 2.1.8.8 Reinforcement bar Priming for Corrosion Protection

- 2.1.8.1 Priming of the exposed steel reinforcement bars shall take place immediately after the cleaning operation is complete and the bar is dry.
- 2.1.8.2 Priming shall be done with approved make epoxy based priming product as per manufacturer's specifications.
- 2.1.8.3 Two continuous coating shall be applied to all exposed reinforcement bars using a suitable paint brush. Care shall be taken to ensure and achieve regular coating all around each bar. The minimum wet film thickness will be approximately 70 microns. The primer shall be allowed to dry for minimum 1 hour.

## 2.1.9 **Guniting/ Shortcreting** (wherever necessary)

Guniting/ Shortcreting shall be provided to concrete surface with 1:1:2 cement mortar (1 cement : 1 coarse aggregate 6mm downgraded : 2 sand) and including providing & fixing of MS welded wire mesh (IRC fabric) of approved manufacturer having wire dia 4mm and mesh opening size 80mm X 80mm, necessary scaffolding, cleaning of reinforcement and disposing of debris.

Strengthening and repairing concrete with CFRP is to reinforce the original structure by bonding CFRP fabric to the surface of the structure. Generally, it is suitable for the tension parts of slabs and beams, shear parts of beams and columns and piers, parts with insufficient anchorage length of reinforcing bars, reinforcement of columns and piers, and bending, shear and tensile reinforcement of roof trusses. Carbon fiber is also used in civil buildings, structures, anti-seismic, anti-cracking, anti-corrosion reinforcement. Compared with traditional reinforced concrete or steel-bonded concrete, carbon fiber has the advantages of space saving, simple construction, no need for site fixing facilities, easy



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



construction quality assurance, no increase in structural size and weight, corrosion resistance, good durability and so on.

### 2.1.10 Design principle of reinforcement

In the calculation of concrete beams and slabs strengthened with CFRP, the effect of concrete in tension zone is neglected. The average strain of concrete, CFRP and steel after bending conforms to the assumption of plane section, and the linear elastic stress-strain relationship is adopted for CFRP. According to the assumption of plane section, the strain of carbon fiber should be slightly greater than that of reinforcing bar. To simplify the calculation, the tensile strain of carbon fiber can be approximately equal to that of reinforcing bar. According to the principle of equal tension, the area of CFRP can be transformed into the equivalent area of steel bars, and then the equivalent area of steel bars can be obtained. Carbon fiber material specification: As per requirement of design calculation or single layer thickness is 0.167 mm, tensile strength is not less than 3400 MPa, tensile modulus of elasticity is not less than  $2.3 \times 10^5$  MPa, elongation is not less than 1.6%.

#### 3.1 General Specifications

- (a) Minimum cement content and maximum water cement ratio shall be normally as per stipulations of BIS codes.
- (b) Unless specifically approved by the Engineer the maximum nominal size of coarse aggregates for concrete shall be 20mm and down.
- (c) All reinforced concrete work will be of minimum grade M30.
- (d) Steel reinforcement to be used shall be Fe500 grade or equivalent shall be used unless otherwise specified.
- (e) Wherever there is a joint of old and new concrete, suitable chemical treatment shall be provided to the surface of old concrete to develop adequate bond.
- (f) Any other technical specification related to civil/structural not mentioned here shall be followed CPWD specification (Latest version).
- (g) Design Loads

Loads due to normal operating condition as well as due to extra ordinary conditions shall be taken into account. For normal operating condition, following loads shall be considered.



### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



- Dead loads
- Live loads
- Load throw loads
- Piping loads
- Thermal loads
- Unbalanced dynamic loads from turbine and generator
- Torque load
- Temperature load (as specified by manufacturer) For extra ordinary conditions, following loads shall be considered.
- Seismic load (as per IS: 1893)
- Wind load (as per IS: 875)
- Short Circuit load
- Any other abnormal load due to machine breakdown, as specified by manufacturer.
- The load combinations shall be as per IS: 2974(part-3)

#### 3.1.1 Design Calculations

The necessary design calculations shall be submitted by the Bidder along with construction drawings.

### 3.1.2 Quality Control

The Bidder shall carryout all required checks and tests, and as directed by the Purchaser, and submit the results thereof. Acceptance of works shall be subjected to achieving required quality as laid down in code of Bureau of Indian Standards.

#### 4.1 List of Civil Engineering Drawings & Documents for Approval/Information

#### 4.1.1 Group I: For Approval

a) Drawing numbering system.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (MECHANICAL & CIVIL)



- b) List of drawings, with drawing Nos. and title.
- **4.1** In general, Stipulations of the following Standards (latest) shall be considered as guidelines, unless otherwise specified above
  - 1) IS: 2974
  - 2) IS: 1893
  - 3) IS: 456
  - 4) IS: 4247