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1 FILTER/STRAINER ASSEMBLY FOR WATER APPLICATION

1.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of *Automatic backwash/ automatic self-flushing/ Duplex* filter assembly (*Project specific*). The filter shall be used for continuous supply of filtered clean water for use in Cooling water/ Ventilation system/ Fire Fighting system (*Project Specific*) in XXX Hydro Power Plant of NHPC.

1.2 Specific Parameters and Design Consideration:

The filter shall be suitable for installation in existing foundation.

The project is situated in Himalayan region where silt content during high flow period is excessive and peaks abnormally. The filter is expected to handle water with heavy silt concentration during high flood. The Contractor shall critically study silt data of water and take the same into account in designing the filter susceptible to abrasive effect of silt, making all such specific provisions and measures including selection of materials, surface coating, corrosion protection/ painting which will help to resist silt erosion/abrasion and enable easy and quick maintenance/replacement of worn out components

1.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

1.4 Functional Characteristics

The filter assembly shall arrest the debris, tree leaves, pebbles, coarse and fine sand that may appear in the water tapped from *river/ draft tube (project specific)*. The assembly shall be designed to operate satisfactorily under silt concentration upto 3000/5000 ppm (project specific) during high flood.

1.5 Construction

1.5.1 Filter

The filter shall be wedge wire (*Project Specific*) type capable to remove particle of size XXXX microns and above. The strainer shall have cast steel body with stainless steel filter element. Automatic drain valve that shall operate based on both i.e. set time and differential pressure. Automatic control shall be integral part of the automatic filter

Adequate sensing arrangement shall be provided to sense the pressure drop across the filter for further integration with plant SCADA system

1.5.2 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1	Type of filter	<i>Automatic backwash/ automatic self flushing / duplex</i>
2	Type of filtering media & Thickness	Wedge wire & XXX mm
3	Location of filter	<i>Inlet/ outlet of pump</i>
4	Degree of filtration	XXXX micron
5.	Design water flow rate	XXXX LPM
6.	Design pressure/ test pressure	XX X/ XXX Bar
7.	Maximum permissible pressure drop across strainer at design flow & 50% clogged condition	XXX bar
8.	Inlet and Outlet Flange Size	XXX NB
9.	Wash water actuator type	<i>Electro pneumatic/ Motorized</i>
10.	Detail of wedge wire/ element	As per attached drawing
11	Dimensional detail of assembly (Diameter & Height)	As per attached drawing
12.	Ends	<i>Flanged, Dimensions conforming to ANSI B 16.5 RF, 150 lb</i>
13	Motor	
a.	Supply Voltage	415 VAC +/-10%, 50 HZ+/- 5Hz
b.	Rating	XXX KW
c.	Protection	IP 54
14.	Control Panel Location	As per Requirement
15.	Quantity	XX Nos.
16.	Material of Construction	
a.	Filter Tank	Cast steel/ carbon steel
b.	<i>Rotating back flush arms</i>	<i>Stainless steel (AISI 316 or better)</i>
c.	Element/ Candle/ Screen	Stainless steel
17.	Whether Differential pressure gauge with alarm contacts provided	Yes

1.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing operation principles, dimensions and other technical details.
- ii) General Arrangement drawing comprising of element configuration and material Part list.
- iii) Technical Data Sheet.
- iv) O&M manual comprising of all above including list of recommended spare parts, Assembly and disassembly procedure etc.

2 HORIZONTAL CENTRIFUGAL WATER PUMP

2.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of horizontal centrifugal water pump. The pump shall be used for continuous supply of water to Cooling water/ Ventilation system (*Project Specific*) in XXX Hydro Power Plant of NHPC.

2.2 Specific Parameters and Design Consideration:

The pump motor set shall be suitable for installation in existing foundation.

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally. Pump set may be expected to handle water with heavy silt concentration during high flood. The Contractor shall critically study silt data of water and take the same into account in designing the pump set susceptible to abrasive effect of silt, making all such specific provisions and measures including selection of materials, surface coating, corrosion protection/ painting which will help to resist silt erosion/abrasion and enable easy and quick maintenance/replacement of worn out components.

2.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

2.4 Functional Characteristics

The pump set shall be able operate under the debris, tree leaves, pebbles, coarse and fine sand that may appear in the water tapped from *river/ draft tube (project specific)*. The pump set shall be designed to operate satisfactorily under silt concentration upto 3000/5000 ppm (project specific) during high flood.

2.5 Construction

2.5.1 Pump

The material of the pump impeller and casing shall be XXXX (*ASTM/ AISI XXX or better*) and cast steel/grey cast iron respectively. The selected impeller material shall have excellent abrasion and corrosion resistance properties. The pumps shall be complete with continuous duty electric motors with class F insulation (temperature rise limited to class B), control panels, anchor bolts and other mounting materials complying with suitable Indian and International Standards. The motor shall be suitably sized to drive the pump continuously over the specified characteristics without getting overloaded. The pumps shall be suitable for 415V \pm 10%, 50Hz \pm 5% with contacts for remote operation / indication. The speed of pumps shall not be more than XXXX rpm.

Adequate arrangement shall be provided to prevent the pump from rotation in reverse direction

2.5.2 Motor

Motor shall be of totally enclosed fan cooled type. All outdoor installed motors shall be of weatherproof design (*project specific*). Motor shall be able to withstand at least three cold starts per hour, equally spaced. Motor shall be capable of withstanding three successive starts under the same conditions or once every twenty minutes without detrimental heating. Motor capable of operating continuously under rated output conditions at any frequency between 95% - 105% of rated frequency &/or with voltage variation between 90%-110% of the nominal voltage. Transient over voltage of 130% of the nominal voltage shall as well be sustained. Motor shall be capable to maintain stable operation, when running at 70% nominal voltage for a period of 10seconds. Pull out torque shall be at least 160% of the rated torque.

With 85% of the nominal voltage applied to the motor terminals, motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque. The maximum starting currents shall not exceed 5 times of rated current for LV motors rated 100kW or above.

Motor shall be provided with terminal box. Terminal box shall be weather proof IP54 and firmly fixed to the motor frame. The terminal studs shall be adequate for the current duty required and shall be identified. The terminal box shall have approved cable plates, sealing chambers or conduit entries. The arrangement of the terminal box shall be such as to facilitate installation of cables and allow interchanging of any two phases leads without disturbing the sealing compound, if this is used at cable terminations. Terminals, terminal Box and Cable glands of terminal boxes of motor should be suitable for cable size required for the motor

2.5.3 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1	Item description	<i>Horizontal Centrifugal pump motor set</i>
2	Pump	
a.	Type	<i>End suction/ Axial split etc.</i>
b.	Rated head	XXX mwc
c.	Rated Discharge	XXX LPM
d.	No. of Stages	XX
e.	Pump Efficiency a duty point	Not less than XX %
f.	Power input to pump at duty point	Not more than XX kW
9.	Bearing (running life)	<i>Not less than XXXX hours</i>
10.	Coupling Type	<i>Flexible/ Rigid</i>
11.	NPSH required	XX m

12.	Rated Speed	<i>Not More than XXXX rpm</i>
13.	Coupling guard provided	Yes
14.	Orientation of Suction/ Delivery ends	As per attached drawing
15.	Material of Construction	
a.	Casing	Cast Steel/ Grey cast Iron
b.	Impeller	XXXX
c.	Wearing ring	XXX
d.	Pump Shaft	Stainless Steel (AISI 410 or better)
e.	Shaft sleeve	Stainless Steel (AISI 410 or better)
f.	<i>Mechanical Seal/ Gland Packing (as applicable)</i>	XXX
16	Motor	
a.	Type	<i>3 phase, AC, Sq. Cage Induction Motor, IE2 or better efficiency</i>
b.	Supply Voltage	415 VAC +/-10%, 50 HZ+/- 5Hz
c.	Rating	XXX KW
d.	Protection	IP 54
e.	Frame size	XXXX
f.	Motor service factor	<i>1.1/1.15</i>
g	Duty	S1 (Continuous)
h.	Applicable standard	IS:325, IEC:60034, IS:12615
i	Insulation Class	Class F (Temp. Rise limited to class B)
j	Degree of protection	IP55
k	Type of enclosure & cooling	<i>TEC/ FAN Cooled</i>
l	Noise level	Not to exceed 85db
m	Min. Starting voltage	85% of rated voltage
n	Rated current	Not to exceed XXX A
o	Connection	<i>DOL/ Start Delta</i>
p	Space heater provided	Yes/No
q	Motor capable of operation for a period of 5 mins at 75% of rated voltage at nominal frequency without injurious overheating	Yes
r.	Control Panel Provided	Yes/ No (As per Requirement)
s	Foundation details	As per attached drawing/ sketch

t	Suction/ Delivery size & Flange details	As per attached drawing
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2.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) General Arrangement and cross section drawing with material Part list.
- iii) Pump set performance curves
- iv) Technical Data Sheet.
- v) O&M manual comprising of all above including list of recommended spare parts, Assembly and disassembly procedure etc.

3 HORIZONTAL CENTRIFUGAL PUMP FOR FIRE FIGHTING SYSTEM

3.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of horizontal centrifugal water pump. The pump shall be used for supply of water to Fire Fighting system in XXX Hydro Power Plant of NHPC.

3.2 Specific Parameters and Design Consideration:

The pump motor set shall be suitable for installation in existing foundation.

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally. Pump set may be expected to handle water with heavy silt concentration during high flood. The Contractor shall critically study silt data of water and take the same into account in designing the pump susceptible to abrasive effect of silt, making all such specific provisions and measures including selection of materials, surface coating, corrosion protection/ painting which will help to resist silt erosion/abrasion and enable easy and quick maintenance/replacement of worn out components.

3.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

3.4 Functional Characteristics

The pump set shall be able operate under the debris, tree leaves, pebbles, coarse and fine sand that may appear in the water tapped from *river/ draft tube (project specific)*. The pump set shall be designed to operate satisfactorily under silt concentration upto 3000/5000 ppm (project specific) during high flood.

3.5 Construction

3.5.1 Pump

The material of the pump impeller and casing shall be XXXX (*ASTM/ AISI XXX or better*) and cast steel/grey cast iron respectively. The selected impeller material shall have excellent abrasion and corrosion resistance properties. The pumps shall be complete with continuous duty electric motors with class F insulation (temperature rise limited to class B), control panels, anchor bolts and other mounting materials complying with suitable Indian and International Standards. The motor shall be suitably sized to drive the pump continuously over the specified characteristics without getting overloaded. The pumps shall be suitable for 415V \pm 10%, 50Hz \pm 5% with contacts for remote operation / indication. The speed of pumps shall not be more than XXXX rpm.

Pump shall be capable of furnishing not less than 150% of rated capacity at a head of not less than 65% of the rated head. The shutoff head shall not exceed 120% of rated head.

The fire pump-motor set shall be suitable for fire application and shall meet the applicable Indian/ international standards/NFPA.

Adequate arrangement shall be provided to prevent the pump from rotation in reverse direction

3.5.2 Motor

Motor shall be of totally enclosed fan cooled type. All outdoor installed motors shall be of weatherproof design (*project specific*). The motor rating shall be at least equivalent to the horsepower required to drive the pump at 150% of its rated discharge.

Motor shall be able to withstand at least three cold starts per hour, equally spaced. Motor shall be capable of withstanding three successive starts under the same conditions or once every twenty minutes without detrimental heating. Motor capable of operating continuously under rated output conditions at any frequency between 95% - 105% of rated frequency &/or with voltage variation between 90%-110% of the nominal voltage. Transient over voltage of 130% of the nominal voltage shall as well be sustained. Motor shall be capable to maintain stable operation, when running at 70% nominal voltage for a period of 10seconds. Pull out torque shall be at least 160% of the rated torque.

With 85% of the nominal voltage applied to the motor terminals, motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque. The maximum starting currents shall not exceed 5 times of rated current for LV motors rated 100kW or above.

Motor shall be provided with terminal box. Terminal box shall be weather proof IP54 and firmly fixed to the motor frame. The terminal studs shall be adequate for the current duty required and shall be identified. The terminal box shall have approved cable plates, sealing chambers or conduit entries. The arrangement of the terminal box shall be such as to facilitate installation of cables and allow interchanging of any two phases leads without disturbing the sealing compound, if this is used at cable terminations. Terminals, terminal Box and Cable glands of terminal boxes of motor should be suitable for cable size required for the motor

3.5.3 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1	Item description	<i>Horizontal Centrifugal pump motor set</i>
2	Pump	
a.	Type	<i>End suction/ Axial split etc</i>
b.	Rated head	XXX mwc
c.	Rated Discharge	XXX LPM

d.	No. of Stages	XX
e.	Pump Efficiency a duty point	Not less than XX %
f.	Power input to pump at duty point	Not more than XX kW
9.	Bearing (running life)	<i>Not less than XXXX hours</i>
10.	Coupling Type	<i>Flexible/ Rigid</i>
11.	NPSH required	XX m
12.	Rated Speed	<i>Not More than XXXX rpm</i>
13.	Coupling guard provided	Yes
14.	Orientation of Suction/ Delivery ends	As per attached drawing
15.	Material of Construction	
a.	Casing	Cast Steel
b.	Impeller	XXXX
c.	Wearing ring	XXX
d.	Pump Shaft	Stainless Steel (AISI 410 or better)
e.	Shaft sleeve	Stainless Steel (AISI 410 or better)
f.	<i>Mechanical Seal/ Gland Packing</i>	XXX
16.	Motor	
a.	Type	<i>3 phase, AC, Sq. Cage Induction Motor, IE2 or better efficiency</i>
b.	Supply Voltage	415 VAC +/-10%, 50 HZ+/- 5Hz
c.	Rating	XXX KW
d.	Protection	IP 54
e.	Frame size	XXXX
f.	Motor service factor	1.1/1.15
g.	Duty	S1 (Continuous)
h.	Applicable standard	IS:325, IEC:60034, IS:12615
i.	Insulation Class	Class F (temp. Rise limited to class B)
j.	Degree of protection	IP55
k.	Type of enclosure & cooling	<i>TEC/ FAN Cooled</i>
l.	Noise level	Not to exceed 85db
m.	Min. Starting voltage	85% of rated voltage
n.	Rated current	Not to exceed XXX A

o	Connection	<i>DOL/ Start Delta</i>
p	Space heater provided	Yes/No
q	Motor capable of operation for a period of 5 mins at 75% of rated voltage at nominal frequency without injurious overheating	Yes
r.	Control Panel Provided	Yes/ No (As per Requirement)
s	Foundation details	As per attached drawing/ sketch
t	Suction/ Delivery size & Flange details	As per attached drawing

3.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) General Arrangement and cross section drawing with material Part list.
- iii) Pump set performance curves
- iv) Technical Data Sheet.
- v) O&M manual comprising of all above including list of recommended spare parts, Assembly and disassembly procedure etc.

4 CYCLONE SEPARATOR FOR COOLING WATER SYSTEM

4.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of cyclone separator. The cyclone separator shall be used to supply continuous clean filtered water to *Cooling/ HVAC/ Shaft sealing system* in XXX Hydro Power Plant of NHPC.

4.2 Specific Parameters and Design Consideration:

The separator shall be suitable for installation in existing foundation.

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally. Cyclone separator may be expected to handle water with heavy silt concentration during high flood. The Contractor shall critically study silt data of water and take the same into account in designing the equipment susceptible to abrasive effect of silt, making all such specific provisions and measures including selection of materials, surface coating, corrosion protection/ painting which will help to resist silt erosion/abrasion and enable easy and quick maintenance/replacement of worn out components.

4.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

4.4 Functional Characteristics

The separator shall be able handle debris, tree leaves, pebbles, coarse and fine sand that may appear in the water tapped from *river/ draft tube (project specific)*. The separator shall be designed to operate satisfactorily under silt concentration upto 3000/5000 ppm (project specific) during high flood.

4.5 Construction

4.5.1 Cyclone Separator

The material of the cyclone separators casing shall be *stainless steel (316or better) (Project specific)*. The separators shall be of continuous duty with flanged inlet and outlet for use with raw water pumped from draft tube/tail race. Individual separators shall preferably be capable for removal of all material as small as XXX microns with the efficiency of 98%. The thickness of cyclone separator casing shall be minimum Schedule 80.

Bolting type lower and upper half of cyclone separator is preferable in view of maintenance aspects.

The separators shall be complete with purge valve and controls for automatic continuous operation.

4.5.2 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1	Type	Cyclone separator
2.	Installation Arrangement	<i>Vertical/ Inclined</i>
3.	Quantity	XX Nos.
4.	Liquid to be handled	River Water
5.	Location of Installation (w.r.t pump)	<i>At outlet of Pump</i>
6.	Design / Test head	XXX mwc
7	Flow rate, Normal/ Maximum/ Minimum	XXX LPM / XXX LPM/ XXX LPM
8.	Filtration effectiveness/ Particle retention	Upto XX microns at 98 % efficiency.
9.	Whether bolting arrangement for lower and upper half provided	Yes
10.	Separator casing thickness	Minimum Sch. 80
11.	Maximum Pressure drop	Not to exceed XX mwc
12.	Orientation of Suction/ Delivery ends	As per attached drawing
11	End Connections	<i>XXXNB Flanged, 150lb SO RF</i>
13	Material of Construction	
a.	Casing/ Body	<i>Stainless steel</i>
b.	Flange	<i>Stainless steel</i>
b	Pipes/ Pipe Thickness	Seamless Stainless/ Minimum Schedule 80
14	Whether purge valve and controls for automatic continuous operation provided.	Yes

4.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) General Arrangement and cross section drawing with material Part list.
- iii) Technical Data Sheet.
- iv) O&M manual comprising of all above including list of recommended spare parts, Assembly and disassembly procedure etc.

5 HEAT EXCHANGER FOR COOLING WATER APPLICATION

5.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of plate type heat exchanger with associated accessories. The heat exchanger shall be used to transfer heat gained during the circulation through various coolers to raw water in *Cooling/ HVAC/ Shaft sealing system* in XXX Hydro Power Plant of NHPC.

5.2 Specific Parameters and Design Consideration:

The heat exchanger shall be suitable for installation in existing foundation.

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally. Heat exchanger may be expected to handle water with heavy silt concentration during high flood. The Contractor shall critically study silt data of water and take the same into account in designing the equipment susceptible to abrasive effect of silt, making all such specific provisions and measures including selection of materials, surface coating, corrosion protection/ painting which will help to resist silt erosion/abrasion and enable easy and quick maintenance/replacement of worn out components.

5.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

5.4 Functional Characteristics

The heat exchanger shall be able to handle debris, tree leaves, pebbles, coarse and fine sand that may appear in the water tapped from *river/ draft tube*.

5.5 Construction

5.5.1 Heat Exchanger

Heat exchanger shall be wide gap (not less than 4mm) plate type capable of transferring all the heat gained during the circulation through the various coolers to raw water.

Material of the plates shall be stainless steel (ASTM A 316 or better) and need to be suitable for prevailing water conditions. The pressure drop across heat exchanger shall not exceed 0.5 bar. The design of heat exchanger shall be based upon the maximum temperature rise of 5°C. The thickness of plate shall be at least 0.6mm.

The heat exchanger shall be provided with flanged connections for cooling water inlet and outlet on both sides. Temperature indicators, temperature transmitter, differential pressure switches & gauges shall be provided at the inlet and outlet, at the primary and at the secondary waterside of the heat exchanger for visual local and remote indication and alarm.

5.5.2 Specific Technical Parameter (Project Specific)

Sl. No.	Parameter	Value
1	Type	Wide gap plate type
2.	Design / Test head	XXX mwc
3	Rated Discharge	XXX LPM
4	Fluid Name (Primary Side/ Secondary Side)	River Raw water/ Clean water
5.	Plate thickness	Not less than 0.6mm
6.	Maximum Pressure drop	Not to exceed XX bar
7	Operating Temperature. IN/OUT – HOT Side	XX/ XX Degree C
8	Operating Temperature. IN/OUT – COLD Side	XX/ XX Degree C
9	Design Temperature	80 Degree C
10	Number of Plates	XX Nos.
11	Total Effective area	As per requirement/ Drawing
12	Total heat load	As per requirement/ Drawing
13	Orientation and size of Suction/ Delivery ends	As per attached drawing
14	Material of Construction	
a.	Heat Transfer Plates	Stainless steel, Gr. 316 or better
b.	Frame & Pressure Plate	Carbon/ Mild Steel or better
c.	Tightening bolt & nuts	Stainless steel 304 or better
d.	Support Column	Carbon Steel/ Mild Steel or better

5.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) General Arrangement and cross section drawing with material Part list.
- iii) Technical Data Sheet.
- iv) O&M manual comprising of all above including list of recommended spare parts, Assembly and disassembly procedure etc.

6 WIRE ROPE FOR POWER HOUSE EOT CRANE

6.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of wire rope in single length for main and auxiliary hoist for power House EOT crane of XXX MT and XX MT respectively. The wire rope shall be used for handling of power house E&M components in XXX Hydro Power Plant of NHPC.

6.2 Specific Parameters and Design Consideration:

The wire ropes shall be of proper design and construction for crane service. The wire ropes shall be of *extra flexible plow steel or alloy steel (Project Specific)* conforming to latest relevant Indian Standard.

6.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

6.4 Wire rope Construction

6.4.1 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1	Wire rope for Main hoist	
a.	Diameter	XXX mm
b.	Length	XXX meter
c.	Rope Construction	<i>6X36 or 6X37 Construction Right hand Lay Fibre / Steel Core Conforming to IS:2266</i>
d.	UTS	XXXX N/mm ²
e.	Minimum Breaking Strength	XXXX MT
2.	Wire rope for Auxiliary Hoist	
a.	Diameter	XXX mm
b.	Length	XXX meter
c.	Rope Construction	<i>6X36 or 6X37 Construction Right hand Lay Fibre / Steel Core Conforming to IS:2266</i>
d.	UTS	XXXX N/mm ²
e.	Minimum Breaking Strength	XXXX MT

	Strength	
--	----------	--

6.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) Technical Data Sheet.

7 SHEAR PIN FOR HYDRO TURBINE

7.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of Shear pins for use in hydro turbine in XXX Hydro Power Plant of NHPC.

7.2 Specific Parameters and Design Consideration:

The shear pin shall be installed in arm rod of each guide vane. The shear pin is a mechanical sacrificial component designed to shear or break itself as and when the mechanical overload arises to prevent the severe damage of the expensive turbine components. A shear pin must be able to withstand static and dynamic loads but must break/fail under a certain overload that could damage a guide vane.

7.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

7.4 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Quantity	XXX Nos.
2.	Material Standard/ Grade	XXX (As per attached drawing)
3.	UTS of material	XXX MPa
4.	Breaking Load	XXX KN
5.	Dimension	As per attached drawing/ sketch

7.5 Drawing & Manual:

The bidder shall submit following information:-

- i) General Arrangement Drawing and Technical Parameters..

8 FLOW SENSORS / FLOW INDICATING SWITCH/ FLOW METER/ FLOW TRANSMITTER

8.1 Scope of Work

The specification covers the supply and delivery of 'Flow Indicating switch/ Flow meter/ Flow sensor/ Flow Transmitter' (*Project specific*) to be installed in the cooling / Ventilation/ Firefighting (*Project specific*) water pipe lines for measurement and display of water flow and alarm/ tripping (*Project specific*). The flow meter shall be suitable for bidirectional flow measurement. The flow instruments shall be use in XXX Hydro Power Plant of NHPC.

8.2 Specific Parameters and Design Consideration:

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally. Instrumentation may be expected to handle water with heavy silt concentration during high flood. The Contractor shall critically study silt data of water and take the same into account in designing the instrumentation susceptible to abrasive effect of silt, making all such specific provisions and measures including selection of materials, surface coating, corrosion protection/ painting which will help to resist silt erosion/abrasion and enable easy and quick maintenance/replacement of worn out components.

Flow meter/ Flow switches/ Flow transmitter shall be electromagnetic type (project specific) and shall have XXX /suitable nos. of potential free contacts for alarm/ protection.

8.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

8.4 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Quantity	XXX Nos.
2.	Type	<i>Electromagnetic</i>
3.	Service	Water
4.	Density	<i>1000 kg/m3</i>
5.	Pipe line diameter	XXX NB
6.	Maximum withstand water Pressure	Upto XXX bar
7.	Process Connection	<i>A105 ANSI B16.5, 150lb</i>

8.	Calibrated Flow	<i>XXX m3/hr</i>
9.	Alarm setting	<i>XXX m3/hr</i>
10.	Temperature Range	<i>-20 to 80 degree C</i>
11.	Enclosure Rating	<i>IP67</i>
12.	Display	<i>LCD, 04 Line Display + Touch screen</i>
13.	Output	<i>4-20mA 2 relay contacts</i>
14.	Accuracy	<i>0.5 %</i>
15.	Electrode Material	<i>316 or better</i>
16.	Operating Voltage	<i>As per requirement</i>

8.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) Technical Data Sheet.

9 TURBINE FACING PLATE/ CHEEK PLATE

9.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of facing plate to use in hydro turbine. The facing plate shall be use in XXX Hydro Power Plant of NHPC.

9.2 Specific Parameters and Design Consideration:

Facing plates shall be made of superior quality 13Cr-4Ni stainless steel. The facing plate shall be bolted on the inner surface of the head cover / bottom ring and lower/upper face of the head cover/bottom ring coming in contact with water (*Project specific*). Fixing arrangement of facing plate shall be done by suitable stainless steel bolts.

The facing plate shall be accurately machined and ground to a smooth finish as per attached drawing. The design, dimension and construction of facing plate shall strictly be as per the attached drawing. Total XX nos. of facing plates is used in one turbine.

9.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

9.4 Functional Characteristics

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally during high flood. Even though material specifications have been included and it is not the intention to ask for guarantee, yet it is to mention that turbine is expected to operate under silt concentration upto 3000/5000 ppm (project specific) during high flood.

9.5 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Quantity	XXX Nos.
2.	Material	ASTM A240 UNS S41500
3.	Profile	<i>Shall strictly as per attached drawing</i>
4.	Dimension	<i>Shall strictly as per attached drawing</i>
5.	Surface Finish	<i>Shall strictly as per attached drawing</i>

6.	Tolerances on dimension	<i>Shall be as per attached drawing</i>
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9.6 Drawing & Manual:

The bidder shall submit following information:-

- i) General arrangement and machining detail drawing.
- ii) Technical Data Sheet.

10 SCREW TYPE LOW PRESSURE AIR COMPRESSOR

10.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of low-pressure screw type air compressor. The screw compressor shall be installed in XXX Hydro Power Plant of NHPC.

Complete package unit shall include compressor block, direct drive coupling, heavy duty air filter, necessary control & isolating valves, air-oil separator, oil cooler, lubrication system, automatic moisture separator, oil filter, instrumentation, hoses etc. along with state of the art electric control panel.

Oil for first filling shall be supplied along with compressor unit.

10.2 Design standards

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

Standard	Description
IS: 6206	Guide for selection, installation and maintenance of air compressor plants with operating pressure upto 10 bars
IS : 11780	Code for selection and testing of rotary screw air compressor (oil flooded)
IS: 12258	Technical supply condition for air screw compressor (oil flooded) for general purpose and industrial applications

10.3 Specific Parameters and Design Consideration:

The compressor shall be oil flooded, rotary, positive displacement, compact energy efficient, Screw type Air Compressor package unit complete with associated accessories to supply dry and filtered air for use in brake of the generating units and to supply compressed air to service air header & deluge valve of fire protection system (project specific).

Anti vibration pads should be provided on the compressor base for vibration isolation

10.4 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

10.5 Functional Characteristics

Screw Type Air Compressor unit shall be capable of supplying continuously compressed air and shall be complete with automatic star delta/ DOL starter (*Project specific*) for motor along with associated accessories. The compressor block and motor shall be mounted on common skid. Compressor unit shall be provided with canopy of suitable thickness for reduce noise level.

10.6 Control Panel

Control panel shall monitor continuously & accurately (through microprocessor based Regulator and Electronic Controller) the data and shall control the performance through feedback and interlocking arrangements. The operation of the compressor shall be possible in all modes (local, remote and DCS). Control panel shall have LCD/LED display. Built in protection systems, inclusive of following, should be provided for safe and fail-safe operation of the complete compressor system.

- i) Phase sequence protection relay,
- ii) Phase failure protection relay,
- iii) Motor overload Trip,
- iv) High Air / Oil Discharge Temperature Trip.
- v) Protection against starting on load,

10.7 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Quantity	XXX No.
2.	Capacity/ Free air delivery	XXX CFM at 10 kg/cm ² or higher
3.	Maximum working pressure	10 kg/cm ²
4.	Cooling system	Air cooled
5.	No. of stages	single
6	Drive	XX KW , TEC, IP55, Insulation class F (but temp. Rise limited to Class B), Squirrel cage Induction motor, 415V, 3 ph AC supply.
7.	Noise level	Maximum 85db (A) at normal load condition, one meter away from the unit.

10.8 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) General arrangement drawing and wiring details.
- iii) Technical Data Sheet.

11 RECIPROCATING TYPE HIGH PRESSURE AIR COMPRESSOR

11.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of high pressure reciprocating type air compressor. The air compressor shall be installed in XXX Hydro Power Plant of NHPC.

Complete package unit shall include compressor block, heavy duty air filter, necessary control & isolating valves, air- oil separator, oil cooler, lubrication system, automatic moisture separator, oil filter, instrumentation etc. along with state of the art electric control panel.

Oil for first filling shall be supplied along with compressor unit.

11.2 Design standards

The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards.

11.3 Specific Parameters and Design Consideration:

The compressor shall be oil flooded, positive displacement, compact energy efficient, reciprocating air Compressor unit complete with associated accessories to supply dry and filtered air for use in oil pressure unit of the turbine governing system as well as the oil pressure unit of the main inlet valve (project specific).

Motor set shall be equipped:

- Automatic lubrication,
- Air intake filter and silencer,
- Thermometers for measuring the temp. of compressed air with one thermal switch for automatic shut down if discharge air temp exceeds a predetermined adjustable value.
- Unloader valve
- Water drain valves,
- Water/Oil separator with automatic drain valve
- Compressed air cooler
- Pressure gauges

Discharge of compressor shall be connected to HP air receiver through isolating valve.

Following instruments/ devices shall also be provided::

- a. Stage pressure gauge
- b. Oil Pressure Gauge
- c. Final Delivery Pressure Gauge
- d. Safety Valve on each Compression Stage
- e. Delivery Non Return Valve/Check Valve
- f. Base Foundation Anti Vibration Mount/ Shock Absorber
- g. Crankcase Oil Filler and sight level glass
- h. Crank Breather

- i. Back pressure-maintaining valve
- j. High outlet gas Temperature Cut out
- k. Low Oil Pressure Cut Out

11.4 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

11.5 Functional Characteristics

Air Compressor unit shall be capable of supplying continuously compressed air and shall be complete with automatic star delta/ DOL starter (*Project specific*) for motor along with associated accessories. The compressor block and motor shall be mounted on common skid.

11.6 Control Panel

Control panel shall monitor continuously & accurately (through microprocessor based Regulator and Electronic Controller) the data and shall control the performance through feedback and interlocking arrangements. The operation of the compressor shall be possible in all modes (local, remote and DCS). Control panel shall have LCD/LED display. Built in protection systems, inclusive of following, should be provided for safe and fail-safe operation of the complete compressor system.

- i) Phase sequence protection relay,
- ii) Phase failure protection relay,
- iii) Motor overload Trip,
- iv) High Air / Oil Discharge Temperature Trip.
- v) Protection against starting on load,

11.7 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Quantity	XXX No.
2.	Free air delivery	XXX CFM at XX kg/cm ² or higher
3.	Nominal delivery pressure	XX kg/cm ²
4.	Cooling system	Air cooled
5.	No. of stages	XXX
6	Electric Motor	XX KW, TEC, IP55, Insulation

		<i>class F (but temperature Rise limited to Class B), Squirrel cage Induction motor, 415V, 3 -phase AC supply, Speed – XXXX rpm</i>
7.	Noise level	<i>Maximum 85db (A) at normal load condition, one meter away from the unit.</i>
8	Whether after cooler provided	Yes
9	Drain Trap	<i>Automatic</i>

11.8 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) General arrangement drawing and wiring details.
- iii) Technical Data Sheet.

12 CARBON BRUSHES FOR HYDRO GENERATOR

12.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of Carbon brushes for hydro generator. The carbon brushes shall be installed in XXX Hydro Power Plant of NHPC.

12.2 Design standards

The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards.

12.3 Specific Parameters and Design Consideration:

The generator of a hydro system is excited by means of rotating slip ring and stationary carbon brush, which is used for feeding DC Power to rotor pole. Due to continuous use and wear between slip ring and soft carbon brush, the sizes of carbon brushes are reduced and it is essential to replace the carbon brushes from time to time as per requirement.

12.4 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

12.5 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Quantity to be supplied	XXX Nos.
2.	Quantity used in one generator	XXX nos.
3.	Minimum Current density	XXX A/mm ²
4.	Carbon brush dimension	As per attached drawing/ sketch

12.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) General arrangement drawing and Technical data sheet.

13 GENERAL PURPOSE O-RING/ RUBBER CORDS/ RUBBER SHEET FOR DIFFERENT E&M COMPONENTS

13.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of general purpose O-rings/ Rubber Cords/ Rubber sheets, which shall be used in different assemblies/ components of E&M equipment in XXX Hydro Power Plant of NHPC.

13.2 Design standards

The items shall be designed, built, tested and installed to the latest revisions of the applicable standards.

13.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

13.4 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Item Description	O-Ring/ Rubber Cord/ Rubber sheet
2.	Quantity to be supplied	XXX Nos.
2.	Material	Nitrile rubber Shore A, Hardness 70
3.	Applicable standard	BS:2751 & BS: 3734
4.	Dimensional Details, O-Ring / Rubber Cord	Diameter – 3mm to 24mm Length – XX mm
5.	Dimensional Details, O-Ring / Rubber Cord	Length X WidthX Thickness – XXmm x XXmm x XXmm

13.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.

14 GENERAL PURPOSE DIFFERENT TYPE OF VALVES FOR WATER APPLICATION

14.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of general purpose Isolation/ Flow regulating valves. The valves shall be used in hydro power plant for water application for isolation of system/ to regulate water flow in *Cooling water/ Fire Fighting/ Ventilation/ Drainage system* (Project specific) in XXX Hydro Power Plant of NHPC.

14.2 Design standards

The items shall be designed, built, tested and installed to the latest revisions of the applicable standards.

14.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

14.4 Specific Parameters and Design Consideration:

The valves shall be leak proof in either direction (except non-return valve). Unless otherwise stated, the valve shall be designed for at least 1.5 times of the working pressure but minimum for “nominal pressure” PN10 (Project specific) and tested with 1.5 times of the design pressure. Valves shall be closed clockwise and be provided with position indicators and pad lock kit.

Gate valves shall be rising stem type (Project specific).

All valves with design pressures higher than PN 10 and diameters larger than DN 100 shall be workshop-tested to relevant Indian Standard for tightness and soundness of materials. Valves DN200 and above shall preferably be worm gear manual operated (*project specific*). The drive units of motor-driven valves shall also be provided with hand wheels for manual operation. The hand wheel shall be operable under all conditions and shall be independent of the motor drive. Further, it shall not be rigidly coupled to the motor drive and shall not compulsory turn when the motor is energised.

Valves shall be suitable for opening and closing against full unbalanced pressure, including closure against free discharge. All valves shall be capable of open under 100% unbalance condition.

14.5 Specific Technical Parameter (Project Specific)

Sl. No.	Parameter/ Description	Value
1.	Valve Actuation	Manual/ Motorized/ Gear Operated
2.	Type	Gate/ Globe/ Ball/ Needle/ Non Return Valve
3.	Class	150/ 300/ 600/ 800
4.	Size	DN20 – DN 600
5.	Pressure Rating	PN10 and above
6.	Application	Water
7.	Duty	ON-OFF/ Flow Regulation
8.	Dimensional Installation details	As per drawing
9.	Body and seat test pressure	XXX Bar and XXX Bar
10	Actuator	
a.	Type	As per requirement
b.	Rating	As per requirement
c.	Torque	As per requirement
11.	End Connection/ Body style	As per requirement
12	Applicable standard	XXXXX
13	Material of Construction	
a.	Valve body (DN 50 and below)	Forged Stainless steel (ASTM A182 Gr. F 316) or better grade
b.	Valve body (Above DN 50)	Cast/ Forged steel (ASTM A216 Gr. WCB/ ASTM A182Gr. F316) or better grade
c.	Valve spindle/ shaft	Forged Stainless steel (ASTM A182 Gr. F316) or better grade
d	Disc/ ball/ Wedge	Cast/ Forged Stainless steel (ASTM A 351 Gr. CF8M/ ASTM A182 Gr. F316) or better grade

14.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) General arrangement and cross section drawing with material part list.
- iii) Technical data sheet.

15 GENERAL PURPOSE SIREN

15.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of general purpose Siren, which shall be installed in the vicinity of Dam/ Hydro plant for warning to people prior to release of water from the Dam/ hydro machine (*Project specific*) in XXX Hydro Power Plant of NHPC.

15.2 Design standards

The items shall be designed, built, tested and installed to the latest revisions of the applicable standards.

15.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

15.4 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Item Description	<i>Electro-Mechanical / Electronic/ Battery</i>
2.	Quantity to be supplied	XXX Nos.
3.	Range	0.5km/1.0km/1.5km/2.0km
4.	Mounting type	<i>Horizontal/ Vertical, single/ double mounted</i>
5.	Operating voltage & Frequency	<i>220VAC/415VAC or 24/48VDC & 50HZ</i>
6.	Phase	<i>Single/ Three</i>
7.	Speed	<i>2800rpm/6000rpm</i>

15.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) Technical data Sheet.

16 HIGH PRESSURE AIR SAFETY VALVE

16.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of high-pressure air safety valve. Air Safety Valve shall be direct mounted type spring-loaded HP air release cum safety valve with flanged body & closed bonnet and a handle for manually relieving the excess pressure of air from air pressure receiver. The valve shall also be provided with adjustable nozzle ring for blow down adjustment. The valve shall be designed to automatically reclose (with spring force) and prevent the flow of air.

16.2 Design standards

The items shall be designed, built, tested and installed to the latest revisions of the applicable standards.

16.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

16.4 Specific Parameters and Design Consideration:

The design shall incorporate guiding arrangements necessary to ensure consistent operation and tightness. The spring shall be designed so that the full lift spring compression shall not be greater than 80% of the nominal solid deflection. The permanent set of the spring (defined as the difference between the free height and height measured 10 mins. after the spring has been compressed solid three times after pre-setting at room temperature) shall not exceed 0.5% of the free height.

The valve seat shall be fastened to the valve body such that the valve seat shall not lift and valve shall have with provision for sealing of all components for external adjustments

The stem shall be manufactured from AISI 410 stainless steel. The spring of pressure relief valve shall be manufactured from phosphated carbon steel or chrome alloy steel

16.5 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Item Description	Air safety Valve
2.	Quantity to be supplied	XXX Nos.
3.	Medium to be discharged	Compressed air

4.	Type of connection	<i>Inlet XX" flange/ Outlet XX" flange</i>
5.	Valve blow off/ set pressure	<i>XX kg/cm²</i>
6.	Accumulation	<i>10% above set pressure</i>
7	Valve to reseal at and above	<i>XX kg/cm²</i>
8	Back pressure	<i>Atmospheric</i>

16.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) General Arrangement drawing and Technical data Sheet.

17 LOW PRESSURE AIR SAFETY VALVE

17.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of low-pressure air safety valve. LP Air Safety Valve is directly mounted type spring loaded LP air release cum safety valve with flanged body & closed bonnet and a handle for manually relieving the excess pressure of air from air pressure receiver. The valve shall also be provided with adjustable nozzle ring for blow down adjustment. The valve shall be designed to automatically reclose (with spring force) and prevent the flow of air. .

17.2 Design standards

The items shall be designed, built, tested and installed to the latest revisions of the applicable standards.

17.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

17.4 Specific Parameters and Design Consideration:

The design shall incorporate guiding arrangements necessary to ensure consistent operation and tightness. The spring shall be designed so that the full lift spring compression shall not be greater than 80% of the nominal solid deflection. The permanent set of the spring (defined as the difference between the free height and height measured 10 mins. after the spring has been compressed solid three times after pre-setting at room temperature) shall not exceed 0.5% of the free height.

The valve seat shall be fastened to the valve body such that the valve seat shall not lift and valve shall have with provision for sealing of all components for external adjustments

The stem shall be manufactured from AISI 410 stainless steel. The spring of pressure relief valve shall be manufactured from phosphated carbon steel or chrome alloy steel

17.5 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Item Description	Air safety Valve
2.	Quantity to be supplied	XXX Nos.
3.	Medium to be discharged	Compressed air
4.	Type of connection	<i>Inlet XX" flange/ Outlet XX" flange</i>

5.	Valve blow off/ set pressure	<i>XX kg/cm²</i>
6.	Accumulation	<i>10% above set pressure</i>
7	Valve to reseal at and above	<i>XX kg/cm²</i>
8	Back pressure	<i>Atmospheric</i>

17.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing technical details.
- ii) General Arrangement drawing and Technical data Sheet.

18 HYDRO TURBINE – REGULATING/ OPERATING MECHANISM ELEMENTS LIKE CONNECTING ROD, LEVER, LINK, PIN, BUSH HOUSING, BUSHES/ BEARING, SHEAR PIN

18.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of Turbine Wicket Gate *Operating Mechanism Elements like Connecting rod, Lever, Link, Pin, Bush housing and Bushes*. The components shall be used in XXX Hydro Power Plant of NHPC.

18.2 Specific Parameters and Design Consideration:

The final dimensions, fasteners hole size, surface finish, dimensional tolerances, ovality, concentricity and material standard/composition of turbine operating/ regulating ring components shall match with the attached drawings/ sketch.

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally. Turbine bush/ bearing may be expected to handle water with heavy silt concentration during high flood. The Contractor shall critically study silt data of water and take the same into account in designing the bushing/ bearing susceptible to abrasive effect of silt, making all such specific provisions and measures including selection of materials, surface coating, corrosion protection which will help to resist silt erosion/abrasion and enable easy and quick maintenance/replacement of worn out components.

The bush/bearing material/ design shall be such that machine shall operate satisfactorily under silt concentration upto 3000/5000 ppm (project specific) during high flood.

18.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

18.4 Regulating/Operating Mechanism Components

18.4.1 Connecting rod, Lever, Link and Pins

The gate-operating ring distributes servomotor forces and moments simultaneously to all wicket gates. The operating/ regulating ring made up off fabricated of steel plates prevent excessive deflections of the structure when the gate-operating ring is subject to unbalanced thrust of one servomotor with the other servomotor blocked

The turbine wicket gate operating/ regulating mechanism consists of different elements for connecting turbine wicket gates to the gate servomotors, which includes bushes, pins, wicket gate levers, arms, links, operating ring, servomotor connecting rods.

The lever shall be pinned and bolted to the wicket gate.

18.4.2 Shear Pin

Shear pin positioned between each wicket gates and the operating ring, and needs to be strong enough to withstand the normal maximum operating forces. It links the lever and the arm. It shall break in the event of excessive forces either acting in the opening or closing direction and shall protect the rest of the mechanism from damage in case one or more of the wicket gates become blocked.

18.4.3 Bush Housing and Bushes

Bush housings comprise of *self-lubrication bushes or bronze bushes (Project specific)* shall be used in turbine Top cover and Bottom ring/Pivot ring for guide vane stems. Bush housing shall be made from Cast Steel or Carbon steel plates.

Bronze bushings or self-lubricated bushes (*Project specific*) shall be used for parts having contact in motion. Upper bushes shall have double of O-ring(s) to arrest leakage and suitable for operation in high silt. The self-lubricating material shall have following characteristics

- a) Non-metallic and not have harmful effect on water and rubber.
- b) Good machinability and can be machined easily to desired tolerances without any deformation with single point cutting tool.
- c) Good dimensional stability at operating temperature.
- d) Dry running capability for initial start-up condition
- e) Low coefficient of friction at start-up & when run at maximum bearing pressure
- f) Low shaft wear characteristics
- g) Free from asbestos and dust hazards
- h) High compression strength and low coefficient of thermal expansion
- i) Durable and environment friendly
- j) High wear resistance and electrically non-conducting

18.4.4 Specific Technical Parameter (*Project Specific*)

Sl. No..	Parameters	Value
A.	Connecting rod	
1.	Quantity	XXX Nos.
2.	Material Standard/ Grade	XXX (As per attached drawing)
3.	UTS & YS of material	XXX MPa
4.	Dimension, tolerances & surface finish	As per attached drawing/ sketch
B	Lever	
1	Quantity	XXX Nos.
2	Material Standard/ Grade	XXX (As per attached drawing)
3	UTS & YS of material	XXX MPa

4	Dimension, tolerances & surface finish	As per attached drawing/ sketch
C	Link	
1	Quantity	XXX Nos.
2	Material Standard/ Grade	XXX (As per attached drawing)
3	UTS & YS of material	XXX MPa
4	Dimension, tolerances & surface finish	As per attached drawing/ sketch
D	Pin	
1	Quantity	XXX Nos.
2	Material Standard/ Grade	XXX (As per attached drawing)
3	UTS & YS of material	XXX MPa
4	Breaking Load	XXX KN
5	Dimension, tolerances & surface finish	As per attached drawing/ sketch
E	Bush Housing	
1	Quantity	XXX Nos.
2	Material Standard/ Grade (Upper/ Lower)	XXX or As per attached drawing
3	UTS & YS of material	XXX MPa
4	Dimension, tolerances & surface finish	As per attached drawing/ sketch
F	Bushes	
1.	Type (Top/ Bottom/ Intermediate)	<i>Self-lubricated / Bronze</i>
2	Quantity (Top/ Bottom/ Intermediate)	XXX Nos.
3.	Material type/ Grade (Top/ Bottom/ Intermediate)	
4	Diameter (Top/ Bottom/ Intermediate)	XXX mm (or as per attached drawing)
5.	Height (Top/ Bottom/ Intermediate)	XXX mm (or as per attached drawing)
6.	Diameter of Guide Vane stems (Top/ Bottom/ Intermediate)	XXX mm (or as per attached drawing)
7.	Coefficient of friction (Maximum)	XX
8	Compressive Strength of bush material (Min.)	XXX MPa
9.	Normal working strength (Min.)	XXX Mpa

10.	Compressive strength at Yield	XXX Mpa
11	Tensile and Shear strength	XXX Mpa and XXX Mpa
12	Operating temperature	XX degree C
13	Hardness of bush material	XXX HB
14	Surface finish	XX Ra
15	Maximum permissible load on bush	XXX Mpa
16	Maximum Sliding Velocity	XX m/s
G	Shear Pin	
1	Quantity	XXX Nos.
2	Material Standard/ Grade	XXX (As per attached drawing)
3	UTS & YS of material	XXX MPa
4	Breaking Load	XXX KN
5	Dimension	As per attached drawing/ sketch

18.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets showing dimensions and other technical details of Bushes.
- ii) General Arrangement drawing and material part list .
- iii) Technical Data Sheet.

19 TURBINE – STATIONARY & ROTATING LABYRINTH

19.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of turbine labyrinth(s) along with associated fasteners for XXX Hydro Power Plant of NHPC.

19.2 Specific Parameters and Design Consideration:

The final dimensions, fasteners hole size, surface finish, dimensional tolerances, ovality, concentricity, weld details and material standard/composition of Labyrinth shall match with the attached drawings/ sketch.

Labyrinth needs to be free from any distortions and manufacturing defects. Ultrasonic testing of the labyrinths after Casting/Forging (*Project Specific*) and before final machining shall be carried out. Appropriate bracing shall be used during labyrinth fabrication.

HP-HVOF hard coating shall be done on the labyrinth(s) (*Project specific*).

19.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

19.4 Functional Characteristics

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally. Labyrinths may be expected to handle water with heavy silt concentration during high flood. The Contractor shall critically study silt data of water and take the same into account in designing the labyrinth seal susceptible to abrasive effect of silt, making all such specific provisions and measures including selection of materials, surface coating, corrosion protection which will help to resist silt erosion/abrasion and enable easy and quick maintenance/replacement of worn out components. The labyrinth shall be designed to operate satisfactorily under silt concentration upto 3000/5000 ppm (project specific) during high flood.

19.5 Construction

19.5.1 Rotating Labyrinth

Replaceable 13Cr-4Ni stainless steel rotating labyrinth seal shall be fixed to the runner both at the top and bottom ends with the help of stainless steel *fasteners or shrink fitted (Project specific)* to reduce the leakages.

19.5.2 Stationary Labyrinth

A replaceable 13Cr-4Ni stainless steel labyrinth seal ring or rings , accurately machined to form a water tight seal with the Runner Crown and shaped to reduce leakage , shall be secured to Head cover.

A replaceable 13Cr-4Ni stainless steel labyrinth seal ring or rings, accurately machined to form a watertight seal with the Runner Band, shall be secured to *discharge ring or Bottom ring/ Pivot ring (Project specific)*.

19.5.3 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
A.	Upper / Lower Stationary Labyrinth	
1	Quantity	XXX nos.
2.	Material Type /Standard & Grade	<i>Forged / ASTMA473 UNSS41500 or Casting /ASTMA 743 A 6NM or As per attached drawing</i>
3.	UTS & YS of material	XXX MPa & XXX MPa
4.	Hardness	XX HB
5.	Dimension, tolerances & surface finish	As per attached drawing
6	Fasteners/ Dowels	
a.	Quantity	XX Nos.
b.	Material Type/ Standard & Grade	As per attached drawing
c.	Diameter/ size	XX mm
B.	Upper / Lower Rotating Labyrinth	
1	Quantity	XXX nos.
2.	Material Type /Standard & Grade	<i>Forged / ASTMA473 UNSS41500 or Casting /ASTMA 743 A 6NM or As per attached drawing</i>
3.	UTS & YS of material	XXX MPa & XXX MPA
4.	Hardness	XX HB
5.	Dimension, tolerances & surface finish	As per attached drawing
6	Fasteners/ Dowels	
a.	Quantity	XX Nos.
b.	Material Type/ Standard & Grade	As per attached drawing
c.	Diameter/ Size	XX mm

19.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Machining drawing with material Part list.
- ii) Technical Data Sheet.

Technical Specifications for HP-HVOF Coating

1 Surface Preparation as per ISO 8501-1988

- (i) Surface to be sprayed should be thoroughly clean and free from contamination, oil, grease other foreign particles. Clean surface should be obtained by vapour degreasing, steam or application of an industrial cleaning solvent based on the condition of surface.
- (ii) Surface should be roughed by grit blasting to achieve better mechanical bonding. After grit blasting, spraying should be carried out within one hour to avoid oxidation or contamination of the base material surface.
- (iii) After the grit blasting surface should be checked for defects, if any, to be rectified with appropriate action.
- (v) Work piece should be preheated immediately before coating, which drives off moisture from the job surface. Heat also helps expanding the work piece so that the surface cools with coating, minimizing the stress created in coating during cooling.

2 Coating Requirements

- (i) The HP-HVOF coating of thickness of 250-300 Microns should be applied through ROBOT with suitable gun for the process. Machine to be used by the vendor shall be JP-5000 HP-HVOF or equivalent or better.
- (ii) The composition of the coating powder shall be of 86% Tungsten carbide, 10% Cobalt & 4% Chromium. The firm should have necessary test certificate (From NABL certificate/ Govt. approved laboratory) in support of above mentioned materials composition of the coating powder.
- (iii) The firm should take prior approval of the type & make of coating powder.
- (iv) Hardness of coated surface shall be 1200 HV or better.
- (v) Surface roughness of the coated surface should be RA 6 or better.
- (vi) Porosity of the coated surface shall be less than 1%.
- (vii) Coated surface should be free from defects such as blowholes, cracks and imperfections.
- (viii) Bond strength should be 12000 psi or better. The particle velocity should be 700m/sec or higher.
- (ix) The final dimensions of the coated Labyrinths shall be as per Drawing dimensions and tolerance.

20 TURBINE – SHAFT SLEEVE

20.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of turbine shaft sleeve. The turbine shaft sleeve shall be used in XXX Hydro Power Plant of NHPC.

20.2 Specific Parameters and Design Consideration:

The final dimensions, fasteners hole size, surface finish, dimensional tolerances, ovality, concentricity, weld details and material standard/composition of Turbine shaft sleeve shall match with the attached drawings/ sketch. Stress relieving shall be carried out before final machining.

20.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

20.4 Functional Characteristics

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally. Shaft sleeve may be expected to operate in water having heavy silt concentration during high flood. The Contractor shall critically study silt data of water and take the same into account in designing the shaft sleeve susceptible to abrasive effect of silt, making all such specific provisions and measures including selection of materials, surface coating, corrosion protection which will help to resist silt erosion/abrasion and enable easy and quick maintenance/replacement of worn out components. The turbine shaft sleeve shall be designed to operate satisfactorily under silt concentration upto 3000/5000 ppm (project specific) during high flood.

20.5 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1	Item description	Turbine Shaft sleeve
2	Quantity	XX Nos.
3	Material Type/ Standard & Grade	As per attached drawing
4.	UTS & YS of material	XXX MPa & XXX MPa
5.	Hardness	XX HB
6.	Dimension, tolerances & surface finish	As per attached drawing

20.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Machining drawing with material Part list.

ii) Technical Data Sheet.

21 HYDRAULIC BOLT TENSIONER WITH POWER PACK UNIT

21.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of hydraulic torque tensioner. The hydraulic bolt tensioner shall be used for tightening of bolts/ Studs in XXX Hydro Power Plant of NHPC. A hydraulic bolt tensioner is an annular jack that fits over the bolt and nut to be tightened.

21.2 Specific Parameters and Design Consideration:

Power pack unit shall be heavy duty and designed to provide optimal services with bolt tensioner upto XXX diameter. Power pack unit shall have at least XX m cable along with hoses, level switch and protective frame. It shall be suitable for all job conditions.

21.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

21.4 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1	Item description	Hydraulic Bolt Tensioner with power pack unit
2	Quantity	XX Nos.
3.	Bolt Tensioner suitable for bolt size	XXXX (Bolt dia. X Pitch)
4	Capacity	XXX Tons
5.	Stroke	XXX mm
6.	Maximum working pressure	XXXX Bar
7.	Scope shall include supply of main parts	<ul style="list-style-type: none">• Hydraulic Tightening Tool/ Tensioner head• Puller• Bridge• Quick Connect coupler
8.	<i>Electric motor with gear pump (Power Pack unit) or High pressure hand operated Hydraulic pump Unit</i>	
a.	Maximum Pressure	XXX Bar
b.	<i>Speed</i>	<i>XXX RPM</i>

c.	Maximum flow	XXX L/Min
d.	<i>Sound Level</i>	<i>Upto 80db(A)</i>
e.	Oil tank capacity	XX litre
f.	Accessories	High-pressure (min. 1500 bar) flexible hose of min. 10m length with quick couplers at both the ends.

21.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the offered models.
- ii) Technical Data Sheet.

22 HYDRAULIC TORQUE WRENCH

22.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of hydraulic torque wrench for use in turbine/ MIV for tightening/ loosening of nuts of different sizes in XXX Hydro Power Plant of NHPC.

22.2 Specific Parameters and Design Consideration:

Hydraulic torque wrench shall be heavy-duty, robust, light weight and compact design for small operating radius, complete with suitable attachments and operable with common power pack through manifold for tightening and loosening of nuts of different sizes. The torque wrench shall have optimized strength to weight ratio.

22.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

22.4 Construction

All stressed components of the torque wrench shall be made of high strength & high quality steel for durability. The wrench including reaction arm shall be Nickel plated for corrosion protection. The wrench shall be certified for flameproof & explosion proof operation & suitable for use up to surface temperatures of 135° C. The ratchet mechanism shall be of fine tooth design to avoid backlash & tool locking without any external ratchet freeing mechanism. All the moving parts shall be totally enclosed to prevent any damage from dirt/dust & to ensure safety for operator.

Hydraulic Power pack (electrically operated) is compatible with the Torque wrench offered and is suitable for safe operating of two wrench of same capacity simultaneously. The Power pack shall be compact, lightweight, portable, powerful, versatile and provide fully automatic and continuous bolting / tightening operations (for a minimum of 4 hours continuous use) to the present torque without any vibrations / noise or overheating. Manifold block with Four Port for facilitating connecting of additional Hydraulic torque wrench in future shall be provided.

The pump shall have inbuilt oil cooling heat exchanger. The oil tank of suitable capacity with oil sight glass shall be provided. There should be an in-built Pressure Relief Valve in the tool or in the hose-connecting joint for safeguarding the seals of the tool from over pressurization.

22.5 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1	Item description	Hydraulic Torque wrench with Power pack
2	Quantity	XX Nos.

3.	Torque Range (Min.)	XXXX Nm
4	Torque Range (Max.)	XXXX to XXXX Nm
5.	Accuracy	+/-3% or better
6.	Drive	XX inch Male square drive (capable of rotation in same direction)
7.	Weight of the wrench (without power pack)	Vendor to specify
8.	Rotation	360 degree Uni- Swivel quick release coupling
9.	Operation	Double acting
10	Finish	Nickel plates for excellent corrosion protection
11	Safety features	Wrench should be have anti-backlash secondary Pawl to prevent backward rotation ratchet gear.
12	Hydraulic power pack	
a.	Maximum operating pressure	700 bar (must be suitable for continuous duty)
b.	Remote	Remote control pendant with 10m cable
c.	Safety features	Inbuilt heat exchanger & safety relief valve
d	Power supply	230V+/- 10%,50+/- 5Hz, Single phase power
e	Hose length	10m hydraulic hose with safety hose burst guards
f	Hose type	Twin type with quick release coupler on both ends
13	Following inserts are to be supplied along with torque wrench:	
a.	Socket for Nut sizes MXX to MXX with X" (inch) Female square drive – X Nos. eah	

22.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the offered models.
- ii) Technical Data Sheet.
- iii) O&M manual in soft and hard copies.

23 GENERAL PURPOSE HANDLING DEVICES

23.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of General Purpose Handling Devices for use in handling of different E&M components in XXX Hydro Power Plant of NHPC.

23.2 Specific Parameters and Design Consideration:

General purpose handling devices shall be heavy-duty, robust, lightweight and compact design.

23.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

23.4 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
A.	Steel wire rope with eye (on both ends)	
1	Quantity	XX Nos.
2	Type & material	<i>Steel wire rope with eye on both ends</i>
3.	Rope diameter	XX mm to XX mm
4	Rope length	XX m to XX m
5	Eye type	Mechanical splicing
6.	Applicable standard	IS:2266
B.	Polyester Round Sling	
1.	Quantity	XX Nos
2.	Type	<i>Twin path endless round sling with Anti cutting sleeve</i>
3.	Material	Polyester
4.	Working load limit capacity	X to XX ton
5.	Basket	200% of working load
6	Choker	80% of working load
7	Length / circumferential length	X to XX m/ X to XX m
8	Overload indicator	Yes

9	Applicable standard	BS 6688 Part - 21987/ DIN 61360/ ISO 4879
C	Polyester webbing sling	
1.	Quantity	XX Nos
2.	Type	<i>Webbing sling with eye at both ends</i>
3.	Material	Polyester
4.	Working capacity straight lift	X to XX ton
5.	Basket	200% of working load
6	Choker	80% of working load
7	Length	X to XX m
8	Applicable standard	BS 3481 Part 2/ DIN 61360
D	Polyester duplex Flat webbing sling	
1.	Quantity	XX Nos
2.	Type	<i>Duplex Flat webbing sling with eye at both ends</i>
3.	Material	Polyester
4.	Working load limit	X to XX ton
5.	Basket	200% of working load
6	Choker	80% of working load
7	Length	X to XX m
8	Applicable standard	BS 3481 Part 2/ DIN 61360
E	Eye bolts	
1.	Quantity	XX Nos
2.	Type	<i>Solid forged, quenched and tempered without any weld</i>
3.	Size	XX
4.	Working load limit	X to XX Kgs
5.	Applicable standard	<i>IS: 4190</i>
F	D- Shackles	
1.	Quantity	XX Nos
2.	Type	<i>Solid forged, quenched and tempered without any weld</i>
3.	Grade	40
4.	Working load limit	X to XX Kgs
5.	Applicable standard	IS: 6131
G	Handling Cart	

1.	Quantity	XX Nos
2.	Type	<i>Battery operated</i>
3.	Capacity	<i>0.5T</i>
4.	Size of platform (approx..)	<i>1500x1000mm</i>
5	Type of Battery	<i>2VX12V</i>
6	Quantity of batteries	<i>Two</i>
7.	Details of Drive motors	<i>1 HP traction motor operating on 24V</i>
8.	Tyres type & nos.	Slid rubber & 3 nos.
9.	Battery Charger	Plug in type
10	Brake	Mechanical brake
H	Fork lifter	
1.	Quantity	XX Nos
2.	Type	<i>Battery operated</i>
3.	Capacity	<i>3T</i>
4.	Maximum fork height	<i>3000mm</i>
5	No. of stages of mast	<i>Duplex mast</i>
6	Battery type & Quantity	<i>Lead acid & One</i>
7.	Details of Drive motors	<i>10 Kw</i>
8.	Tyre type & nos.	Slid rubber & 3 nos.
9.	Controllers	Electronic controller
10	Steering	Power steering
11	Tyres type	Pneumatic
12	Turning radius	Max. 2150mm
13	Fork length and width (approx.)	<i>1070 and 120</i>
14	Overall height with raised fork (approx.)	42000mm
15	Overall height without fork raised (approx.)	1980mm
16	Overall length with forks (approx.)	3450mm
17	Overall width (approx.)	1180mm
18.	Battery Charger	Provided
19	Weight	Upto 4300 kg

23.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the offered models.

- ii) Technical Data Sheet.
- iii) O&M manual in soft and hard copies.

24 TOOLS & TACKLES - PRECISION MEASURING TOOLS LIKE DIAL GAUGE, MICRO METERS, CALIPERS, BLOCK LEVEL

24.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of precision measuring tools & tackles like Dial Gauge, Micro meters, Callipers, Block Level for use in XXX Hydro Power Plant of NHPC.

24.2 Specific Parameters and Design Consideration:

Precision measuring tools shall be highly accurate, robust, lightweight and compact design. The high accuracy tools shall be used in erection, alignment etc. of turbine, generator and other associated auxiliary equipment in powerhouse.

24.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

24.4 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
A. Dial gauge		
1	Quantity	XX Nos.
2	Type	<i>Peak hold type dial gauge/ Adjustable hand held dial gauge with magnetic stand</i>
3.	Graduations	0.01mm,
4.	Range	Upto 10mm
5.	Repeatability	3 micrometre
B. Micrometres		
1.	Quantity	XX Nos
2.	Type	<i>Outside/ Inside/Digital</i>
3.	Accuracy	XX
4.	Measurement Range	XX
C Callipers		
1.	Quantity	XX Nos
2.	Type	XX
3.	Accuracy	XX
4.	Measurement Range	XX

D	Block Level	
1.	Quantity	XX Nos
2.	Type	<i>High precision</i>
3.	Least count	0.02mm/m

24.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the offered models.
- ii) Technical Data Sheet.

25 MOTORISED HYDRAULIC POWER PACK

25.1 Scope of Work

The specification covers the design, manufacture, Shop testing, delivery at site, installation, commissioning, performance and acceptance testing of Motorised Hydraulic Power Pack for use in XXX Power station of NHPC Limited. The scope shall comprise of:

- i) Pump-motor with electrical control panel
- ii) Hand operated pump.
- iii) Filter, valves, pressure gauges and other accessories.

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.

25.2 Standards and Regulations:

The system and equipment shall be designed, built tested and installed to the latest revisions of applicable standards.

25.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

25.4 Functional Characteristics

The Hydraulic power pack shall be used for jacking the rotor of hydro generator during generator maintenance by pumping high-pressure oil in to a number of jacks in parallel.

25.5 Constructional Feature

The power pack shall be trolley mounted portable/movable type. All component and accessories of system shall be suitable for continuous use. The pump-motor shall be directly mounted on tank and various auxiliaries like valve, pressure gauge etc. shall be mounted on the tank or on a panel above the tank. The hand pump shall also be fitted on oil tank. The pump motor shall be TEFC type with class F insulation. DOL starter shall be fitted with thermal overload relay and single phase preventer.

The unit shall have a positive displacement pump capable of generating working pressure of XX bar and oil flow rate of XX lpm. Oil shall be ISO VG 46 or XX. Suction line filter with cleanable stainless steel element shall have filtration effectiveness, as 25 micron shall be provided.

Both motorised pump and hand pump shall be provided with in-built non-return valve. One NRV valve shall be fitted to the delivery line. One main and one auxiliary safety valve shall be provided which shall be suitable for site adjustment. Air breather with an oil filter shall be provided on oil filling port in the tank.

One oil tank shall be provided with capacity not less than XX litres. Tank shall be painted inside and outside. The inlet and outlet ports from the power pack shall be XX BSP(M).

Two high-pressure flexible hoses with end fittings XX BSP (F), each at least 10 m long, shall be provided for fitting to the inlet and outlet of the unit. Space for storing these flexible hoses one side of tank shall be provided.

Suitable size cable, one end of which shall be connected to the starter and other end to motor terminal box shall be provided.. Earth connection shall also be provided for the unit.

The components shall be assembled such that they can easily be dismantled for maintenance.

25.5.1 Specific Technical Parameter (Project specific)

Sl. No.	Parameter	Value
1	Pump Motor set	
a	Motor Rating	XX KW/HP
b	Voltage/Freq./ Phase	415 V, 50Hz, 3ph
c	Insulation Class	F
d	Pump Capacity	XX lpm mim
e	Working pressure	XX Bar
f	Working Fluid	Oil, ISO VG 46 or XX

2	Whether hand Pump provided	Yes
3	Suction line filter filtration capacity	XX micron
4	Return line filters filtration capacity	XX micron
5	Oil tank	
a	Material & thickness	XX , XX mm
b	Capacity	XX Litre
6	Air breather with oil filter	XX micron
7	Hose material, diameter & withstand Pressure	XX, XX mm, XX Bar
11	Noise level	< 80 db at a distance of 1m

25.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets giving operational principles, dimensions and other technical details.
- ii) General arrangement drawing comprising of elements of configuration and material part list.
- iii) Technical Data sheet
- iv) O&M manual comprising of all above including list of recommended spare parts, assembly and disassembly procedure.

26 GENERATOR AIR COOLERS

26.1 Scope of Work

The specification covers the design, manufacture, Shop testing, delivery of Generator air coolers for use in XXX Power station of NHPC Limited.

26.2 Standards and Regulations:

The system and equipment shall be designed, built tested and installed to the latest revisions of applicable standards.

26.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

26.4 Functional Characteristics

The cooler shall be designed in a way to allow the generator to operate continuously at rated output, without exceeding the temperature rise specified values, at XX °C ambient temperature and when the capacity of the air-water heat exchangers is reduced by 15% due to internal or external deposits of foreign bodies.

26.5 Constructional feature

The air-water heat exchangers (stator air coolers) shall be used for cooling of heated air. These coolers shall be mounted on the stator frame, each provided with shut-off valves at inlet and outlet connected to common manifolds.

The air cooler shall be designed for at least 10 bars nominal pressure & pressure test 50% above nominal pressure.

Air coolers shall withstand the machine's vibrations and all elements shall be fully protected against corrosion. Lifting lugs shall be provided to facilitate the removal of any cooler through the top of the generator cover.

The bidder shall ensure that offered generator air Coolers shall be suitable for installation in the existing space and shall have same dimension, heat transfer area and construction. Inlet/ outlet flanges diameter of air coolers water pipes and orientation/positions of fitment hole shall match with existing air coolers.

26.5.1 Specific Technical Parameter (*Project specific*)

SI. No.	Parameter	Value
1	Quantity of Air coolers	XX nos.
2	Air cooler loss	XX KW
3	Cooling tubes	

a.	No. of tubes	Not less than XX
b.	Tube diameter	XX mm
c.	Tube thickness	1.0mm or more
d.	Tube material	Cupro-Nickel 90:10
e	Number of passes	XX
4	Heat transfer area of all tubes	Not less than XXXX m ²
5	Fluid circulated	
a	Duct side	Hot air
b	Tube side	Cooling Water
6	Cooling water inlet/Outlet temperature	XX/XX °C
7	Cold air/Hot air temperature	XX/XX °C
8	Material of Fins	Aluminum/XX
9	Water Tube Design pressure	Min. 10 Bar
10	Water Tube Test pressure	Min. 15 Bar
11	Cooling water flow rate	Min. XX lpm
12	Cooling water pressure drop	Note more than XX bar
13	Air quantity per cooler	XX m ³ /s
14	Air pressure drop in cooler	Not more than XX Bar
15	Dimensional detail of existing air coolers	Dimensions shall strictly match with attached drawing
16	Material	
a.	Frame body	Cast Steel/Mild Steel
b	Tube Plate	Mild Steel plate IS 2062 Gr B or better
c	Tie rod	Bright steel bars IS:9550 Gr. C20 or better
d	Stud bolt & nuts	6.8 or better
e	Pipe flange - Standard	ANSI B 16.5 RF or XXX

17	Accessories	Cooler arrangement shall be supplied together with all accessories like flanges, hardware etc.
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26.6 Drawing & Manual:

The bidder shall submit following information:-

- i) General arrangement drawing and material part list.
- ii) Technical Data sheet
- iii) O&M manual comprising of all above including list of recommended spare parts. Assembly and disassembly procedure.

27 BRAKE DUST COLLECTION SYSTEM

27.1 Scope of Work

The specification covers the design, manufacture, delivery at site, installation and commissioning of Brake dust collection System for use in XXX Power station of NHPC Limited. The scope shall comprise of :

- i) One set of flexible pipe/hose & accessories
- ii) One set of filter box including washable filter
- iii) One set of fan & motor with control panel

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.

27.2 Standards and Regulations:

The system and equipment shall be designed, built tested and installed to the latest revisions of applicable standards.

27.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

27.4 Functional Characteristics

The brake dust collection system shall suck the brake dust generated during braking action of generator. The filters used shall be washable type having high efficiency. The pipes/flexible hoses of brake dust system shall comprise of XX material. During the braking operation, fan shall be started and sucks the brake dust produced and collected in the filter box. Operating temperature of System shall be XX °C.

27.5 Construction:

27.5.1 Flexible Pipe/Hose

Flexible Pipe/hose are connected in each brake assembly for collection of brake dust produced during braking operation of generator. Pipe/hose from each assembly is taken out and connected to a common hose. This common hose is connected to brake dust collector equipment. The piping of brake dust system shall comprise of PVC pipes and flexible hoses. If metal pipes are used, they shall be coupled with straub coupling in order to facilitate quick dismantling and erection.

27.5.2 Fan motor set

The brake dust collector unit shall contain washable filter, box and fan motor set. During the braking operation of generator, fan shall be turned on automatically and sucks the brake dust produced and collected in the filter box.

27.5.3 Control Panel

Control Panel Motor control panel shall be provided with DOL starter, TP switch disconnecter, over load protection with single-phase preventer, power contactor, auxiliary contactor for power contactor. Indicating lamp for

indication of control supply healthiness, motor ON/OFF/thermal over load trip, Start stop push buttons, emergency stop push button, etc.

Ammeter along with CT shall be provided for measurement of motor current. Control transformer, selector switch, auxiliary contactor space heater and thermostat, terminal block, MCB, Cu cable and other accessories shall also be provided for complete control and protection of system. Gasket shall be provided in door of panel and degree of protection shall be IP-52 or more.

The brake dust collector system shall be suitable for installation in available space within the existing system.

27.6 Specific Technical Parameter

Sl. No.	Parameter	Value
1	Flexible Pipe/hose	
a.	Nominal Diameter	XX mm
b.	Material of Hose	XX
2	Filter	
a.	Material	XX
b.	Filter Efficiency	Minimum 99% for 0.5 micron
c.	Filtering Capacity	XX Lit/Sec at XX Pa
d.	Filter box capacity	XX litre
3	Fan & Motor	
a	Flow Rate	XX m ³ /Hr
b	Casing	Minimum 2 mm Galvanized Sheet Steel
c	Impeller Material	XX\ Die cast Aluminum
d	Motor Rating	XX KW,
e	Voltage, Freq, rpm	415 V, 3-Phase, 50Hz, XX rpm
f	Degree Of Protection	IP-55
g	Noise level	Shall be less than 85 db at 1 m of distance
4	Control Panel	
a	DOL starter	XX KW motor
5	Accessories	Brake dust collection system along with control panel shall be supplied

		together with all accessories control and power terminal, wiring and hardware etc.
6	GA drawing	Attached herewith for reference.

27.7 Drawing & Manual:

The bidder shall submit following information:-

- i) General arrangement drawing and material part list.
- ii) Technical Data sheet
- iii) O&M manual comprising of all above including list of recommended spare parts, assembly and disassembly procedure.

28 GENERAL PURPOSE PIPE – WATER, AIR AND OIL APPLICATION

28.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of general-purpose pipes for water, air and oil application. The pipes shall be used in XXX Hydro Power Plant of NHPC.

28.2 Specific Parameters and Design Consideration:

The material standard / grade, type, thickness or pipe schedule shall be as mentioned in the technical specification. The pipe length, dimensions tolerances etc. shall be in accordance to the relevant national/ international standard.

Unless otherwise stated, piping shall be designed for a "nominal pressure" PN 10. All piping shall be tested with 1.5 the design/nominal pressure.

All piping shall be acid treated to guarantee clean surfaces, completely free from welding residues. The minimum steel pipe wall thickness shall be the "normal" or "standard" wall thickness as stated in the applicable standards.

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	ASTM A53	Specification for pipe, steel, black and hot dipped, zinc coated , welded and seamless
2.	ASTM A312	Specification for seamless and welded austenitic stainless steel pipes
3.	ANSI B 36.19	Stainless steel pipe
4.	ASTM A 106	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
5.	IS: 1239	Steel tubes, tubular and other wrought steel fittings
6.	IS : 3589	Steel pipes for water and sewage
7.	IS : 4736	Specification for Hot dip Zinc coating on mild steel tubes

28.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

28.4 Pipes

28.4.1.1 Water and air application

Pipes shall be heavy-duty class carbon steel confirming to ASTM A53 Gr. B/ASTM A106/ ASTM A312 or mild steel, IS: 1239 (Part -1)/ IS: 3589 or other equivalent applicable standard as per Employers approval confirming to the requirement.

Pipe size less than 25mm shall be of minimum schedule 80 or equivalent pipe thickness. All pipes 25mm and above shall be of minimum schedule 40 or heavy-duty type as per relevant applicable Indian/ international standard. Pipe sizes of diameter 80 NB and below shall be of seamless stainless steel. Steel pipes 100 NB in diameter and above shall be made of galvanised carbon steel/ mild steel.

The penstock, spiral case, bypass valve, head cover balancing pipe and other high pressure or pipe to be use in critical application shall be seamless carbon / mild steel type of minimum schedule 80 or pipe thickness corresponding to schedule 80.

28.4.1.2 Oil application

All oil application pipes shall be seamless stainless steel confirming to ASTM A312/ Indian standard or other applicable national/ international standard as per Employers approval confirming to the requirement. All oil piping shall be of minimum schedule 80 except drainpipe, which shall be at least schedule 20. All oil hydraulically piping shall be hydrostatically tested at a pressure 100% greater than the maximum working/ design pressure

28.4.1.3 Specific Technical Parameter (*Project Specific*)

Sl. No..	Parameters	Value
A.	Water and Air Pipes	
1.	Quantity	XXX m.
2.	Material Standard/ Grade/ type/ schedule or pipe thickness/ type of pipe ends for :	
a.	Pipe diameter 25NB and below	XXX
b.	Pipe diameter 40NB to 80NB	XXX
c.	Pipe diameter 100 NB and above	XXX
B	Oil Pipes	
1	Quantity	XXX m
2	Material Standard/ Grade/ type/ schedule or pipe thickness/ type of pipe ends for all sizes of pipes	XXX

28.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the product manufacturer.
- ii) Technical Data Sheet.

29 GENERAL PURPOSE - PIPE FITTINGS & ITS FASTENERS

29.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of pipe fittings and fasteners for XXX Hydro Power Plant of NHPC.

29.2 Specific Parameters and Design Consideration:

Fittings to be used in piping shall conform to relevant IS/ASTM/ANSI/ASME Standards and in conformity with the parent pipe standard.

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	ASTM A105	Specification for carbon steel forgings for piping application
2.	ASTM A182	Specification for forged or rolled alloy steel pipe flanges , forged fittings & valves & parts for high temperature services
3.	ASTM A193	Specification for alloy steel & stainless steel bolting material for high temperature services
4.	ASTM A194	Specification for carbon steel & alloy steel nuts for bolts for high pressure or temperature services
5.	ASTM A234	Specification for pipe fittings of wrought carbon steel and alloy steel for moderate and high temperature service
6.	ASTM A312	Specification for seamless and welded austenitic stainless steel pipes
7.	ASTM A403	Specification for wrought austenitic stainless steel pipe fittings
8.	ASME B16.5	Steel pipe Flanges and flanged fittings
9.	ANSI B16.9	Steel Butt – Welded Fittings
10	ANSI B16.11	Forged steel fittings – Socket welding and threaded
11	ASME/ ANSI B16.21	Butt welding Ends
12	IS 1239	Steel tubes, tubulars and other wrought steel fittings
13	IS 1364	Hexagon head bolts, Screws and nuts for Product grades A and B
14	IS 1367	Technical supply conditions for threaded steel fasteners
15	IS 2062	Steel for general structural purpose

29.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

29.4 Pipe Fittings and fasteners

All fittings shall have smooth surfaces, workmanship like finish and be free from loose scales, defects like laps, seams, folds, cracks etc. Pipefitting shall have metric flanges. Welded flanges shall be weld- neck or slip on flange type and raised face shall be machined.

Bends and flanged shall preferably be forged type for size below DN 200. Mitered/ fabricated bends and flanges shall be allowed for larger sizes. Material for pipe bend/ flange shall match with pipe material and for galvanised pipe application, all fittings shall be galvanised.

Piping flanges and counter flanges & their drilling shall generally conform to ANSI B 16.5 or XX of relevant pressure & temperature class. Flanges shall conform to ANSI B.16.5 or XX class 150 (min.) or XX (min.).

The general-purpose hexagon head machine bolts shall conform to IS: 1367 class 4.6 (min) or XX and hexagon head nuts shall conform to IS: 1367 class 4.0 (min.) or XX for carbon steel/ mild steel pipe & fittings and for galvanised pipes & fittings, galvanised shall be as per IS: 4736 or equivalent standard. The general-purpose stainless steel bolts and nuts shall conform to ASTM A-193, Gr. B-7 & ASTM-193, Gr. 2H or XX for stainless steel pipes & fittings.

Material for washer shall match with pipe & fittings material. In case of galvanised pipes & fittings, galvanised washers shall be used. Gasket material shall be of Aramid fibre with NBR or XX for pipefitting.

29.4.1.1 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
A.	Elbow/ Reducer/ Tees	
1.	Quantity	XXX nos.
2.	Material & material Standard/ Dimensional standard / type/ Joint type for :	
a.	Sizes 15NB to 40 NB	XXX
b.	Sizes 50NB to 80NB	XXX
c.	Sizes 100 NB to 150NB	XXX
c.	Sizes 200 NB to 600 NB	XXX
B.	Flanges	
1	Type / Material & material	

	Standard/ Dimensional standard / type	
a.	Sizes 15NB to 40 NB	XXX
b.	Sizes 50NB to 80NB	XXX
c.	Sizes 100 NB to 150NB	XXX
d.	Sizes 200 NB to 600 NB	XXX
C.	Fasteners (Bolts/ Nuts & screws)	
a.	Quantity	XX Nos.
b.	Bolt sizes	M XX
c.	Applicable standard	IS: 1367 or XX
d.	Class of Bolt/ screw (min.)	4.6 or XX
e.	Class of nut (min.)	4.0 or XX
D.	Washer	
a.	Quantity	XX Nos.
b.	Diameter	M XX
c.	Material	Stainless steel/ Mild steel/ Galvanised steel
d.	thickness	1.5mm or XX mm
E	Gasket	
a.	Quantity	XX nos.
b.	Type	Aramid fibre with NBR or XX
c.	Thickness	3mm or XX mm
d.	Applicable standard	ASME B16.21 or XX

29.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the product manufacturer.
- ii) Technical Data Sheet.

30 VENTILATION AND AIR CONDITIONING SYSTEM – FANS/ BLOWERS

30.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of fans/ blowers for used in Air Ventilation system for underground/ surface power plant. The components shall be used in XXX Hydro Power Plant of NHPC.

30.2 Specific Parameters and Design Consideration:

All equipment shall be heavy-duty type suitable for installation in heavy industries and for long period of uninterrupted service. All materials used shall conform to the specification and shall new and first class in all respects.

30.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

30.4 Design and Construction

30.4.1.1 Axial Flow Fan

Axial air fans shall be of the multi blade vane type. The vanes shall be adjustable individually at standstill. The hub of the impeller shall be directly coupled to the motor shaft and its diameter adapted to the motor frame. The impeller shall be statically and dynamically balanced.

All bearings shall be pre-lubricated, self-aligning and selected for a minimum of 100,000 hour's average life at the maximum design rating. If, however, frequent lubrication is required this should be possible from the outside of the fan casing without disturbing the fan duct assembly. Bearing supports shall be specially designed for trouble-free bearing service. All fan shafts and wheels shall be designed to operate at their maximum rated speed, which is below the first critical speed.

The first critical speed of the rotating assembly shall be at least 25% above the operating speed. Fan wheels shall be statically and dynamically balanced according to ISO 1940 Grade 6.3.

The steel casing of the air fans shall be made of hot-dip galvanized steel or aluminium. Where the impeller is accessible in operation, guards shall prevent injuries to maintenance personnel.

Each axial flow fan unit shall be complete with

- Fan impeller of aerofoil design & casing/short duct, (wherever required).
- Electric drive motor of suitable rating with coupling if any, including motor brackets.
- Inlet cone and grouting framework, if any.
- Rain protection cowl with bird-screen made of GI, bolts etc..
- Vibration isolators

30.4.1.2 Centrifugal flow blower

The centrifugal blower shall be of Aerofoil *Forward/ Backward* (project specific) inclined type vane design and of limit load characteristics. Blowers shall have double width double inlet (DWDI) or XX (*project specific*) blower wheel and scroll. They shall be constructed of heavy gauge galvanized steel. They shall be designed for continuous operation at the maximum rated fan speed and motor horsepower.

Full rotating assembly including shaft, impeller and pulley shall be both statically and dynamically balanced for the close level of vibration & noise free operation at specified speed. The aerofoil section blades shall be accurately formed from single sheet of galvanised steel and welded at the trailing edge. The impeller blades shall be galvanised steel and securely welded to both the back plate and shroud. All centrifugal blowers are coupled to the drive motors with V-belts.

Shaft of blower shall be of material EN-8 and suitably designed to take up the various torque & bending moments of the total systems. The first critical speed of the rotating assembly shall be at least 25% above the operating speed. Blower wheels shall be statically and dynamically balanced according to ISO 1940 Grade 6.3.

The bearing of the blower shall be of spherically seated, roller, antifriction self-aligning, grease packed, pillow type. They will be designed to run continuously for a year between greasing. The life of the bearings shall be at least 100,000 hours.

Each centrifugal flow blower unit shall be complete with

- Impeller (backward or forward curved) with casing & supports and required steel frame/ supporting structure, if any.
- Electric drive motor of suitable rating
- Drive Pulleys, V-belt, belt guards, slide rails etc.
- Dampers at inlet and flexible connection (Rubber Canvas or XX) with matching flanges
- Vibration isolators, foundation bolt and nuts.
- Removable drain plug with the fan casing,
- Coupling guards and belt guards shall be furnished as applicable.

30.4.1.3 Electric motors

All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 144. Cable termination points shall be of class IP55.

Where motors are installed outdoors, a weatherproof design shall be chosen. L.V. motors of IEC size 132 and above shall be equipped with automatically controlled heating elements for protection against internal condensation of moisture during standstill periods. Such A.C. heater shall be suitably fixed inside the motor casing; the leads shall be led to a separate L.V. terminal box. Motors installed outdoors and directly subjected to solar radiation shall be rated such as not to exceed a maximum metal temperature of 85°C. Where necessary, such motors shall be provided with sun shields. Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

The bearings shall be fitted with grease nipples permitting the use of a universal grease gun.

Vertical motors shall have approved thrust bearings.

Each motor shall have adequately sized bolts with washers at the lower part of the frame for earthing. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips. Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).

A.C. motors shall be capable of operating continuously under rated output conditions at any frequency between 95% and 105% of the rated frequency and/or with any voltage variation between 90% and 110% of the nominal voltage. A transient overvoltage of 130% of the nominal voltage shall as well be sustained.

Generally, all motors shall be able to withstand three cold starts per hour, equally spaced. In addition, each M.V. motor shall be capable of enduring two successive starts with the motor initially at operating temperature. Each L.V. motor shall be capable of withstanding three successive starts under the same conditions or once every twenty minutes without detrimental heating.

A.C. motors shall be designed for direct on-line starting. They shall be capable of being switched on without damage to an infinite busbar at 110% of the nominal voltage with an inherent residual voltage of 100% even in phase opposition. For starting the motors from the individual main and auxiliary busbars, a momentary voltage drop of 20% referred to nominal voltage should be taken into consideration. With 85% of the nominal voltage applied to the motor terminals, each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.

Further, the motors shall be capable of maintaining stable operation when running at 70% nominal voltage for a period of 10 seconds. The pullout torque for continuously loaded motors shall be at least 160% of the rated torque and for intermittently loaded motors 200% of the rated torque.

The insulation of all motors shall be of class F but maintain in operation the temperature limits of class B materials.

30.4.1.4 Painting

All the inside and external metal surface of housing, impeller etc. shall be given two coats of epoxy primer and 3 coats of epoxy painting of approved colour. The external surfaces shall be painted with 3 coats of approved paint enamel after primer. All the surface shall be thoroughly cleaned & checked, rough edges or weld spatter removed and then cleaned with non-chlorinated solvent and dried before painting.

30.4.1.5 Foundation

The purchaser shall provide the concrete foundation. However, base frame, vibration isolators and foundation bolts will be in the scope of the supplier. The base frame design shall be such that it ensures minimum vibration to the fan.

30.4.1.6 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
A	Fans	
1	Axial Flow Fan Unit	
a.	Quantity	XX Nos.
b.	Application & Duty	XX & Continuous
c.	Type	Adjustable multi blades (vanes) aerofoil section for smooth flow to provide high efficiency or XX
d.	Capacity	XX m ³ /hr
e.	Static pressure at rated speed	XX mm W.G.
f.	Altitude of installation	EI. XXXX M
g.	Inlet & outlet size of fan	XX mm & XX mm
h.	Total head at rated speed	XX mm WG
i.	Type of mounting of fan	Wall mounted or XX
k.	Fan power at rated speed	XX Kw
l.	Fan efficiency	Min. XX %
m	Noise level at 1.5m distance (as per IS : 12065 & 12075)	Not to exceed 85 db or XX
n.	Wheel diameter	XX mm
o.	No. of blades	XX mm
p.	Outlet velocity	Not to exceed XX m/s
q.	Material of Construction	
i)	Inlet & Outlet Flange	Hot Dip Galvanised or XX
ii)	Impeller	Al. Die casted adjustable bladed impeller or XX
iii)	Casing	Hot dip galvanised M.S or XX
iv)	Shaft	C-45 or XX
v)	Hub	Aluminium or XX
r.	Motor details	
i)	Motor Rating & Speed	XX KW & XX rpm
ii)	Applicable standard	IS:325/IS:12615 or XX
iii)	Rated voltage of motor	415VAC +/-10%, 50 HZ +/-5%
iv)	Efficiency	Not less than XX %
v)	Power factor at full load	Not less than XX
vi)	Insulation	Class F with temp. rise limited to class B

vii)	Type of drive	Direct
viii)	Type of mounting of motor	Foot mounting or XX
ix)	Type of motor	TEFC Sq. cage Induction motor
x)	Type of starting	DOL or Start Delta
xi)	Degree of protection of enclosure/ terminal box	IP 55 or XX
s.	Overall dimension of fan-motor assembly	Shall match with the existing assembly, refer attached drawing.
t.	Painting details	Hot dip galvanised/ Hot dip galvanised and FRP lining inside casing for battery or XX area.
2	Centrifugal Air blower Unit	
a.	Quantity	XX Nos.
b.	Application & Duty	XX & Continuous
c.	Type	Forward// Backward curved inclined , aerofoil section blade, high efficiency or XX
d.	Capacity	XX m ³ /hr
e.	Static pressure at rated speed	XX mm W.G.
f.	Altitude of installation	El. XXXX M
g.	Total pressure at rated speed	XX mm WG
h.	Critical speed of blower	XX rpm
i.	Type of mounting of blower	Wall mounted or XX
j.	Blower power at rated speed	XX Kw
k.	Blower efficiency	Min. XX %
l	Noise level at 1.5m distance (as per IS : 12065 & 12075)	Not to exceed 85 db or XX
m.	Inlet vane requirement	Yes
n.	Wheel diameter	XX mm
o.	Outlet velocity	No to exceed XX m/s
p	Flexible connection with counter flanges	Yes
q.	Material of Construction	
i)	Inlet Cone	Hot Dip Galvanised or XX
ii)	Impeller	Al. Die casted or XX
iii)	Casing (Scroll)	Hot dip galvanised M.S or XX

iv)	Shaft	C-8 or XX
v)	Shroud	Aluminium or XX
vi)	Blades	Die casted galvanised MS or XX
vii)	Base frame & pedestal	Mild steel or XX
r.	Motor details	
i)	Rating & Speed	XX KW & XX rpm
ii)	Applicable standard	IS:325/IS:12615 or XX
iii)	Rated voltage of motor	415VAC +/-10%, 50 HZ +/-5%
iv)	Efficiency	Not less than XX %
v)	Power factor at full load	Not less than XX
vi)	Insulation	Class F with temp. rise limited to class B
vii)	Type of drive	Through V belt
viii)	Type of mounting of motor	Foot mounting or XX
ix)	Type of motor	TEFC Sq. cage Induction motor
x)	Type of starting	DOL or Start Delta
xi)	Degree of protection of enclosure/ terminal box	IP 55 or XX
s.	Overall dimension of blower-motor assembly	Shall match with the existing assembly, refer attached drawing
t.	Painting details	Hot dip galvanised/ Hot dip galvanised and FRP lining inside casing for battery or XX area.

30.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of equipment and General Arrangement drawing with material Part list.
- ii) Technical Data Sheet.
- iii) O&M manual comprising of all above including list of recommended spare parts, assembly and disassembly procedure

31 GENERATOR - BRAKE & JACK ASSEMBLY

31.1 Scope of Work

The specification covers the design, manufacture, Shop testing, delivery at site, installation, commissioning including performance testing of Brake & Jack assembly for use in XXX Power station of NHPC Limited. The scope shall comprise of supply of XX sets of brake and jack system. Each set scope shall comprise of:

- i) Brake Cylinders and brake pads and its associated accessories,
- ii) Jacking oil pump with suction strainer, oil tank etc.,
- iii) Seamless Stainless Steel pipe & fittings,
- iv) Required instrumentation like pressure gauges with electrical contacts, pressure switches, oil level indicators, proximity/ contact limit switches etc.
- v) Isolating valves, NRVs, pressure reducer, solenoid valves, shuttle valves, direction control valves, pilot valve, pressure relief valves, flexible hoses with couplings, fasteners, etc.

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.

31.2 Standards and Regulations:

The system and equipment shall be designed, built tested and installed to the latest revisions of applicable standards.

31.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

31.4 Functional Characteristics

Common jacks are used for the braking as well as lifting of generator rotor. For applying brakes, compressed air is passed through the jacks which is thereby lifted up to a certain height. The brake pads mounted on its top, come in contact with the brake track mounted below the rotor. The friction then created brings the rotor stop. After stopping the generator rotor, the rotor may be required to lift for maintenance work and this achieved by high oil pressure the same jack

It shall include a complete control unit with indicating devices for manual and automatic control of braking and jacking system, arranged in panels..

The brake and jack system shall be capable mechanically to withstand all electrical, mechanical and other stresses, which may be experienced during the operation of the unit.

31.5 Design and Construction

The bidder shall ensure that offered system/equipment be suitable with the existing system in respect of material, constructional and operational feature. The jack/ cylinder dimensions, stroke, liner, pump capacity, operating pressure and applying force shall match with the existing system and suitable for installation in available space.

Existing control logic diagram and brake & Jack assembly drawings are attached for reference.

31.5.1 Brakes

Brakes shall be pneumatically operated, and shall be made of asbestos-free material, to bring the rotating parts of generator and turbine to stop from 30% or XX rated speed in normal condition. However, under emergency condition it shall be possible to apply the brakes at 50% of rated speed without any damage to brakes and brake ring. The brakes shall normally be applied automatically, by drawing air from the air receiver.

Necessary interlocking shall be provided so that brakes are not applied unless turbine wicket gate are fully closed, Generator Circuit Breaker are open, and machine speed is less than 20% or XX under normal operating condition. This interlock should work even during the manual braking operation. Electrical solenoid operated valves shall be provided in air circuit for brake operation.

A bypass valve shall be provided for exceptional operation of brakes. This bypass valve & electrical operated solenoid valve shall be installed inside the brake panel cabinet to avoid inadvertent operation and shall be suitably tagged. Manual operation buttons on the panels shall be provided with suitable covers.

It shall be possible to operate brakes both from unit control board and brake control panel. Compressed air at 7 Kg/cm² air pressure required for operation of the brakes shall be provided from the compressed air system by NHPC.

The brake linings shall be of durable, asbestos free material adequately arranged to facilitate inspection and replacement. The minimum lining thickness shall be supervised and an alarm shall be provided.

Brake shall be provided with proximity sensors of IP 67 class with auxiliary contacts to provide starting interlocks and "ON", "OFF" indication on Unit Control Board.

Piping in the brake and jack system shall be of stainless steel seamless type.

31.5.2 Jacks

The brake cylinder shall also be designed to serve as hydraulic jack to lift the generator rotor to a sufficient height to facilitate removal and adjustment of bearing pads. A limit switch for operation of an indicating lamp and tripping of jacking pump shall be provided when maximum permissible raised position of the rotor is reached. A manual and motor operated high pressure oil pump shall be supplied with the each brake & jack assembly. The jacks shall be lockable in any desired position to permit release of the jacking oil pressure.

Mechanical locks shall be provided to limit the rotor lifting range. After each jacking operation the entire oil is drained from braking system. A

complete control unit for manual and automatic control shall be provided.

The surface of the piston in contact of cylinders should be chromium plated. Jack shall be provided with reliable and durable seal arrangement.

31.5.3 High pressure oil pump

High-pressure *gear* or XX oil pump coupled with electric motor, shall be used for pumping the oil at XX bar into the brake jack assembly for lifting the rotor.

For jacking, pressurised oil from oil tank shall be pumped at requisite pressure of XX bar with NRV at pump outlet and suction strainer at pump inlet to lift the rotor.

31.5.4 Electric motors

All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 144. Cable termination points shall be of class IP55.

Where motors are installed outdoors, a weatherproof design shall be chosen. L.V. motors of IEC size 132 and above shall be equipped with automatically controlled heating elements for protection against internal condensation of moisture during standstill periods. Such A.C. heater shall be suitably fixed inside the motor casing; the leads shall be led to a separate L.V. terminal box. Motors installed outdoors and directly subjected to solar radiation shall be rated such as not to exceed a maximum metal temperature of 85°C. Where necessary, such motors shall be provided with sun shields. Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

As far as possible, the motors shall have sealed ball or roller bearings lubricated for life. All other motors with ratings of about 1 kW and above shall be equipped with lubricators permitting greasing while the motor is running and preventing over-lubrication. Additionally, the bearings shall be fitted with grease nipples permitting the use of a universal grease gun.

Vertical motors shall have approved thrust bearings.

Each motor shall have adequately sized bolts with washers at the lower part of the frame for earthing. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips.

A.C. motors shall be capable of operating continuously under rated output conditions at any frequency between 95% and 105% of the rated frequency and/or with any voltage variation between 90% and 110% of the nominal voltage. A transient overvoltage of 130% of the nominal voltage shall as well be sustained.

Generally, all motors shall be able to withstand three cold starts per hour, equally spaced. In addition, each M.V. motor shall be capable of enduring two successive starts with the motor initially at operating temperature. Each L.V. motor shall be capable of withstanding three successive starts under the same conditions or once every twenty minutes without detrimental heating.

A.C. motors shall be designed for direct on-line starting. They shall be capable of being switched on without damage to an infinite busbar at 110% of the nominal voltage with an inherent residual voltage of 100% even in phase opposition. For starting the motors from the individual main and auxiliary busbars, a momentary voltage drop of 20% referred to nominal voltage should be taken into consideration. With 85% of the nominal voltage applied to the motor terminals, each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.

Further, the motors shall be capable of maintaining stable operation when running at 70% nominal voltage for a period of 10 seconds. The pullout torque for continuously loaded motors shall be at least 160% of the rated torque and for intermittently loaded motors 200% of the rated torque.

The insulation of all motors shall be of class F but maintain in operation the temperature limits of class B materials.

Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).

31.5.5 Piping, Hoses and Fittings

Seamless stainless steel pipes shall be provided along with fittings, valves, NRV, shuttle valves etc. strong enough to withstand high pressure of the system.

Hoses used shall be heavy duty flexible wire reinforced or XX type.

31.5.6 Control Panel

Control panel shall be provided terminal blocks, MCB, fuses contactor switch with indication like all brakes “ON”, any brake “ON”, all brakes “OFF”.

A limit switch for operation of an indicating lamp and tripping of jacking pump shall be provided when maximum permissible raised position of the rotor is reached.

Schematic diagram for operation brake and jack system & Instruction plate shall be provided on the control panel.

31.6 Specific Technical Parameter (*Project specific*)

Sl. No.	Parameter	Value
1	Rated speed of Generator (rpm)	XX rpm
2	No. of Brake jack assembly per machine	XX nos.
3	Nominal braking air pressure	7 Bar
4.	Nominal jacking oil pressure	XXX Bar
5	Brake	
a.	Rated braking force per jack	XX Newton
b.	Testing pressure for braking air circuit	XX Bar

c.	Brake liner, material size	Asbestos free, XXmm x XXmm x XX mm (thick) (As per attached drawing)
d.	Whether Limit switch for indicating the liner wear	Yes
6	Jack	
a.	Nominal oil pressure during jacking	XX Bar
b.	Testing pressure for jacking oil circuit	XX Bar
c.	Nominal lifting force per jack	XX Newton (as per attached drawing)
d.	Spring return force per jack, if applicable	XX Newton
e.	Maximum travel of piston, stroke	XX mm (as per attached drawing)
f.	Bore diameter	XX mm (as per attached drawing)
g.	Closed height of assembly	XX mm (as per attached drawing)
h.	Overall dimension of assembly	XXmm x XX mmx XX mm (as per attached drawing)
7	Pump–Motor Set	
a.	Motor rating	XX KW
b.	Voltage & Freq	415 VAC , 50 Hz
c.	Type	Sq. cage Induction motor, TEFC
c.	Insulation Class	Class F but temperature rise limited to class B
d.	Degree of protection	IP 54
e.	Type of OIL pump	<i>Gear pump</i> or XX
f.	Capacity and Pressure	XX lpm and XX Bar
8	Whether manual Operation hand pump provided	Yes
9	Oil Type	XX

31.7 Drawing & Manual:

The bidder shall submit following information:-

- i) Write up on operational principle and other technical details.
- ii) General arrangement drawings and control logic diagram of brake and jack system and material part list.
- iii) Technical Data sheet

- iv) O&M manual comprising of all above including list of recommended spare parts, assembly and disassembly procedure.

32 HS LUBRICATION SYSTEM

32.1 Scope of Work

The specification covers the design, manufacture, shop testing, delivery at site, installation, commissioning and performance testing of HS Lubrication System for use in XX Power station of NHPC Limited. The scope shall comprise of supply of XX sets of HS lubrication system. Each set shall comprise of:

- i) One set of primary AC motor driven pump and standby DC motor driven pump including oil filter(s) with clogging indicators,
- ii) Piping, fittings, couplings, adopters, pipe supports, clamps, fasteners, gaskets, ferrule, bonded seal, flexible hoses, couplings etc.
- iii) Indicating instruments like pressure gauges with contacts, pressure switches, pressure safety valve, pressure limiter, flow indicator, flow restrictor
- iv) Isolating gate valves and NRVs
- v) Control panel

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.

32.2 Standards and Regulations:

The system and equipment shall be designed, built tested and installed to the latest revisions of applicable standards.

32.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

32.4 Functional Characteristics

HS lubrication system shall be a high-pressure oil lift system, which injects oil into each thrust bearing pad during starting and stopping of the unit. This helps in establish a hydrodynamic oil film between the rotating thrust collar and stationary thrust bearing pads. The presence of the hydrodynamic oil film minimizes bearing wear. Consequently, HS system shall be turned on before the unit starts to rotate.

The maximum wear on the bearing pads occurs at slow speeds, due to hydrodynamic effects, the oil film is not maintained over the entire bearing surface. On unit shutdown, the HS system shall be again turned on when the unit speed decreases and maintained until the unit becomes stand still.

32.5 Design and Construction

The bidder shall ensure that offered system/equipment be suitable with the existing system in respect to material, constructional and

operational feature. The system/equipment shall be suitable for installation in the available space in the existing system.

Existing system control logic diagram and general arrangement drawings are attached for reference.

32.5.1.1 Pump motor set

Pump for HS lubrication system shall be gear/vane or XX type. Motor driven oil pump delivers oil at high pressure in the pipeline to the thrust-bearing pad during the start/ stop of generator. The system shall operate automatically.

AC motors shall have squirrel cage type rotors. One no. AC motor driven pump and one no. 220V DC motor driven pump shall be provided for this system. The AC pump shall be operated as main pump and DC motor driven pump shall be used as standby.

All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 144. Cable termination points shall be of class IP55.

Where motors are installed outdoors, a weatherproof design shall be chosen. L.V. motors of IEC size 132 and above shall be equipped with automatically controlled heating elements for protection against internal condensation of moisture during standstill periods. Such A.C. heater shall be suitably fixed inside the motor casing; the leads shall be led to a separate L.V. terminal box. Motors installed outdoors and directly subjected to solar radiation shall be rated such as not to exceed a maximum metal temperature of 85°C. Where necessary, such motors shall be provided with sun shields. Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

As far as possible, the motors shall have sealed ball or roller bearings lubricated for life. All other motors with ratings of about 1 kW and above shall be equipped with lubricators permitting greasing while the motor is running and preventing over-lubrication. Additionally, the bearings shall be fitted with grease nipples permitting the use of a universal grease gun.

Vertical motors shall have approved thrust bearings.

Each motor shall have adequately sized bolts with washers at the lower part of the frame for earthing. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips.

A.C. motors shall be capable of operating continuously under rated output conditions at any frequency between 95% and 105% of the rated frequency and/or with any voltage variation between 90% and 110% of the nominal voltage. A transient overvoltage of 130% of the nominal voltage shall as well be sustained.

Generally, all motors shall be able to withstand three cold starts per hour, equally spaced. In addition, each M.V. motor shall be capable of enduring two successive starts with the motor initially at operating temperature. Each L.V. motor shall be capable of withstanding three successive starts under the same conditions or once every twenty minutes without detrimental heating.

A.C. motors shall be designed for direct on-line starting. They shall be capable of being switched on without damage to an infinite busbar at 110% of the nominal voltage with an inherent residual voltage of 100% even in phase opposition. For starting the motors from the individual main and auxiliary busbars, a momentary voltage drop of 20% referred to nominal voltage should be taken into consideration. With 85% of the nominal voltage applied to the motor terminals, each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.

Further, the motors shall be capable of maintaining stable operation when running at 70% nominal voltage for a period of 10 seconds. The pullout torque for continuously loaded motors shall be at least 160% of the rated torque and for intermittently loaded motors 200% of the rated torque.

The insulation of all motors shall be of class F but maintain in operation the temperature limits of class B materials.

D.C. motors shall be capable of operating continuously under rated output conditions at any voltage between 90% and 110% of the nominal voltage with a fixed brush setting for all loads. Unless otherwise approved, the speed drop between no-load and full-load shall not exceed 10% of no-load speed.

Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).

32.5.1.2 Oil filter

In order to ensure the delivery of oil free from any foreign particles, filter(s) shall be used with metallic element clogging detector. The design of the filter is such that it can easily dismantle for cleaning. The filter(s) shall be of XX micron meter rating.

32.5.1.3 Piping, Hoses and fittings

Pipes in HS lubrication system shall be of stainless steel seamless type and pipe joints shall be ferrule type. The pipe and fittings shall be strong enough to withstand high pressure of the system.

Hoses used shall be heavy duty flexible wire reinforced or XX type

32.5.1.4 Indicating instruments/Valves

For measurement of oil flow and pressure, flow meter and pressure gauge with electrical contact and shall be provided. Pressure switches shall be used in system for low pressure indication/alarm. PRV adjustable, NRV and valve shall be used of suitable rating.

32.5.1.5 Control Panel

The system shall be provided with suitable rating control panel for operation control and protection. Powder coated control panel having dust proof enclosure suitable for dusty and hot atmosphere having all required indication / logic, terminal block, power, control cables, space heater, earthing bus bar, hardware shall be provided for the system.

It shall be provided suitable rating MCCBs, MPCB with short circuit & over current protection, power & auxiliary contactors, thermal over load trip, push buttons, Ammeter with CT, selector switch etc.

Indicating lamps for “ON/ OFF” status of AC and DC pump and control supply healthy shall be provided.

Schematic diagram for operation HS lubrication shall be provided on the control panel.

32.5.1.6 Specific Technical Parameter (*Project specific*)

Sl. No.	Parameter	Value
1	Type of oil used	XX.
2	Pump-Motor Set, AC (Main)	
a	Working Pressure & Flow	XX bar & XX lpm
b	Type of pump	<i>Gear Or XX</i>
c	Type of Motor	Sq. cage induction motor
c	Motor KW/Voltage/ freq	XX KW, 415 Volt, 3ph, 50 Hz
d	Speed (rpm)	XX rpm
e	Degree Of Protection	IP-54
f	Insulation class of motor	Class F with temperature rise limited to class B.
3	Pump-Motor Set, DC (Stand by)	
a	Working Pressure & Flow	XX bar & XX lpm,
b	Type of pump	<i>Gear or XX</i>
c	Type of motor	XX
d	Motor KW/Voltage	XX KW, XX DC Volt,
e	Speed (rpm)	XX rpm
f	Degree Of Protection	IP-54
4	Oil tank, if applicable	XX Liter
5	Flow meter	0-XX lpm
6	Micro Filters filtration effectiveness	XX micron meter

32.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Write up on operational principle and other technical details.

- ii) General arrangement drawing and material part list.
- iii) Technical Data sheet
- iv) O&M manual comprising of all above including list of recommended spare parts, assembly and dis-assembly procedure.

33 FIRE HOSE AND OTHER ACCESSORIES

33.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of fire hose and associated accessories. The fire hose and associated accessories shall be used for fire protection system in XXX Hydro Power Plant of NHPC.

33.2 Specific Parameters and Design Consideration:

Fire fighting components shall be in conformity with the applicable national/ international standards and shall be marked with applicable Standard Mark. It shall be suitable for fire protection in power plant.

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IS: 636	Specification for Non- Percolating Flexible Fire Fighting Delivery Hose
2.	IS:903	Fire Hose Delivery couplings, Branch Pipe, Nozzles and Nozzle spanner- Specification
3.	IS: 884	Specification for First Aid Hose Reel for Fire Fighting
4.	IS:5290	Landing Valves- Specification

33.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

33.4 Specific Technical Parameter (Project Specific)

Sl. No.	Parameter	Value
A.	Fire Fighting Hose Pipes	
1	Quantity	XX Nos.
2	Type and applicable standard	Non- Percolating Flexible Fire Fighting Delivery hose, IS:636, Type A or B
3.	Size (s), (Diameter X length)	XX mm x XX m
4	Burst Pressure	XXX kg/cm ²
5.	Working Pressure	XXX kg/cm ²
6.	Proof Pressure test	XXX kg/cm ²

7	End connection	Pair of male & female part
8	Type of coupling	SS-304 (IS:3444, Gr. 1 or XX) instantaneous or <i>Bronze/Gun metal</i> type ISI marked coupling
9	Size of coupling	XX mm x XX mm
10	ISI Marked	Yes
B.	Couplings	•
1.	Quantity	XX Nos.
2.	Type and applicable standard	Instantaneous type Fire hose Delivery couplings, IS:903
3.	Material	
a.	Male & Female Coupling	SS-304/ IS:3444, Gr.1 or XX
b.	Washer	Rubber or XX, IS: 937, Type –A
c.	Spring	SS or XX, IS:6528
4	Size of coupling	XX mm x XX mm
5	Hydrostatic Pressure Test	21 kg/cm ²
6	Finishing	All couplings shall be polished & Burrs & sharp edges to be removed
7.	ISI marked	Yes
C.	Landing Valves (Hydrant Valves)	
1.	Quantity	XX Nos.
2.	Type and applicable standard	Single outlet, Female Oblique type, IS:5290, Type A OR double head outlet, Female Oblique type, IS:5290, Type B
3.	Size	XX NB
4.	Flow Test	900 lpm at 7 kg/cm ² (Min.)
5.	Working pressure	Min. 3.5 to. 7.0 kg/cm ²
6.	Hydraulic Test pressure	21 kg/cm ²
7.	Construction features	
a.	Bonnet	Screwed
b.	Stem	Rising
8.	End Connections	
a.	Inlet connections	75NB or XX , Flanged Inlet drilled to ANSI B16.5
b.	Outlet connections	63NB or XX, 150lb Flat Face Instantaneous spring lock type coupling as per IS:5290 with blank cap & chain

9.	Material	
a.	Body & Bonnet	SS-304/ IS:3444, Gr.1 or XX
b.	Stop valve, valve seat & trim	SS-304/ IS:3444, Gr.1 or XX
c.	Instantaneous coupling	SS-304, IS:3444 or XX
d.	Blank cap	SS 304 or XX
e.	Chain	SS-304
f.	Valve spindle	SS:304/ IS:6603 or XX
g.	Spring	SS:304/ IS:6528 or XX
h.	Washer	Rubber as per IS:937, Type A or XX
10.	Colour code	Fire Red
11.	ISI marked	Yes
D.	Branch Pipe with Nozzles	•
1.	Quantity	XX Nos.
2.	Type and applicable standard	Short branch pipe with nozzle, IS:903
3.	Material	
a.	Branch pipe	SS-304/ IS:3444, Gr.1 or XX
b.	Nozzle	SS-304/ IS:3444, Gr.1 or XX
c.	Washer	IS:937, Type B Rubber or XX
4	Size	XX mm
5	Hydrostatic Pressure Test	
a.	Branch Pipe	21 kg/cm ²
b.	Nozzle	21 kg/cm ²
6	Spanner	Yes, Stainless steel, as per IS:903
7.	ISI marked	Yes
E.	Hose Reel with Drum	
1.	Quantity	XX Nos.
2.	Type and applicable standard	Manual wall mounted (swinging) type
3.	Hose Diameter & Length	19mm & 30m
3.	Material	
a.	Hose reel tubing	Rubber, IS:444, Type -2
b.	Wall bracket	Mild steel, IS: 513
c.	Sides	Mild Steel, IS:513
d.	Shut Off Nozzle	PVC

e.	Stop Valve	<i>LTB-II , IS: 318 As per IS:778</i>
3	Working Pressure	7 kg/cm2
4.	Hydraulic Test Pressure	21 kg/cm2
5.	Paint colour	Fire red
6.	ISI marked	Yes

33.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the offered models and General arrangement drawings.
- ii) Technical Data Sheet.
- iii) User / instruction manual.

34 WORKSHOP EQUIPMENT (MECHANICAL)

34.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of Drilling Machines, Pipe Bending Machine and Mobile Air Compressor and Power Hacksaw for maintenance of different electro-mechanical equipment in XXX Hydro Power Plant of NHPC.

34.2 Specific Parameters and Design Consideration:

The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards. Equipment shall be heavy-duty, robust, and compact design.

34.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

34.4 Design and Construction

34.4.1.1 Drilling Machines

A) Electrical Hand Drilling Machine

XX nos. of electrical hand drilling machine shall be supplied.

Each drilling machine shall have drilling capacity of maximum 23mm in steel. The drilling shall have overload protection and two (2) speeds electronic speed control. Each drilling machine shall be supplied with following.

- ◆ One (1) set of HSS drills of best quality covering the whole drilling range.
- ◆ One (1) spare drill jar socket,
- ◆ One (1) spare key for drill jar socket,

Weight of the machine shall not be more than 5 kgs.

B) Universal Radial drilling machine

XX no. of universal drilling machine shall be supplied.

Radial drilling machine shall be suitable for 60mm diameter capacity in mild steel complete with accessories etc. The worktable shall at least be of 1000x750mm. The maximum and minimum distance from the base plate to spindle shall be 1600mm and 400mm respectively or XX. The no. of spindle speed should not less than 12.

The drilling machine shall at least be supplied with:

- ◆ One (1) vice for drilling machine,
- ◆ Two (2) drill chucks of different sizes,
- ◆ Two (2) sets of Morse Taper Adapter from nos. 5 to 1 in step of one (1),

- ◆ 1 Complete set of Cooling device and machine lamp,
- ◆ 1 no. Universal table for angular work settings,
- ◆ Five (5) sets of carbide tipped twist drills of best quality covering the whole drilling range of 2 - 60 mm.

C) Portable Magnetic Base Electrical Drilling Machine

XX nos. of Portable magnetic electrical drill machines shall be supplied.

Drilling machine shall have at least 4 variable speed which shall be suitable for drilling upto 32 mm or XX diameter capacity in steel complete with all accessories.

Each drilling machine shall at least be supplied with:

- ◆ One(1) drill chuck of adequate size,
- ◆ One set of Morse Taper covering the drilling range of 2-32 mm,
- ◆ One (1) set of drill bits of best quality covering the whole drilling range of 2 - 32 mm

Weight of the machine shall not be more than 30 kg.

34.4.1.2 Pipe Bending Machine

XX nos. of pipe bending machine shall be supplied.

Pipe bending machine shall be hydraulic and hand operated type for bending of mild steel pipes of dimensions 25 mm to 75 mm with bending guides of different sizes and complete in all respect.

34.4.1.3 Mobile air compressor

XX sets of mobile air compressor shall be supplied

The electrically operated mono block-piston type with air receiver, air dryers, pressure switches and motor protection for fully automatic operation shall be complete with electric cable, pressure pipe hose / coupling etc. The design features for the compressor unit shall be as follows:

- ◆ Inlet volume 20 - 30 Nm³/h
- ◆ Nominal working pressure 8 bar at continuous operation
- ◆ Maximum discharge pressure 10 bar
- ◆ Receiver capacity 200 litres
- ◆ Power supply Three-phase, 415/240V, 50 Hz

34.4.1.4 Power Hacksaw

XX sets of Power hacksaw shall be supplied.

Power hacksaw shall be suitable for operation with 415V±10 %, 50Hz±5% power supply with following particulars:

Cutting capacity:

- Round section (mm) 300
- Rectangular section (mm) 250x250
- Stroke per minute 50 to 100

The following standard accessories shall be provided with both the hacksaws:

- One (1), coolant tank (with chips separator) electrically driven coolant,
- Pump with motor and coolant piping and nozzle,
- Fifty (50) power blades extra,
- One (1) adjustable bar rest,
- One (1) V shape vice jaws to cut materials in bundle,
- Emergency stop push button.

34.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the offered models.
- ii) Technical Data Sheet.
- iii) User / instruction manual.

35 WELDING SETS AND BRAZING SET

35.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of welding & brazing set and cutting equipment for use in maintenance of different E&M components in XXX Hydro Power Plant of NHPC.

35.2 Specific Parameters and Design Consideration:

The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards. Equipment shall be heavy-duty, robust and compact design.

35.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

35.4 Design and Construction

35.4.1 Welding Machines

A) Rectifier type welding machine

XX sets of rectifier welding machine (Thyristorised) shall be supplied.

Welding machines suitable for operation on $415V \pm 10\%$, $50Hz \pm 5\%$ power supply confirming to relevant standard with following specifications:

◆	Output current range	:	40-600 A
◆	Duty cycle	:	60%
◆	Class of insulation	:	H
◆	Cooling	:	Forced air
◆	Electrode size (Max.)	:	2.0-6.3mm
◆	Control Type	:	Stepless
◆	Open circuit voltage (max.)	:	100V

The welding machine shall be provided with the following accessories/items:-

- ◆ One (1) no. of twenty (20) meters, of extra flexible rubber covered electrode, copper cable with electrode holder attached,
- ◆ One (1) no. gouging attachment for use with carbon gouging electrodes.

B) Welding generator

XX sets of welding generator shall be supplied.

Welding generator suitable for operation on $415V \pm 10\%$, $50Hz \pm 5\%$ power supply. Supply confirming to relevant standard with following specifications:

- ◆ Output current range : 40-400 A
- ◆ Duty cycle : 60%
- ◆ Class of insulation : F
- ◆ Cooling : Water cooled
- ◆ Electrode size (Max.) : 2.0-6.3mm
- ◆ Control Type : Stepless with range selector switch
- ◆ Open circuit voltage (max.) : 90V
- ◆ Fuel tank capacity : Not less than 70 litre
- ◆ Engine Starting : Electric start
- ◆ Noise : 75db at 1m (max.)
- ◆ Enclosure : Shall be sound proof as per norms

The welding machine shall be provided with the following accessories/items:

- ◆ One (1) no. of twenty (20) meters, of extra flexible rubber covered electrode, copper cable with electrode holder attached,
- ◆ One (1) no. gouging attachment for use with carbon gouging electrodes.

C) TIG welding machine

XX sets of TIG welding machine (Thyristorised) shall be supplied.

Welding machines suitable for operation on 220V AC power supply confirming to relevant standard with following specifications:

- ◆ Output current range : 40-600 A
- ◆ Duty cycle : 60%
- ◆ Class of insulation : H
- ◆ Cooling : Forced air
- ◆ Control Type : Stepless
- ◆ Open circuit voltage (max.) : 100V

The welding machine shall be provided with the following accessories/items:-

- ◆ One (1) no. of twenty (20) meters, of extra flexible rubber covered electrode, copper cable with electrode holder attached,
- ◆ One (1) no. gouging attachment for use with carbon gouging electrodes.

D) MIG welding machine

XX sets of MIG welding machine (Thyristorised) shall be supplied.

Welding machines suitable for operation on 415V±10%, 50Hz±5% power supply confirming to relevant standard with following specifications:

- ◆ Output current range : 40-600 A
- ◆ Duty cycle : 60%

- ◆ Class of insulation : H
- ◆ Cooling : Forced air
- ◆ Control Type : Stepless
- ◆ Open circuit voltage (max.) : 80V

The welding machine shall be provided with the following accessories/items:-

- ◆ One (1) no. of twenty (20) meters, of extra flexible rubber covered electrode, copper cable with electrode holder attached,
- ◆ One (1) no. gouging attachment for use with carbon gouging electrodes.

35.4.2 OXY-ACETYLENE BRAZING AND CUTTING EQUIPMENT COMPLETE

XX sets of Oxy- acetylene brazing and cutting equipment complete in all respect shall be supplied.

Each shall consist of:

- ◆ One welding/brazing blow-pipe with two (2) sets of five (5) welding tips of different sizes,
- ◆ One cutting attachment with two (2) sets of four (4) cutting tips of different sizes,
- ◆ Twenty five (25) m of oxygen hose,
- ◆ Twenty five (25) m of acetylene hose,
- ◆ One (1) set of regulators and hose ferrules,
- ◆ One (1) wheel borrows, for carrying standard size of oxygen and acetylene cylinders (cylinders not included).

35.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the offered models.
- ii) Technical Data Sheet.
- iii) User / instruction manual.

36 GRINDING SETS, HYDRAULIC JACK SET AND GREASE GUNS

36.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of miscellaneous equipment like Grinding Machines, Hydraulic Jack set and Grease Guns for use in maintenance / handling of different E&M components in XXX Hydro Power Plant of NHPC.

36.2 Specific Parameters and Design Consideration:

The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards. Equipment shall be portable, heavy-duty, robust, low weight and compact design.

36.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

36.4 Design and Construction

36.4.1.1 Grinding machines

A) Double ended pedestal mounted grinding machine

XX sets of electrical angle grinder complete in all respect shall be supplied.

It shall consist of

- ◆ Grinding discs of max. Diameter 300 mm or XXmm.
- ◆ Drill grinding device
- ◆ Ten (10) zircon grinding discs
- ◆ Four (4) rotary wire brushed
- ◆ Wheel dresser – 1 Set, water pot- 1 set ., twist drill grinding attachment – 1 set,
- ◆ Standard Accessories – Electric motor, Vee Belts, Wheel guards, 2 adjustable tools rests.

B) Electrical Angle Grinder

XX sets of electrical angle grinder complete in all respect shall be supplied.

Electrical Angle grinders (hand) shall be of sizes 4", 7" and 9" or XX " along with 24 or XX nos. Zircon wheels.

Weight of the grinders shall not be more than 5 kgs or XX kgs.

36.4.1.2 Hydraulic Jack Set

XX sets of hydraulic jacks each of 10, 25, 40, 50 or XX MT capacity shall be supplied. Scope shall include supply of independent lifting cylinders of above capacities and a hydraulic hand pump connected to high-pressure flexible hosepipe with suitable size couplers.

The technical parameter of Jack set shall be as per below:

- ◆ **Hydraulic Jack (of XX capacity) :**
 - a) Rated Capacity –XX MT
 - a. Type – Single acting spring return or XX
 - b. Cylinder stroke or lift (maximum) - XX mm
 - Plunger type – Solid or XX
 - c. Cylinder Collapsed Height – XX mm
 - d. Cylinder Class – XX MT
- ◆ **Hand Pump :**
 - b) Pump speed – Two or XX
 - c) Hose length – 1.8 m or XX
 - d) Pressure rating – 700 bar or XX
 - e) Selection of stages – Automatic

36.4.1.3 Grease Guns

A) Trolley Mounted Pneumatically Operated Grease Gun

XX sets of trolley mounted pneumatically operated grease gun shall be supplied.

Each grease gun shall be high pressure installed on wheel for easy portability and should handle any grade of grease. It should have inbuilt pressure regulator valve assembly to adjust upto 4 bar or XX pressure.

It should be suitable to mount directly on a standard 200 kg barrel.

The technical parameter shall be as per below:

- ◆ Output at 8.5 kg/cm² air pressure – 300 kg (min.)
- ◆ Working pressure range of air –4.5 to 10.5 bar or XX
- ◆ Recommended working pressure of air – 8.5 bar or XX
- ◆ Air requirement (FAD) - XX lpm
- ◆ Type of hose – Wire braded oil resistant high pressure
- ◆ Delivery hose length – 2.2 m (min.)
- ◆ Drum Capacity – 25 kg or XX kg

B) Hand held grease gun of 10 kg capacity

XX sets of hand held grease gun shall be supplied.

Each grease gun shall be portable for ease of handling and hand lever operated.

The technical parameter shall be as per below:

- ◆ Output per stroke – 3g (min.)
- ◆ Blocked pressure– 140 bar
- ◆ Type of hose – Wire braided, oil resistant high pressure
- ◆ Delivery hose length – 2.2 m (min.)
- ◆ Drum capacity – 10 kg

36.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the offered models.
- ii) Technical Data Sheet.
- iii) User / instruction manual.

37 AHU, CHILLER, AC UNIT, COOLING COILS AND DAMPERS

37.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of AHU, Cooling coil, Package AC, Chiller and damper for use in Ventilation and Air Conditioning system (VAC) in XXX Hydro Power Plant of NHPC.

37.2 Specific Parameters and Design Consideration:

Equipment shall be portable, heavy-duty, robust, low weight and compact design.

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

Standard/ Guidebook	Description
ASHRAE	ASHRAE Handbook, data and guidebook
IS 4720	Code for practice for ventilation of surface hydel power stations
IS 325	Three phase Induction motors
IS:4894	Centrifugal fans
IS 3103	Code of practice for industrial ventilation
IS 8148	Packaged air conditioners
ANSI/ Standard 62	ASHRAE Ventilation for acceptable indoor air quality
ARI	Chiller Standards
AMCA Class II	Fan Rating
UL 555	Fire dampers

37.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|---|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |
| v) | Design temperature (Deg. C) & relative humidity (%):- | | ----- |
| vi) | Indoor DBT and Relative humidity (%) to maintain:- | | ----- |
| vii) | Raw water temperature (Max. & Min.) | :- | ----- |

37.4 Design and Construction

37.4.1.1 Air Handling Unit (AHU)

A) General description

XX no. of Air handling unit shall be supplied.

Unit shall be central station air handler. It shall consist of a fan with the following factory-installed components as indicated on the equipment schedule (as applicable):

- Cooling coil section with chilled water coil
- Heating coil section with electric coil
- Access and plenum section.
- Filter section
- Mixing box section:
- Face and bypass damper sections for:
 - Multi zone damper section.
 - Air mixer section.
 - Return fan section.
 - Exhaust section.

Units shall ship in the number of sections necessary to meet project requirements. All sections shall be flanged and gasketed to allow easy assembly and disassembly.

B) Casing

i) Construction

The AHUs shall be double skinned free floor standing type, constructed as a stable compact galvanized steel casing, factory assembled , divided in several cubicles for easier installation

- Casing panels shall be removable for easy access to unit. All panels shall be gasketed to ensure a tight seal.
- The construction of the AHU shall allow for easy maintenance/replacement of faulty components without dismantling the whole assembly
- Access sections shall have a double-wall hinged access door on both sides of component.

ii) Insulation

Each section shall be factory insulated. Insulation shall have full coverage waterproof adhesive to firmly secure the material to the unit casing. Insulation shall meet the erosion requirements of UL 181. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.

iii) Drain Pans

Drain pans shall be constructed of insulated double wall stainless steel. The pan shall be sloped toward the drain fitting.

C) Fans

i) General

Forward-curved fans *or Backward curved fans* shall have one double width double inlet (DWDI) fan wheel and scroll. They shall be constructed of heavy gauge galvanized steel. They shall be designed for continuous

operation at the maximum rated fan speed and motor horsepower. Fans shall have a minimum AMCA Class II rating.

Aerofoil fan sections shall have one DWDI aerofoil fan wheel and scroll. aerofoil blades shall be double thickness design. They shall be painted with zinc chromate primer and enamel paint. Fans shall have a minimum AMCA Class II rating.

Plenum fan sections shall have one single width single inlet (SWSI) aerofoil fan wheel. aerofoil blades shall be double thickness design. Wheels shall be painted with zinc chromate primer and enamel paint. They shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fans shall have a minimum AMCA Class II rating.

Fan shafts shall be solid steel, turned, ground, polished and coated with rust preventative oil.

ii) Coils

- General Fabrication:
 - All water and refrigerant coils shall have 15 mm or XX mm OD seamless copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be XX mm.
 - Copper plate fin type with belled collars. Copper-finned coils shall be supplied with stainless steel casing and tube sheets.
- Water Cooling Coils
 - Headers shall be non-ferrous with steel MPT connections.
- Refrigerant Coils:
 - Headers shall be seamless copper tubes with brazed joints.
- Electric Heating Section
 - Electric heating sections shall be constructed of pre painted galvanized steel and shall provide mounting of the heater control box access door on the side of the unit.
 - The manufacturer shall furnish an integral control box. It shall contain thermal cut-outs, primary and secondary control, sub-circuit fusing, airflow switch, and fused control transformer.
- Filter Sections

Flat filter sections shall accept 25, 50, 100 mm (1-in, 2-in., or 4-in.) width filters in any combination that totals 25, 50, 75, 100 mm (1, 2, 3 or 4 inches).

▪ Dampers

Mixing boxes, filter-mixing boxes, and exhaust boxes shall have parallel blades and interconnecting outside-air and return-air dampers.

Damper blades shall be constructed of galvanized steel with a double-skin aerofoil design.

▪ Air Mixer

Air mixer shall be constructed of welded aluminium framing and turbulators. The mixer shall have no moving parts. It shall contain a primary set of

direction-changing vanes, a secondary set of turbulator vanes, and a cone design for mixing of air streams.

D) Humidifier

AHUs shall be provided with Humidifier, Pan Type steam boiler, to raise and maintain specified level of indoor Relative Humidity (RH). The Humidifier will consist of insulated Pan, electric heater, water connection and wiring.

Accessories will include float switch for low water level cut-out, float valve with SS Ball, thermostat, sight glass and humidistat for sensing/controlling humidity.

It will be duly factory wired (control as well as power) with copper bus bar connection and terminal box. The pan will be thermally insulated. In addition to providing heating element of required rating, the humidifier will be provided with 0.5 KW heater with thermostat to maintain water temperature.

E) Air filters

The air filter media shall have layers of V-fold HDPE (High density Polyethylene) supported by Aluminium wire mesh with water as the mode of cleaning medium. Separation degree may be similar to EU4 (rough air filter), according to EUROVENT or DIN 24185 standards.

The frame structure of the panel cells shall be made of aluminium sections.

A properly positioned pressure gauge of the inclined tube type shall give an indication of the degree of dust loading on the filters for establishing the periods between services.

F) Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Quantity	XX Nos.
2.	Quantity of air handles	XX Cum/hr
3.	Material of Construction	Galvanised
4.	Insulation thickness	25mm (min.) or XX
5.	Cooling coil	
a.	Type	Fin type or XX
b.	Quantity of air handled	XX cum/hr
c.	Cooling coil power	XX kW
d.	Size of coil XX mm	
e.	Entering air temperature	
	- Dry bulb	XX Deg C
	- Wet bulb	XX Deg C
f.	Leaving air temperature	
	- Dry bulb	XX Deg C
	- Wet bulb	XX Deg C

g.	Quantity of water required	XX GPM
h.	Pressure drop through coil	Not to exceed XX mwc
i.	Entering water temperature	XX Deg C
j.	Leaving water temperature	XX Deg C
k.	Test pressure of coil	21 kg/cm ²
l	Material of construction	
	- Casing/ frame	SS, 18G
	-End shield	SS, 18G
	-Tube	Seamless copper
	-Fins	Copper fins
	-Headers	Copper
6.	Proportion of fresh air to recirculated air	XX CMH
7.	Maximum delivery head pressure (Pa)	XX mm WC
8	Type of Unit (Single / double skin)	Double skin
9	Fan Section	
a	Type	Backward Curved or Forward
b	Number of fan & Class of rating curved	XX & XX
c	Drive arrangement	V belt or XX
d	Total air quantity	XX CMH
e	Whether statically and dynamically balanced	Yes
f	Speed	XX rpm
10	Air filter	
a	Type	V Fold, HDPE supported by Aluminium wire mesh with water as the mode of cleaning or XX
b	Rated Flow	XX CMH
c	Face velocity	XX CMH
d	Built in air damper	Yes or No
11.	Provision of the following in AHU	
a	Inlet Louver	Yes
b	Mixing Chambers	Yes
c	Filter section	Yes
d	Cooling coil	Yes

e	Electric heating	Yes or No
f	Centrifugal fan	Yes
g	Anti-vibration frame for fan and motor	Yes
h	Anti-vibration sleeve at the outlet/ inlet	Yes
i	Filter clogging indicator	Yes
j	Filter clogging switch	Yes
12	Overall dimension of Unit	Shall not exceed XXmmxXXmmxXXmm

37.4.1.2 Water Cooled Chiller Unit (WCC)

The water cooled liquid chiller will consist of accessible, hermetic/semi-hermetic, direct driven centrifugal compressor with independent circuits evaporator, condenser, microprocessor based control and a unit-mounted motor starter, refrigerant charged, factory run-tested and ready for operation.

Total XX no. of water-cooled chiller unit shall be supplied under this scope.

A) Centrifugal compressor

The compressor will be centrifugal type of proven design for use with ozone friendly refrigerant (HFC-134a). The specification shall be subject to Employer's approval.

The design of the compressor should ensure vibration-free operation over a wide range of operating conditions and high energy-efficiency to ensure that IKW/TR at part load is always less than IKW/TR at full load.

The capacity controlling device shall be arranged for unloaded start. Power consumption shall proportionately reduce with the stepping down of compressor capacity to as low as 25% of full load in direct response to refrigeration load changes.

◆ Compressor Motor Assembly

The compressor will have, accessible hermetic direct drive motor with 2950 rpm (or as per manufacturer's design speed), working on 415V \pm 10%, 3 phase, 50 Hz \pm 5%, power supply. The motor will be squirrel-cage two-pole induction type and will be suction-gas-cooled. Due consideration will be given while deciding the protection devices to take care of probable voltage fluctuations prevailing at site.

Rolling element-bearing groups will be provided at each end of both rotors, separately housed, and pressure lubricated. The system will be provided with oil separator and filtration devices

B) Condenser

Condenser coil shall be water cooled with integral sub-cooler constructed of aluminium fins mechanically bonded to seamless copper tubes, which shall be then cleaned, dehydrated and sealed. The capacity of condenser shall match with compressor.

Water-cooled condenser coil shall be leak tested at 10 KG/sq. cm (150 PSIG) and pressure tested at 21 KG/sq. cm (300 PSIG).

C) Chiller (Cooler)

Chillers shall be direct-expansion/ flooded type comprising mild steel shell, integrally finned copper tubes rolled into tube sheets cast iron water headers, liquid line connection, suction header, drain plug and purge valves.

Shell and tube type chillers shall have the following components:

◆ Shell and Water Boxes

The chiller shell shall be formed of carbon steel, provided with cast iron water boxes having standard flange type connections suitable for 10KG. Per sq. cm (150 psig) working and 21 KG/sq. cm (300 PSIG) test pressure. Water boxes shall be provided with drain connections and shall be easily openable for tube cleaning. Suitable tapping shall be provided in the water boxes/ water lines for temperature control bulb and gages.

◆ Tubes

12.5 to 19 mm or XX mm diameter seamless copper tubing, shall be used for evaporator surface. Each tube shall be individually replaceable.

◆ Insulation

The chiller shell shall be covered with expanded polystyrene in multiple layer of thermal insulation with vapour barrier. Suction line of refrigerant circuit piping shall also be provided with thermal insulation.

D) Refrigerant piping and components

Refrigerant piping and fittings inter connecting compressor, condenser and chiller shall be all copper and valves shall be brass/ gunmetal construction.

Refrigerant circuit components shall include hot gas muffler, high side pressure switch, liquid line shut off valves, filter drier moisture-indicating sight glass, stepper motor actuated electronic expansion valve or thermostatic expansion valve, and complete operating charge of refrigerant and compressor oil.

E) Controls

i) Unit Control Module

The unit shall be provided with microprocessor control system for water-cooled centrifugal chiller with latest chiller control technology.

It shall have control logic with the Clear Language Display, which will have various functions that allow the operator to read unit information and adjust set points.

ii) Unit Control Module (UCM) Features

◆ Equal Compressor Sequencing - The control system shall maximize both compressor and motor life by equalizing the number of starts and the operating hours.

◆ Chiller Flow Protection - The in-built protection will automatically detect a no water flow condition.

iii) Chiller System Logging

The UCM will display data required to log the chiller system. The following information will be available as standard feature with the water-cooled centrifugal chiller Microprocessor:

- Entering and leaving chilled water temperatures,
 - Ambient air temperature,
 - Evaporator and condenser refrigerant temperatures and pressures,
 - Percent RLA for each compressor,
 - Percent line voltage,
 - Compressor starts and running hours,
 - Active set points:
 - ◆ Chilled water set point
 - ◆ Current limit set point
 - ◆ Low ambient lockout set point
 - Over 90 diagnostic and operating conditions,
 - Part failure diagnostics:
 - ◆ Water temperature sensors
 - ◆ Refrigerant temperature sensor
 - Compressor contactors
- iv) Interface to the Station SCADA System

The system should have at least the following provisions and facility for interfacing the chiller with plant SCADA System:

- Chiller inputs will include:
 - ◆ Chiller enable/ disable
 - ◆ Circuit enable/ disable
 - ◆ Chilled water set point
 - ◆ Current limit set point
- Chiller outputs will include:
 - ◆ Compressor running indication
 - ◆ Alarm indication (for each circuit)
 - ◆ Maximum capacity
- Cooling water pumps:
 - ◆ Remote/local selector switch,
 - ◆ Start/stop push buttons
 - ◆ Pump operation sequencing for equal running hours of pumps and change over in case of electrical/hydraulic fault.

F) Specific Technical Parameter (*Project Specific*)

SI. No.	Parameter	Value
1.	Capacity of each Chiller Unit	XX TR (Minimum)
2.	Type	Water cooled

3.	Refrigerant used	Ozone friendly (R407C/410a) or XX
4	Noise level	Note more than 75 db(A) at 1.5m
5	Compressor	
a	Type	Hermetic direct driven scroll/ reciprocating type
b	Suction temperature	XX degree C (Maximum)
c	Suction pressure	XX kg/cm2
d	Class of protection	Class F temp. rise limited to class B
e	Duty or class of motor	Continuous type, IP-54
f	Type of start	DOL or Star Delta
6	Cooling coil	
a.	Type	Flooded type with copper tubes and aluminium fins
b	Face area	XX m2
c	Air face velocity	XX m/sec
d	Air side pressure drop	XX mmWC
e	Sensible & Latent cooling capacity at design conditions	XX Kcal/hr
7	Condense	
a	Type	Water cooled condenser
b	Heat rejection capacity at design condition	XX Kcal/ hr
c	Cooling water flow rate	XX m3/hr
d	Cooling water inlet temperature	XX degree C
e	Cooling water outlet temperature	XX degree C

37.4.1.3 Package Air Conditioner Unit (Water cooled)

XX sets of package air conditioner unit shall be supplied. The packaged air conditioner shall be of water cooled ducted split type enclosed in a cabinet housing and shall consist of accessible, hermetic direct driven scroll/reciprocating compressor, cooling coil, filter, fan, condenser, microprocessor based control and a unit-mounted motor starter, refrigerant charged, factory run-tested and ready for operation. The cabinet housing shall be of made of sheet steel, corrosion resistant, finished with synthetic enamel paint, and thermally and acoustically insulated with foamed nitrile rubber or equivalent material. Suitable drain connection shall be provided for removal of condensate collected inside a tray under cooling coil. The access panels shall be easily removable. The cabinet shall be floor mounted on vibration isolators.

A) Compressor

The compressor will be hermetic reciprocating/ scroll type of proven design for use with ozone friendly refrigerant (R407C/410a). The specification shall be subject to Employer's approval.

The design of the compressor should ensure vibration-free operation over a wide range of operating conditions and high energy-. The capacity controlling device shall be arranged for unloaded start. Power consumption shall proportionately reduce with the stepping down of compressor capacity to as low as 25% of full load in direct response to refrigeration load changes.

❖ Compressor Motor Assembly

The compressor will have, accessible hermetic direct drive motor with 2950 rpm (or as per manufacturer's design speed), working on 415V \pm 10%, 3 phase, 50 Hz \pm 5%, power supply. The motor will be squirrel-cage two-pole induction type and will be suction-gas-cooled.

B) Condenser

The water-cooled condenser shall be of shell and tube type with carbon steel shell and integrally finned copper tubes. Water-cooled condenser coil shall be leak tested at 2 times of design pressure.

C) Air Handling Fan

The fan shall be direct or V-belt driven centrifugal with backward curved impeller. The impeller shall be statically and dynamically balanced. The design of the fan should ensure vibration and noise-free operation.

D) Cooling coil and filter

Cooling coil shall be of flooded type with copper tubes and aluminium fins. Cooling coils shall have 9.5 mm or XX mm OD seamless copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be at least 0.3mm. The air before entering the cooling coil shall be filtered by dry and cleanable type filter.

E) Refrigerant piping and components

The refrigeration piping shall be complete with externally equalised thermostatic expansion valve, liquid line strainer, dehydrator and liquid line shut-off valve.

Refrigerant piping and fittings shall be all copper and valves shall be brass/ gunmetal construction.

The piping shall be designed for an internal pressure representing the most severe condition of coincident pressure and temperature expected in normal operation including fluid head.

Piping design pressure for refrigerants of higher-pressure side shall not be less than saturated vapour pressure of refrigerant at 50°C for water cooled systems. For low-pressure side, the design pressure shall not less than the saturated vapour pressure of refrigerant at 32.5°C. If any other eco-friendly refrigerant is used, having a critical temperature below 55°C, the design pressure for the higher-pressure side shall not be less than 1.2 times the critical pressure and design pressure for low-pressure side shall not be less than 2 Kg/cm².

The test pressure for piping shall be 2.0 times the design pressure.

The water cooled packaged air conditioner shall be factory piped with adequate charge of refrigerant and oil.

F) Controls

❖ Unit Control Module

The unit shall be provided with microprocessor control system for water-cooled packaged air conditioner unit with latest technology. Controls shall be interfaced with plant SCADA.

It shall have control logic with the Clear Language Display, which will have various functions that allow the operator to read unit information and adjust set points.

❖ Unit Control Module (UCM) Features

Equal Compressor Sequencing - The control system shall maximize both compressor and motor life by equalizing the number of starts and the operating hours. The UCM will start the compressor with the least number of starts and turn off the compressor with the most operating hours, equalizing starts and running hours. This will provide equal compressor wear to various units.

The main technical parameters for supply of Water cooled package air conditioner Units are:

G) Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Capacity of fully assembled Units (XX working + XX standby)	XX TR (Minimum)
2.	Type	Water cooled ducted split type enclosed in an cabinet housing
3.	Refrigerant used	Ozone friendly (R407C/410a) or XX
4.	Noise level	Note more than 75 db(A) at 1.5m
5.	Compressor	
a	Type	Hermetic direct driven scroll/ reciprocating type
b	Suction temperature	XX degree C (Maximum)
c	Suction pressure	XX kg/cm ²
d	Class of protection	Class F temp. rise limited to class B
e	Duty or class of motor	Continuous type, IP-54
f	Type of start	DOL or Star Delta
6.	Cooling coil	
a.	Type	Flooded type with copper tubes and aluminium fins
b	Face area	XX m ²

c	Air face velocity	XX m/sec
d	Air side pressure drop	XX mmWC
e	Sensible & Latent cooling capacity at design conditions	XX Kcal/hr
7	Condense	
a	Type	Water cooled condenser
b	Heat rejection capacity at design condition	XX Kcal/ hr
c	Cooling water flow rate	XX m ³ /hr
d	Cooling water inlet temperature	XX degree C
e	Cooling water outlet temperature	XX degree C
f	Proportion of fresh air to recirculated air	XX CMH
g	Maximum delivery head pressure (Pa)	XX mm of Hg
h	Type of Unit (Single / double skin)	Double skin
8	Fan Section	
a	Type	Backward Curved or Forward curved
b	Number of fan & Class of rating	XX & XX
c	Drive arrangement	V belt or XX
d	Total air quantity	XX CMH
e	Whether statically and dynamically balanced	Yes

37.4.1.4 Cooling Coils

All water and refrigerant coils shall have 15 mm OD seamless copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be 0.06 mm (0.025 inches).

Copper plate fin type with belled collars. Copper-finned coils shall be supplied with stainless steel casing and tube sheets.

❖ Water Cooling Coils

- Headers shall be non-ferrous with steel MPT connections. Headers shall have threaded drain and vent connections accessible from outside the unit casing.
- Coils shall be drainable, with non-trapping circuits. Working pressure shall be 21 bars (300 psig) at 93°C (200 F).

❖ Refrigerant Coils:

- Headers shall be seamless copper tubes with brazed joints.
- Coils shall be provided with a minimum of two brass liquid distributors with solder type connections. Distributors shall have removable brass venturi (nozzles). Distributor to coil capillary feeder tubes shall be seamless copper.
- Coils for full face-active or face-split operation shall have intertwined circuits for equal loading on each circuit. Suction and liquid connections shall be on the same end.

A) Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1.	Type	Fin Type or XX
2.	Quantity of air handled	XX cum/hr
3.	Cooling coil power	Not less than XX KW
4.	Size of coil	XX mm
5.	Face area of the coil	XX sq. m
6.	Face velocity	XX m/s
7.	No. of rows	XX
8.	No. of tubes/ row	XX
9.	Tube spacing	XX mm
10.	Fin spacing	XX mm
11.	Air pressure drop	Not more than XX mm of w.g
12.	Air velocity	XX m/sec
13.	Entering air temperature	
a.	Dry bulb	XX deg C
b.	Wet bulb	XX deg. C
14.	Leaving air temperature	
a	Dry bulb temp	XX deg. C
b	Wet bulb temp	XX deg. C
15.	Quantity of water required	XX GPM
16.	Pressure drop through the coil	Not to exceed XX mwc
17.	Entering water temperature	XX degree C
18.	Leaving water temperature	XX degree C
19.	Material of Construction	
a.	Casing/ frame	Stainless steel, 18 G
b.	End shields	Stainless steel, 18 G

c.	Tube	Seamless copper
d.	Fins	Copper fins
e.	Headers	Copper

37.4.1.5 Air Louvers Damper

❖ Outside Air Louvers

Outside air louvers of each of the fresh air and exhaust air systems shall prevent the entrance of rain, insects, birds and trash into the ducts. They shall be stamped and pressed out of one piece of aluminium sheet of at least 2 mm thickness. The frames shall also be made of aluminium.

❖ Indoor Louvers Dampers

Indoor double acting louvers shall be fabricated with a welded frame of rolled section. Bearings shall be of the oil retaining porous bronze type and shall be fixed into the frame. The louver dampers as well as the steel frames shall be hot-dip galvanized after fabrication. Louvers and dampers shall be equipped with related limit switches to be used in control and interlocking system.

❖ Fire Dampers

Motorised type electrically operated fire dampers shall be operated with the help of signal from smoke detectors/thermal sensors. Motors shall remain energised in normal condition to effect opening of dampers. In the event of fire, the motors will be de-energised and the damper will close due to spring action. .

37.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the offered models.
- ii) Technical Data Sheet.
- iii) O&M manual in soft and hard copies

38 ELECTRO-MAGNETIC AND EHT BRAKE

38.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of DCEM and EHT brake in EOT crane application, which shall be used, for handling of different electro-mechanical components of hydro plant. The item shall be used in XXX Hydro Power Plant of NHPC.

38.2 Specific Parameters and Design Consideration:

Equipment shall be portable, heavy-duty, robust, low weight, maintenance free and compact design. The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards.

38.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

38.4 Design and Construction

38.4.1.1 Electro-Magnetic and Electro-Hydraulic Thruster brakes

Bridge and trolley drives shall be equipped with a spring-set, electrically (solenoid or electro-hydraulic) released shoe or disc brake, with capacities of at least 1.5 times the full operating torque of the drive.

The brake shall be applied when the motor control switch or the main switch is in the "off" position and/or in case of power failure in any phase. The braking action shall be gradual and the brake shall become fully effective after a certain time lag.

The hoisting brakes shall be of fail safe and shall have adequate capacity to bring the fully loaded crane to rest in shortest possible time and to arrest the motion and sustain any load up to and including test load at any position while hoisting and lowering. Each brake shall be capable of meeting the complete hoisting requirements independently.

All brakes shall have ample thermal capacity for the frequency of operation required by the application and shall be adjustable to compensate for lining wear. The friction surfaces of all brake drums, wheels and discs shall be free of defects that interfere with operation.

All brakes on travelling motions shall be selected for 1-hour intermittent duty or higher and shall be equally effective in both directions of movement. All holding brakes on hoist motions shall be designed for continuous duty. Magnets for all brakes shall be rated for continuous duty.

Braking system shall be automatically set when controls are released or power is interrupted.

38.4.1.2 Specific Technical Parameter (*Project Specific*)

Sl. No..	Parameters	Value
A.	Electro-Magnetic Brake	
1.	Quantity	XX Nos.
2.	Drum Diameter	XX mm
3.	Braking Torque	XXX Kgm
4.	Stroke	XXX mm
5.	Voltage Input	XX
6.	Coil	Copper wire epoxy coated resin encapsulated
7.	Rating	Continuous or XX hour duty
8.	No. of operations per hour	600 or XX
9.	Insulation class	Class F or XX
10.	Supply voltage	XX
B.	Electro-Hydraulic Thruster (EHT) Brake	
1.	Quantity	XX Nos.
2.	Drum Diameter	XX mm
3.	Braking Torque	XX Kgm
4.	Force (Thruster capacity)	XXX Kg
5.	Thruster Stroke	XX mm
6.	Oil capacity	XX litre
7.	Rating	Continuous or XX hour duty
8.	No. of operations per hour	600 or XX
9.	Supply voltage	415V AC or XX
10.	Motor protection class	IP 55 of IS:4691
11.	Insulation of motor	Class F (temp. rise limited to class B) or XX

38.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the product manufacturer and General arrangement drawing.
- ii) Technical Data Sheet.
- iii) User / instruction manual.

39 PRESSURE GAUGE, PRESSURE SWITCH & PRESSURE TRANSMITTER

39.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of pressure measurements instrumentation like pressure gauges, pressure switches and pressure transmitter. The item shall be used in XXX Hydro Power Plant of NHPC.

39.2 Specific Parameters and Design Consideration:

Instrumentation shall be heavy-duty, robust, maintenance free and compact design. The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards.

39.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

39.4 Design and Construction

39.4.1.1 Pressure measurements

Pressure gauges shall be shock and vibration-proof (preferably by filling with glycerine) and shall be equipped with toothed wheels and toothed segments of the machined type. They shall completely be made of stainless steel.

Higher than rated pressure shall not deteriorate the pressure gauge or affect its calibration. The pressure gauges shall be equipped with a radial-connecting stud, to allow the mounting on a gauge holder.

Pressure gauges with potentiometers will not be accepted for use as a pressure transmitter.

The error for pressure transmitters shall be limited to +/-0.5%.

Pressure gauges and transmitters for inflammable liquids shall have filled systems and the filling liquid shall be separated from the inflammable liquid by means of adequate isolating membranes.

Each gauge, pressure switch and transmitter for absolute or differential pressure shall be equipped with a pressure gauge isolating valve including a test connection of the screwed type M20 x 1.5 mm so that such device can be removed without any disturbance of the plant operation.

Pressure gauges for high pressures shall be equipped with a relieve valve for safety reasons in case of leaks (with a rubber reverse flow check). The adjustment of the pointer shall be possible by means of an adjustment device without removing the pointer from its axle. The high and low-pressure connections of differential pressure gauges shall be marked accordingly.

All casings shall be dust and watertight and be made of stainless steel.

Contacts for pressure switches and of all other devices shall be of the snap action type (SPDT).

39.4.1.2 Specific Technical Parameter (*Project Specific*)- Pressure Gauges

Sl. No..	Parameters	Value
A.	Pressure gauges	
1.	Quantity	XX Nos.
2.	Service	Water or XX
3.	Type & Applicable standard	Bourdon , IS:3624
4.	Pressure range	0 – 16 bar or XX bar
5.	Material	
a.	Case	Stainless steel , SS-304 or XX
b.	Bourdon	Stainless steel, SS-316 or XX
c.	Socket	Stainless steel, SS-316 or XX
d.	Movement	Stainless steel, SS-304 or XX
e.	Snubber	Stainless steel , SS-304 or XX
5.	Dial size	150/160mm or XX
6.	Scale size	150mm diameter, white background with black numeral
7.	Pointer, Zero adjustment feature	Micro gear type for zero reset, internal micrometre screw for range adjustment
8.	Window	Toughened glass , Shatter proof glass or XX
9.	Accuracy	+/- 0.5% FSD or XX
10.	Over range protection	130% FSD
11.	Shock & Vibration proof	Filled with glycerine
12.	Blow out Disc	Shall be provided
13.	Process Connection	½” NPT (M) or XX
14.	Mounting	Direct on pipe or <i>Gauge panel</i>
15.	Snubber configuration	½” NPT (F) x NTP (F) or XX
16.	Entry	Direct Bottom entry or XX
17.	Enclosure	IP 65 or XX

39.4.1.3 Specific Technical Parameter (*Project Specific*)- Pressure switches

Sl. No..	Parameters	Value
A.	Pressure Switches	

1.	Quantity	XX Nos.
2.	Service	Water or XX
3.	Type	Bellow or Diaphragm or XX
4.	Adjustable pressure range	X bar - XX bar
5.	Maximum permissible pressure & temperature	XX bar & XX Degree C
6.	Access to setting	External
7.	Material	
a.	Case	Stainless steel , SS-304 or XX
b.	Sensor	Stainless steel, SS-316 or XX
c.	Other Wetted parts	Stainless steel, SS-304 or XX
8.	Micro switch type	Snap acting environmentally friendly
9.	Contact form & Rating	2 SPDT, 15A, 250VAC or XX
10	No. of switches	2 SPDT
11	Cable entry	¾" ET (F), cable gland of PVC with nickel plated double brass compressor hood
12.	Repeatability	+/- 0.5% FSR or XX
13	Over range protection	130% of FSD
13.	Process Connection	½" NPT (M) or XX
14	Electrical connection	½" NPT (F) with double compression cable gland
15.	Mounting	On Line or XX
16.	Protection	Weatherproof, IP66

39.4.1.4 Specific Technical Parameter (*Project Specific*)- Pressure Transmitter

Sl. No..	Parameters	Value
A.	Pressure Transmitter	
1.	Quantity	XX Nos.
2.	Service	Water or XX
3.	Type	PEIZO- RESISTIVE or XX
4.	Calibration range	X bar - XX bar (g)
5.	Select Range	X bar- XX bar (g)
6.	Working principle	2 wire, Variable Capacitance or XX
7.	Accuracy	XX %
8.	Turndown ratio	100:1 or XX

9.	Output	4-20mA (2 wire)
10.	Indicator	Digital, 0-100%
11.	Enclosure	Weatherproof, IP-67 & NEMA 4X
12.	Material	
a.	Housing	Die Cast Aluminium or XX
b.	Diaphragm	Stainless steel, SS-316L or XX
c.	Other Wetted parts	Stainless steel, SS-316 or XX
d.	Mounting bracket	Stainless steel -304 or XX
e.	Case	Stainless steel or XX
8.	Micro switch type	Snap acting environmentally friendly
9.	Contact form & Rating	2 SPDT, 15A, 250VAC or XX
10	No. of switches	2 SPDT
11	Scan time	150ms or XX
12	Local display	5 digital LED (Integral) with unit
13	Temperature Linearization & Compensation	Inbuilt
14	Over range protection	1.5 times of upper range value (Min.)
15	Cable entry	½" or XX weather proof NPT(F), nickel plated brass double compressor hood
16.	Repeatability	+/- 0.5% FSR or XX
17.	Process Connection	½" NPT (M) or XX
18	Electrical connection	½" NPT (F) or XX with double compression cable gland
19.	Mounting	Pipe mounting or XX
20	Diagnostic Features	Required
21	Drain/ Vent	Integral, SS 316
22	Calibration compatibility	Local Zero & Span Adjustment, hand held calibrated and HMS
23	Temperature Limit	0 to 50 degree C
24.	Protection	Weatherproof, IP66

39.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the product manufacturer..
- ii) Technical Data Sheet.
- iii) User / instruction manual.

40 LEVEL INDICATOR CUM TRANSDUCER, LEVEL SWITCH, LIMIT SWITCH AND FLOAT SWITCH

40.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of level measurement instrumentation like Level Indicator cum transducer, Level switch, limit switch and Float level switch. The items shall be used in XXX Hydro Power Plant of NHPC.

40.2 Specific Parameters and Design Consideration:

Instrumentation shall be heavy-duty, robust, maintenance free and compact design. The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards.

40.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

40.4 Design and Construction

40.4.1.1 Level measurement

The liquid level measurements in reservoirs and tanks with atmospheric pressure shall be made by means of pressure transmitter of mercury less-type, by displacement-type transmitters or float-disc-transmitters. The errors shall not exceed $\pm 1.0\%$ of the total measuring range. Level switches shall be of the externally mounted float or displacement operated type. The switch shall be of packing less construction; there shall be a minimum of moving parts.

Contacts of level switches, and of all other devices shall be of the snap action type (SPDT).

Electric measuring signals of 4-20 mA shall be transmitted to the unit control board / local control boards for essential or regulating circuits. In this case the absence of live zero signals shall lead to a warning signal. Measuring signals for indicating purposes will be 4-20 mA. Transducers shall be provided to convert the signal level to 4-20 mA wherever the signal level is different.

The components shall quickly respond to any changes of the measured magnitudes. Measuring ranges of indicators, transducers, etc. shall be selected in such a way that the rated value of the measured magnitude covers approx. 75% of the range.

All local instruments shall, as far as practicable, be mounted vibration free to allow good reading. Wherever required, damping elements shall be used.

40.4.1.2 Limit switches

Limit switches shall be provided for control, interlocks and indication.

Limit switches shall be mounted suitable for easy adjustment and for rigidly locking in position after being adjusted. They shall be of heavy-

duty rating and have two changeover contacts suitable for 220 V D.C. operations.

Switch fixings shall be positive and shall be unaffected by vibration. At the same time they should be capable of easy adjustment to suit changing parameters of the associated plant.

Contacts of level switches, limit switches, and of all other devices shall be of the snap action type (SPDT).

40.4.1.3 Float level switch

Float level switch shall be used in drainage and dewatering sumps and in the turbine pit for operation and control of pump, indication and alarm.

The float switch should be reliable and environmental friendly. Limit switch does not have any wear and maintenance requirement. No toxic material like lead or mercury shall be used.

Float switch shall be suitable for sludgy, oily, viscous or liquid with high-suspended solid particles.

40.4.1.4 Specific Technical Parameter (*Project Specific*)- Probe type - Level indicator cum transducer

Sl. No.	Parameters	Value
A.	Oil level – Probe type Level indicator cum transducer	
1.	Quantity	XX Nos.
2.	Service	Oil level measurement
3.	Type	Capacitance type or XX
4.	Level probe	
a..	Probe type	Fully insulated (Teflon insulation) or XX
b.	Probe transmitter housing	Weather proof, IP67 or XX
c.	Cable entry	½” BSP or XX (NPT) with cable gland stainless steel
d.	Reference probe	Co-axial reference probe, SS
e.	Probe length	XX mm
f.	Application media	Turbine oil VG46 or XX
g.	Media temperature	0 to XX degree C
h.	Ambient temperature	0 to 50 degree C
i.	Output signal	4-20mA DC corresponding to calibrated span (adjustable) suitable for electrical load of minimum 500 Ohm
j.	Accuracy	+/-0.5% or better, for calibrated span including linearity,

		hysteresis and repeatability
k.	Loop power supply	24VDC (shall be derived from digital indicator cum power supply unit)
l.	Connection	Two wire system
5.	Digital Indicator cum power supply unit	
a.	Display	4/5 digit LED/LCD type
b.	Input signal	4-20mA DC (from level transmitter)
c.	Re-transmitter output	Separate one no. 4-20mA output for retransmission
d.	Configuration push button	Shall be provided for configuration change, range setting and setting of relays set point in the display unit
e.	Power supply available	240VAC +/-10% , 50Hz or XX
f.	Scale reading	0 to XX calibrated length (maximum upto probe length)
g.	Relay output	4 nos. or XX (change over type, SPDT contacts), for alarm and interlock, setting of each relay should be adjustable between full calibrated range.
h.	Relay contact rating	5A/240VAC, 0.2A/220DC or XX
i.	Relay indication	LED indication for operation of each relay should be provided.
j.	Accuracy	+/-0.2%
6.	Material	
a.	Probe	Stainless steel
b.	Housing	Die cast aluminium or XX
7.	Screen cable	To connect level probe cum transmitter with digital indicator cum power supply unit.
a.	Rating	1100/660V
b.	Type	Unarmoured, PVC insulated, multi strand, 2/3 core, 1.5mm ² screen cable
c.	Length	XX m

40.4.1.5 Specific Technical Parameter (*Project Specific*)- Level switch – Magnetic float operated Guided level switch with Control Unit

Sl. No..	Parameters	Value
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A.	Level Switch with control unit	
1.	Quantity	XX Nos.
2.	Service	Oil or Water
3.	Type	Magnetic float operated with guided level switch or XX
4.	Mounting	Top mounting or XX
5.	Guide tube material	Stainless steel , 316 or XX
6.	No. of floats	Four or XX
7.	Terminal enclosure	Cast Aluminium or XX , Weatherproof, IP-66
8.	Conduit connection	½” NPT or XX
9.	Float MOCX Size	SS 316/ Dia. 25 or XX
10.	Process connection	Flanged or screwed
11.	Pre-set level	4 or XX
12.	Switch type	Glass encapsulated hermetically sealed reed contacts or XX
13.	Differential	Fixed (10+/- 5mm) or XX
14.	Accuracy/ repeatability	+/-1mm or XX
15.	Load	Resistive or Inductive
16.	Insulation	100M Ohm at 500 VDC or XX
17.	Maximum temperature	150 degree C
18.	Intrinsically safe with Zener barrier	Yes
19.	Control Unit	
a.	Size	XXmmxXXmmxXXmm
b.	MOC	ABS or Cast Aluminium
c.	Protection	Weather proof, IP-65 or XX
d.	Supply	250VAC or XX
e.	Relay contacts	5A, 250VAC (SPDT or DPDT) or XX
f.	Terminal	Suitable for 1.5mm ² , 2 conductor size
g.	No. of set points	4 or XX
h.	Delay time	2 sec or XX
i.	Site settable relay latching	Yes

40.4.1.6 Specific Technical Parameter (Project Specific)- Limit switch

Sl. No..	Parameters	Value
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A.	Limit switch	
1.	Quantity	XX Nos.
2.	Type	Metal enclosed with roller lever or XX
3.	Contact type	SNAP Action or XX
4.	Contacts	Gold or XX
5.	No. of contacts	2NO+2NC or XX
6.	Contact terminals	Shall be suitable for 0.5mm ² or XX m ² cable cross section
7.	Life of switch and contact	More than 30 million switching cycles or XX
8.	Contact rating	5 A at 240 VAC or 0.25 A at 220v DC or XX
9.	Type of protection	IP 67 or XX
10.	Operating temperature & relative humidity	Upto 125 degree C & 95% RH
11.	Roller	Roller can be fitted on either side or XX
12.	Operation	Shall be possible on both sides through 360 degree in steps of 90 degree or XX
13.	Roller travel	Roller travel shall be suitable for step less adjustment on the actuating axis.
14.	Lever position	Shall be possible to adjustable through 360 degree in steps of 90 degrees.

40.4.1.7 Specific Technical Parameter (*Project Specific*)- Float level switch

Sl. No..	Parameters	Value
A.	Float level switch	
1.	Quantity	XX Nos.
2.	Type	Float – Micro switch operated
3.	Liquid temperature	Suitable for 0 to 60 degree C
4.	Liquid density	Suitable for XX liquid density
5.	Degree of protection	Not less than IP68
6.	MOC	
7.	Body	EPDM rubber or XX
8.	Cable type	PVC rubber / NBR/ Neoprene or XX
9.	Cable length	XX m

10.	Contact type	Micro switch, SPDT
11.	Adjustable Stopper	Stainless steel

40.5 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the product manufacturer and General arrangement drawing.
- ii) Technical Data Sheet.
- iii) User / instruction manual.

41 HVAC INSTRUMENTATION – ANEMOMETER AND PSYCHROMETER

41.1 Scope of Work

The specification covers the design, manufacture, supply and delivery of instrumentation like Anemometer and Psychrometer used in ventilation and air conditioning system. The items shall be used in XXX Hydro Power Plant of NHPC.

41.2 Specific Parameters and Design Consideration:

Instrumentation shall be heavy-duty, robust, maintenance free and compact design. The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards.

41.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

41.4 Functional Characteristics

An anemometer shall be used to measure the air speed or velocity either in a contained flow, such as airflow in a duct, or in unconfined flows.

A Psychrometer shall be used to measure relative humidity in atmosphere .

41.5 Specific Technical Parameter (*Project Specific*)- Anemometer

Sl. No.	Parameters	Value
A.	Anemometer	
1.	Quantity	XX Nos.
2.	Service	Air media
3.	Type	Vane type or XX
4.	Range	XX to XX m/sec
5.	Accuracy	±1% or XX of reading
6.	Resolution	0.01or XX m/s
7.	Display	LCD digital, 1999 counts, backlit
8.	Operating Temp	0 to 50 degree C
9.	Hold display/data feature available	Required
10	Low power indication	Required

41.5.1.1 Specific Technical Parameter (Project Specific)- Psychrometer

Sl. No..	Parameters	Value
A.	Level Switch with control unit	
1.	Quantity	XX Nos.
2.	Service	Air media
3.	Type	Sling or XX
4.	Temperature range	0 to 50 degree C
5.	Accuracy	+/-0.3 degree C or XX
6.	Thermometers	Two

41.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the product manufacturer.
- ii) Technical Data Sheet.
- iii) User / instruction manual

42 CARBON DUST COLLECTOR SYSTEM

42.1 Scope of Work

The specification covers the design, manufacture, shop testing delivery at site, installation, commissioning, performance testing of Carbon dust collector system for use in XX Power station of NHPC Limited. The scope shall comprise of supply of XX sets of carbon dust collection system. Each set scope shall comprise of:

- i) Carbon dust collector unit (motor- fan assembly)
- ii) Filters
- iii) Carbon dust container
- iv) Pipe & fittings
- v) Terminal box, other required hardware accessories.

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.

42.2 Specific Parameters and Design Consideration:

The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards.

42.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | |
|--|----|-------|
| i) Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) Maximum relative humidity (%) | :- | ----- |
| iv) Height above Sea Level (m) | :- | ----- |

42.4 Functional Characteristics

The generator of a hydro system is excited by means of rotating slip ring and stationary carbon brush, which is used for feeding DC Power to rotor pole. Due to continuous use and wear between slip ring and carbon brush, the size of carbon brushes is reduced and carbon dusts formation occurs. As a result, fine carbon dust particles are deposited at the various places, inside and outside of generators housing. The deposition of carbon may create operation hindrances and may lead rotor earth fault. Thus, it is essential to remove the carbon dust formed.

The carbon dust collection system shall suck the carbon dust created during operation of hydro generator. The filters used shall be metallic or XX material, easy cleanable and have high efficiency. The piping used in carbon dust collection system shall comprise of PVC pipes, flexible hose etc.. If metal pipes are used, they shall be coupled with straub coupling in order to facilitate quick dismantling and erection.

42.5 Construction

The bidder shall ensure that offered system/equipment be suitable with the existing system in regard to material, constructional and operational feature. The system/equipment shall be suitable for installation in the available space in the existing system.

Existing system diagram and general arrangement drawings are attached for reference.

42.5.1 Blower- motor assembly

The carbon dust collector unit shall contain filter, box and blower set. During the operation of generator, blower shall be turned on automatically and sucks the carbon dust produced and collected in the filter box

42.5.2 Pipe and Fittings

Pipes shall be routed under the carbon brush assembly for collection of carbon dust formed during operation of generator. Pipe/hose shall be taken out and connected to a common pipe/ tube. This common hose shall be connected to carbon dust collector equipment.

42.5.3 Filter

The filters used shall having high efficiency of 99% down to 15 or XX micron.

42.5.4 Control Panel

Control Panel Motor control panel shall be provided with DOL starter, TP switch disconnecter, over load protection with single-phase preventer, power contactor, auxiliary contactor for power contactor. Indicating lamp for indication of control supply healthiness, motor ON/OFF/ over load trip, Start stop push buttons, emergency stop push button, local remote selector switch etc.

Schematic diagram for operation of carbon dust collector system shall be provided on the control panel.

42.6 Specific Technical Parameter (*Project Specific*)

Sl. No.	Parameter	Value
1	Flexible Pipe/hose	
a.	Nominal Diameter	XX mm
b.	Material of Pipe/ Hose	XX
2	Filter	
a.	Material	XX
b.	Filter Efficiency	Minimum 99% for 15 micron or XX
3	Blower	
a.	Flow Rate	XX m ³ /Hr
b.	Motor Rating	XX kW,
c.	Voltage, Frequency & rpm	415 V, 3-Phase, 50Hz, XX rpm

4	Accessories	All other hardware items required for installation
5	Control panel	With protection relays and indicating lamps as mentioned above for automatic operation and indication / alarm of the system

42.7 Drawing & Manual:

The bidder shall submit following information:-

- i) Technical leaflet of the product manufacturer.
- ii) Technical Data Sheet.
- iii) User / instruction manual

43 CENTRALISED GREASE LUBRICATION SYSTEM (CGLS)

43.1 Scope of Work

The specification covers the design, manufacture, delivery, installation, commissioning, and performance testing of Centralised grease lubrication system (CGLS) for lubrication of turbine wicket gate bushes and/or MIV bush bearings etc. in XX Power station of NHPC Limited. The scope shall include supply of XX sets of Centralised grease lubrication system (CGLS).

43.2 Standards and Regulations:

The system and equipment shall be designed, built tested and installed to the latest revisions of applicable standards.

43.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

43.4 Functional Characteristics

The system shall consists of motor driven grease pump that supplies grease at high pressure automatically to various grease lubrication of turbine wicket gate bushes and/or MIV bush bearings.

The grease lubrication shall be controlled in full automatic manner with a system timer. Timer shall start the grease pump automatically at a predetermined time interval. It shall also possible to operate the grease pump for lubrication at arbitrary time by using a push button switch.

In addition, a manual operated pump with each set shall be provided for grease lubrication to the various points when the automatic system is not in operation.

The system shall be capable of developing XX bars grease pressure at the entry to every bearing under all conditions.

43.5 Design and Constriction

The bidder shall ensure that offered system/equipment be suitable with the existing system in regard to material, constructional and operational feature. The system/equipment shall be suitable for installation in the available space in the existing system.

43.5.1 Dual line CGLS (*project specific*)

The dual line centralised grease lubrication system shall consists of following:

- i) Motorised and manual operated grease lubrication pump,
- ii) Reservoir, level rod and limit switches
- iii) Solenoid operated line changing valves
- iv) In line filters
- v) Feeders

- vi) Non return valves
- vii) Piping and fittings
- viii) Control panel

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.

The system shall feed the lubricant to the guide vane bushes of turbine distributor and/or MIV bushes. The pumping station shall be connected to various points through filters, non-return valve, direction control valve, dose feeders, tubing etc.

When pump start, lubricant start flow in one of the two lines through all the components to the dose feeders and lubricate all the points by feeding set dose. When all the dose feeders discharge lubricant, pressure in the line shall starts building up sharply and the same shall be indicated on the pressure gauge. This increase in line pressure shall be sensed by the end pressure relay and send an electrical signal through control panel to the direction control valve to change over the line. After changeover, the second line to all the lubricating points will also discharge one dose of lubricant and pressure will rise again to cross the set point of the end pressure relay. Now the end relay will give signal to the control panel to stop pump and this complete one cycle.

43.5.1.1 Motorized grease pump

The pump shall be driven by XX KW electric motor, which is coupled, to a reduction gearbox of XX: 1 ratio through a flexible coupling. The reservoir is comprised of level sensor to indicate the grease level in reservoir. The pumping elements shall pump lubricant at high pressure to bush bearing of turbine wicket gate and/or MIV by electrically operated line changing valve through steel tube and various fittings / junction blocks. The lubricant shall flow at all the points by feeding set dose. A pressure relief / regulating valve shall be incorporated in the line to relieve excess lubricant pressure to the tank and required pressure can also be maintained with the help of external knob.

Grease pump shall have following specification:

- i) Grease Reservoir capacity : XX kg
- ii) Pump discharge : XX cc/minute
- iii) Working pressure : XX kg/cm²
- iv) Motor rating : XX KW
- v) Directional control valve solenoid operated- 220VAC or XX V pressure switch
- vi) Limit switch (220V AC or XX V) for low level of lubricant, relief valve, pressure gauge, filling port with NRV and filter, base frame and fasteners

43.5.1.2 Change over valve

A solenoid operated spool valve of 220V operating AC voltage or XX shall be provided. This changeover valve shall select the feeding line. Whenever, the signal is given to the solenoid, the spool changes its

position and changeover takes place from Line-1 to Line-2 or vice-versa.

43.5.1.3 In-line filter

In order to ensure the delivery of lubricant free from any foreign particles, in-line filter in each lubricant line shall be provided. The design of the filter shall be such that it can easily be dismantled for cleaning. The cartridge of the filter shall be of stainless steel with a steel wire mesh of 80 or XX micron meter rating.

43.5.1.4 Dose Feeders

Dose feeders shall be connected with feeding line coming from the pump. Dose feeders shall be installed near to the lubrication points. It shall be possible to adjust grease discharge quantity with the provided grub screw. Dose feeder shall have following specification:

- i) Qty of dose feeder : XX nos.
- ii) Number of outlets per dose feeder : XX nos.
- iii) Discharge per outlet per stroke : XX to XX cc (adjustable)

43.5.1.5 End pressure relay

This senses the end pressure of lines and gives signal when pressure reaches the set value. This signal is passed to control panel, which in turn passed to changeover valve. End pressure relay shall have two pressure switches and two pressure gauges to check and give pressure signal to control panel for changeover. Pressure relay shall have following specification:

43.5.1.6 Piping & fittings

Stainless steel tube or XX material shall be used in main feeding and branch line along with fittings. The piping and associated fittings shall be strong enough to withstand high system pressure. Wherever, flexible hose shall be used, the same shall be double braided wire-reinforced type of heavy-duty type.

43.5.1.7 Manual operated grease pump

In addition to motorized grease pump, manual operated pump shall be provided for greasing of various points when the automatic system is not in operation. The pump shall comprise:

- i) Pump body, handle, reservoir, tank cover
- ii) Level indicator, pressure gauge
- iii) Air vent, grease filling point reversing valve, discharge port etc.

43.5.2 Single line progressive operation type CGL System (*project specific*)

In case of single line progressive operation type centralised grease lubrication system, the system shall consists of following:

- i) Motorised and manual operated grease lubrication pumps
- ii) Main pipe, branch pipe, sub supply pipe
- iii) Master distributor, secondary distributor, tertiary distributor
- iv) Block signal or reset signal
- v) Block signal or auto relief

vi) Control panel

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices

43.5.2.1 Motorized grease pump

The pump shall be driven by XX KW electric motor, which is coupled, to a reduction gearbox of XX: 1 ratio through a flexible coupling. The reservoir is comprised of level sensor to indicate the grease level in reservoir. The pumping elements shall pump lubricant at high pressure to bush bearing of turbine wicket gate and/or MIV by electrically operated line changing valve through steel tube and various fittings / junction blocks. The lubricant shall flow at all the points by feeding set dose. A pressure relief / regulating valve shall be incorporated in the line to relieve excess lubricant pressure to the tank and required pressure can also be maintained with the help of external knob.

Grease pump shall have following specification:

- i) Grease Reservoir capacity : XX kg
- ii) Pump discharge : XX cc/minute
- iii) Motor rating : XX KW
- iv) Working pressure : XX kg/cm²
- v) Limit switch (220V AC or XX V) for low level of lubricant, relief valve, pressure gauge, filling port with NRV and filter, base frame and fasteners

43.5.2.2 Reservoir with level switch

There shall be a follower plate in the reservoir, which fixed to level rod. This follower plate is to keep the smooth grease surface and to shut it off from external air. The level rod runs through a cover on top of the reservoir and shall be provided with a cam to activate the level switch. The level rod is provided with the upper and lower limit marks.

As the grease shall be consumed and the follower plate lowers to a certain level, the switch cam at the end of level rod directly coupled to it shall activate the low level switch.

When low level switch shall be activated, the pump stops and at the same time, the fault signal lamp on the control panel shall be "ON".

43.5.2.3 Pressure switch

The pressure switch shall incorporate a relief valve, indicator for activation of switch and gear vent screw (indicator reset screw). When the discharge pressure shall exceed the relief pressure because of clogging of distributor, the indicator shall come out to activate the switch. Simultaneously "High pressure" alarm shall be issued and the grease pump stopped.

When the grease vent screw shall be loosened, grease shall flow out from the inside, allowing the indicator to return to the normal position.

43.5.2.4 Distributor

The distributor shall be used in the system shall be a single line progressive operation type. Grease shall be divided measured and

discharged as the pistons installed in series in the distributor are operated progressively by the high-pressure grease charged from the inlet port.

- i) Distributor Quantity:
 - a. Master : XX nos
 - b. Secondary : XX nos
 - c. Tertiary : XX nos
- ii) Number of outlets per distributor
 - a. Master : XX nos
 - b. Secondary : XX nos
 - c. Tertiary : XX nos.
- iii) Discharge per outlet per stroke
 - a. Master : XX cc
 - b. Secondary : XX cc
 - c. Tertiary : XX cc

43.5.2.5 Piping & fittings

Piping system shall be single end type. For mainline and branch line, stainless steel tube or XX material shall be provided along with fittings, strong enough to withstand high pressure of the system. Wherever, flexible hose is used, the same shall be double braided/wire reinforced.

43.5.2.6 Filter

In order to ensure the delivery of lubricant free from any foreign particles, filter (s) shall be used in main line. Filters shall be in line 80 or XX micron.

43.5.2.7 Manual operated grease pump

In addition, manual operated pump shall also be provided for greasing the various points when the automatic system is not in operation. The pump shall comprise:

- i) Pump body, handle, reservoir, tank cover
- ii) Level indicator, pressure gauge
- iii) Air vent, grease filling point, discharge port.

43.5.3 Specific Technical Parameter (*project specific*)

Sl. No.	Parameter	Value
1	Motorized grease pump	
a.	Type of pump	Gear or XX
b.	Reduction gear ratio of pump	XX : 1
c.	Discharge pressure	XX Bar
d.	Pump discharge capacity	XX cc/min
e.	Reservoir capacity	XX kg
f.	Electric Motor	
i	Rating	XX KW

ii	Voltage/ freq	415 Volt, 3ph, 50 Hz
iv	Degree Of Protection	IP-54
2	Manual operated grease pump	
a.	Working pressure	XX Bar
b.	Pump Discharge/stroke	XX cc
c.	Grease tank capacity	XX kg
3	Stainless steel /XX material tube (for main line)	
a.	Diameter	XX mm
b.	Thickness	XX mm
c.	Length	XX m
4	Stainless steel /XX material tube (for branch line)	
a.	Diameter	XX mm
b.	Thickness	XX mm
c.	Length	XX m
5	Accessories	Stop valve, lock nut, NRV, O-ring, flexible hose, clamps etc.
6	Whether timer and cycle counter provided	Yes

43.6 Control Panel

It shall be provided DOL starter with necessary contactors, timers, fuses, indicating lamps, push buttons and selector switches etc.

Alarm shall be provided for:

- i) Reservoir is empty (low level),
- ii) Lubrication (running time) continued longer than the set period resulting incomplete lubrication.
- iii) Over load protection of motor
- iv) Line pressure high and pressure switch is activated.

Schematic diagram for operation CGLS shall be provided on the control panel.

43.7 Drawing & Manual:

The bidder shall submit following information:-

- i) Write up on operational principle and other technical details.
- ii) General arrangement drawing and material part list.
- iii) Technical Data sheet
- iv) O&M manual comprising of all above including list of recommended spare parts, assembly and dis-assembly procedure.

44 WATER LEVEL MONITORING SYSTEM

44.1 Scope of Work

The specification covers the design, manufacture, shop-testing delivery at site, installation, commissioning, performance testing of Radar type water level monitoring system complete with software and hardware along with all auxiliaries and accessories for use in XX Power station of NHPC Limited. Each set scope shall comprise of:

- i) XX nos. Non- Contact RADAR level transmitter with inbuilt lightening arrestor and mounting accessories for RADAR level transmitter
- ii) XX nos. Remote display unit.,
- iii) XX nos. Real time data acquisition system -Data logger
- iv) Control Panel housing for Data logger
- v) Instrument/ Control Cable of suitable length
- vi) Suitable converter for communication between Radar transmitter and data logger & remote display unit.
- vii) Installation, testing and commissioning of water level system.

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.

44.2 Standards and Regulations:

The water Level Monitoring System shall be of proven design for intended duty specified to ensure a high reliability and availability. The water Level Monitoring System shall be suitable for flowing water of highly silt laden/muddy water.

The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable standards.

44.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- | | | | |
|------|--------------------------------------|----|-------|
| i) | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii) | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%) | :- | ----- |
| iv) | Height above Sea Level (m) | :- | ----- |

44.4 Functional Characteristics

The water Level Monitoring System shall be of proven design for intended duty specified to ensure a high reliability and availability. The water Level Monitoring System shall be suitable for flowing water of highly silt laden/muddy water.

44.5 Design and Construction

Reservoir water level monitoring systems consisting of XX nos. non-contact radar level sensors. The width of reservoir near to installation is approx. XX meter and Dam/Tail Race top is at EL XXX M.

The data acquisition system (XX no. data logger) connecting the above XX nos. sensors and XX nos. remote displays are to be installed at dam/ tail race etc. control room or other suitable location for continuous real time water level monitoring. Communication cable & connector etc. for sensors upto Dam/ tail race control room or other suitable location is to be provided by the Contractor. The system will also be connected through LAN/IP (connections to be provided by NHPC) for online monitoring and to carry out further analysis (bar chart / curve etc.) on existing PCs by way of software (to be provided by bidder).

Suitable rigid support structure (MS/SS/Aluminium) comprising of mounting stand for RADAR Water Level transmitter along with weather proof canopy for RADAR to protect from direct sunlight and rain shall be provided by the Contactor.

Other accessories as may be required at site during execution viz. connectors, cables, wiring, terminations etc. shall be provided by the supplier for completeness of the system.

240V AC power supply is available at Dam/ Tail race site etc., where water level sensors are to be installed. Suitable convertor, if required for the system shall be provided by the Contactor.

44.5.1 WATER LEVEL SENSOR (NON CONTACT TYPE RADAR BASED

Sl. No	Parameter	Desired specifications
1	Measuring Principle	Radar Level Measurement
2	Frequency	78 GHZ or more (Project Specific)
3	Application	Water level measurement in open hydro Dam / Tail race reservoir (Project specific)
4	Minimum detectable distance:	1 meter from sensor ref-reference point
5	Maximum Measuring range:	35 meters or better (Project specific)
6	Beam angle	10 deg maximum (Project specific)
7	Analog Output	4 to 20mA
8	Accuracy	5 mm or better for full measuring range
9	Location	Outdoor
10	Ambient temperature	(-)10 to 60 Deg Centigrade
11	Enclosure construction	Anti corrosive metallic body
12	Degree of Protection	IP66 or better
13	Lightening Arrestor	LA must be provided
14	Local Display Interface	LED/ LCD Screen Interface must be provided for local programming

44.5.2 REMOTE DISPLAY UNIT

Sr. No.	Description	Requirement
1	Material	Anti corrosive metallic body
2	Display type	7 segment LED display Programmable
3	Display size	5 digits, customized color digit size 50mm or better
4	Operation	Push buttons, Menu guided operation
5	Degree of protection	IP65 or better
6	Interface	RS-485 / RS-232 (Project specific)
7	Input/output	4-20 mA

44.5.3 DATA LOGGER

Sl. No	Description	Requirement
1	Inputs	Minimum 4 Universal Inputs
2	Interface	Touch Screen
3	Recording Cycle	100ms or better, should be adjustable as per need.
4	Additional Memory	Minimum 2GB (Project specific)
5	Alarm	Minimum 4 alarms per channel must be programmable
6	Display	Min 5.0" TFT color LCD/LED Display (Project specific)
7	Display Type	Graphical display including Trend Screen, Data Screen, Bar Graph Screen
8	Dielectric Strength	1000 VAC or more
9	Communication	LAN, MODBUS TCP/IP (Project specific)
10	Degree of protection	IP65 or better
11	Power	100 to 240VAC
12	SMS and E-mail notifications	System enabled SMS and E-mail notifications to specified address/no. in the event of alarms and limit violation (if possible through external device/modem) to be supplied

44.5.4 ONLINE DATA MONITORING SOFTWARE

Sl. No.	Description	Requirement
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1	Software	Licensed software for Online data acquisition, monitoring and recording must be provided by the supplier which can work in existing LAN network for data communication between sensors/ data logger/ remote display unit to existing PC in Dam/ Tail Race control room or other suitable location (Project specific)
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44.5.5 COMMUNICATION CABLE

Sl. No.	Description	Requirement
1	Core	Two
2	Size	1.5 sqmm
3	Type	Signal Cable

Note : The above are minimum specifications and are only indicative. Additional features, if required to setup whole networks and functioning of the system is to be arranged by the supplier.

44.6 Drawing & Manual:

The bidder shall submit following information:-

- i) Write up on operational principle and other technical details.
- ii) General arrangement drawings and control logic diagram of brake and jack system and material part list.
- iii) Technical Data sheet
- iv) O&M manual comprising of all above including list of recommended spare parts, assembly and disassembly procedure.