
TECHNICAL SPECIFICATION

FOR

AGITATORS

CONFIDENTIAL

CUSTOMER : Uttar Pradesh Rajya Vidyut Utpadan Nigam
Ltd(UPRVUNL)
PROJECT : PANKI 1 x 660MW
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM



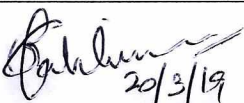
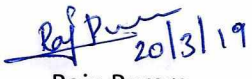
BHARAT HEAVY ELECTRICALS LIMITED
(A GOVT OF INDIA UNDERTAKING)
Flue Gas Desulphurization Group
Ranipet



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

TECHNICAL SPECIFICATION FOR AGITATORS

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Revision – 00 Dated 19-03-19		
COMMENTS : -----		

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1.0 PROJECT INFORMATION:

Panki Thermal Power Project (Coal Based) to be set up by UPRVUNL near Panki in Kanpur district of Uttar Pradesh State, India.

The capacity of the project is 660 MW

a.	Owner	UPRVUNL
b.	Buyer	BHEL, Ranipet
c.	Process/Application	Flue Gas Desulphurization

A) SITE CONDITIONS

Guarantee point

1.	Ambient Temperature and Relative Humidity		
a.	Average Site Condition ASC		
	Ambient Temperature	:	27 deg C
	Relative Humidity	:	60 %

Design point

2.	Ambient Temperature and Relative Humidity		
b.	Average Site Condition ASC		
	Ambient Temperature (Design)	:	45 deg C
	Relative Humidity	:	60 %

Note:

- 1) Reference site conditions shall apply for the Guarantee Values as well as for the Guarantee test/Performance test
- 2) Equipment and Material must be suitable for the range of ambient site conditions.

B) PROJECT LOCATION AND APPROACH

a.	State/Division	UP
b.	District	KANPUR

2.0 APPLICABLE CODES & REGULATIONS

The design and materials shall conform to the requirements of applicable codes and regulations of the latest edition. The design, manufacture, installation and testing of the Agitator shall follow the latest applicable Indian/International (AISI / ASME/EN/Japanese) Standards. GB standards are not acceptable.

3.0 INTENT OF SPECIFICATION

This specification covers the minimum requirements for the complete design, material, manufacturing, shop inspection, testing at the manufacturer's works, supervision of erection &



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performance testing at bidder's works/ site of Agitators along with accessories which is furnished in the Flue Gas Desulphurization plant of Panki 1 x 660 MW FGDF system. The following points may be noted.

- a. This unit is envisaged with one FGD system. Agitators are envisaged in various tanks, details of which are given in technical information Clause 5.
- b. Bidder shall assume full unit responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.
- c. The Bidder shall offer only proven design which meets the Provenness criteria indicated in the **Annexure-I**. Necessary document evidences as per **for qualification** shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, they are denied to participate in this tender.
- d. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (**Annexure-V**)".
- e. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable.
- f. No deviation or exception shall be permitted without the written approval of the purchaser.
- g. Compliance to this specification shall not relieve the Bidder of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.
- h. In case, the Bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, the same shall be recommended along with reasons in a separate section and include the same in scope of supply.
- i. All accessories, items of work, though not indicated but required to make the system complete for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded.

4.0 PROVENNESS CRITERIA:

The Bidders are required to meet the Qualification Requirement (QR) for Agitators as per **Annexure-I**. If bidder is not meeting the QR, their offer is liable for rejection. End user performance certificates shall be submitted for proof of experience.

5.0 TECHNICAL INFORMATION

DETAILS OF AGITATORS ARE GIVEN BELOW:

5.1 AGITATOR DETAILS



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TABLE-A- AGITATOR DETAILS FOR ABSORBER

A.	ABSORBER AGITATOR	
S.No	Description	Requirement
1.	Parameters	
	Type	Marine Propeller – Horizontal Type (Side Entry)
	Medium to be handled	Gypsum slurry
	Seal Type	Mechanical Seal (Flushless)
	Location	Outdoor
	Operation	Whenever Recirculation Pumps are not running.
	Absorber Bottom Tank	
	a. Capacity of slurry	1193m ³
	b. Dimensions	21900mmWX9900mmLX5500mmH (Rectangular)
	c. MOC of Agitator	Agitator Shaft (which is continuously in contact with slurry) and blades shall be made with Alloy 926 or better material
	d. Minimum liquid level in the tank	3.2 m
	e. Normal liquid level in the tank	5.5 m
	f. Maximum liquid level in the tank	6.5 m
	g. Quantity of Agitators per Absorber	2 No's + 1 warehouse spare
	g. Total Quantity	3 No's
2.	Slurry Analysis	
	Slurry to be handled	Gypsum slurry
	Maximum solid particle size	200 mesh (75 micron)
	Normal solid particle size, d50	325 mesh (43 micron)
	Solid to be handled	Gypsum along with Lime Stone and other impurities
	Chloride concentration	30,000 ppm (max)
	Hardness of particle	5-7 (Mho scale)
	Slurry concentration	30 wt%
	Sp. Gravity of slurry	1.2
	Sp. Gravity of Lime Stone & Gypsum	2.32 (Avg)
	Viscosity of Slurry	0.01 Pa.S
	pH	4-8
	SiO ₂ Content	4 to 6 g/l
	Temperature	Normal: 55 Deg C Design: 70 Deg C



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TABLE-B- AGITATOR DETAILS FOR SLURRY TANK

B. AUXILIARY ABSORBENT TANK AGITATOR		
S.No	Description	Requirement
1.	Parameters	
	Type	Vertical Type – (Center Mounted)
	Medium to be handled	Gypsum slurry
	Duty	Continuous
	Location	Outdoor
	Operation	Whenever FGD is under maintenance
	Auxiliary Absorbent Tank	
	a. Capacity of slurry	1400 m ³
	b. Dimensions	12400 mm Dia X 12400 mm H (Vertical cylinder)
	c. MOC of Agitator	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be carbon steel rubber lined .
	d. Minimum liquid level in the tank	1.0 m
	e. Normal liquid level in the tank	11.4 m
	f. Maximum liquid level in the tank	11.6 m
	g. Quantity of Agitators per Tank	1 No + 1 No warehouse spare
	h. Total Quantity	2 No's
2.	Slurry Analysis	
	Slurry to be handled	Gypsum slurry
	Maximum solid particle size	200 mesh (75 micron)
	Normal solid particle size, d50	325 mesh (43 micron)
	Solid to be handled	Gypsum along with Lime Stone and other impurities
	Chloride concentration	30000 ppm (max)
	Hardness of particle	5-7 (Mho scale)
	Slurry concentration	30 wt%
	Sp. Gravity of slurry	1.2
	Sp. Gravity of Lime Stone & Gypsum	2.32 (Avg)
	Viscosity of Slurry	0.01 Pa.S
	pH	4-8
	SiO ₂ Content	4 to 6 g/l
	Temperature	Normal: 55 Deg C Design: 70 Deg C



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TABLE-C- AGITATOR DETAILS FOR SLURRY TANKS

C.	FILTRATE WATER TANK AGITATOR	
S. No	Description	Requirement
1.	Parameters	
	Type	Vertical Type – (Center Mounted)
	Medium to be handled	Gypsum slurry
	Duty	Continuous
	Location	Outdoor
	Operation	Continuous.
	Filtrate Water Tank	
	a. Capacity of slurry	36 m ³
	b. Dimensions	3500 mm Dia X 4200 mm H (Vertical Cylinder)
	c. MOC of Agitator	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be carbon steel rubber lined .
	d. Minimum liquid level in the tank	0.9 m
	e. Normal liquid level in the tank	3.5 m
	f. Maximum liquid level in the tank	3.7 m
	g. Quantity of Agitators per Tank	1 No
	h. Total Quantity	1 No
2.	Slurry Analysis	
	Slurry to be handled	Gypsum slurry
	Maximum solid particle size	200 mesh (75 micron)
	Normal solid particle size, d50	325 mesh (43 micron)
	Solid to be handled	Gypsum along with Lime Stone and other impurities
	Chloride concentration	30,000 ppm (max)
	Hardness of particle	5-7 (Mho scale)
	Slurry concentration	12.5 wt%
	Sp. Gravity of slurry	1.1
	Sp. Gravity of Lime Stone & Gypsum	2.32 (Avg)
	Viscosity of Slurry	0.004 Pa.S
	pH	4-8
	SiO ₂ Content	4 to 6 g/l
	Temperature	Normal: 55 Deg C Design: 70 Deg C

**TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)****PANKI:FGD:AGITATORS:R00****TABLE-C- AGITATOR DETAILS FOR SLURRY TANKS**

D.	WASTE WATER HYDROCYCLONE FEED TANK AGITATOR	
S.No	Description	Requirement
1.	Parameters	
	Type	Vertical Type – (Center Mounted)
	Medium to be handled	Gypsum slurry
	Duty	Continuous
	Location	Outdoor
	Operation	Continuous.
	Waste Water Hydro cyclone Feed Tank	
	a. Capacity of slurry	292 m ³
	b. Dimensions	6900 mm Dia X 8300 mm H (Vertical Cylinder)
	c. MOC of Agitator	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be carbon steel rubber lined .
	d. Minimum liquid level in the tank	1.3 m
	e. Normal liquid level in the tank	7.6 m
	f. Maximum liquid level in the tank	7.8 m
	g. Quantity of Agitators per Tank	1 No.
	h. Total Quantity	1 No.
2.	Slurry Analysis	
	Slurry to be handled	Gypsum slurry
	Maximum solid particle size	200 mesh (75 micron)
	Normal solid particle size, d50	325 mesh (43 micron)
	Solid to be handled	Gypsum along with Lime Stone and other impurities
	Chloride concentration	30000 ppm (max)
	Hardness of particle	5-7 (Mho scale)
	Slurry concentration	16.6 wt%
	Sp. Gravity of slurry	1.112
	Sp. Gravity of Lime Stone & Gypsum	2.32 (Avg)
	Viscosity of Slurry	0.004 Pa.S
	pH	4-8
	SiO ₂ Content	4 to 6 g/l
	Temperature	Normal: 55 Deg C Design: 70 Deg C



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TABLE-C- AGITATOR DETAILS FOR SLURRY TANKS

E.	WASTE WATER TANK AGITATOR	
S.No	Description	Requirement
1.	Parameters	
	Type	Vertical Type – (Center Mounted)
	Medium to be handled	Gypsum slurry
	Duty	Continuous
	Location	Outdoor
	Operation	Continuous.
	Waste Water Tank	
	a. Capacity of slurry	137 m ³
	b. Dimensions	5400 mm Dia X 6500 mm H (Vertical Cylinder)
	c. MOC of Agitator	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be carbon steel rubber lined .
	d. Minimum liquid level in the tank	1.2 m
	e. Normal liquid level in the tank	5.8 m
	f. Maximum liquid level in the tank	6.0 m
	g. Quantity of Agitators per Tank	1 No.
	h. Total Quantity	1 No.
2.	Slurry Analysis	
	Slurry to be handled	Gypsum slurry
	Maximum solid particle size	200 mesh (75 micron)
	Normal solid particle size, d50	325 mesh (43 micron)
	Solid to be handled	Gypsum along with Lime Stone and other impurities
	Chloride concentration	30000 ppm (max)
	Hardness of particle	5-7 (Mho scale)
	Slurry concentration	3.0 wt%
	Sp. Gravity of slurry	1.023
	Sp. Gravity of Lime Stone & Gypsum	2.32 (Avg)
	Viscosity of Slurry	0.003 Pa.S
	pH	4-8
	SiO ₂ Content	4 to 6 g/l
	Temperature	Normal: 55 Deg C Design: 70 Deg C



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TABLE-C- AGITATOR DETAILS FOR SLURRY TANKS

F.	LIMESTONE SLURRY STORAGE TANK AGITATOR	
S.No	Description	Requirement
1.	Parameters	
	Type	Vertical Type – (Center Mounted)
	Medium to be handled	Limestone slurry
	Duty	Continuous
	Location	Outdoor
	Operation	Continuous.
	Limestone Slurry Storage Tank	
	a. Capacity of slurry	568 m ³
	b. Dimensions	8600 mm Dia X 10300 mm H (Vertical Cylinder)
	c. MOC of Agitator	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be carbon steel rubber lined .
	d. Minimum liquid level in the tank	1.5 m
	e. Normal liquid level in the tank	9.6 m
	f. Maximum liquid level in the tank	9.8 m
	g. Quantity of Agitators per Tank	1 No
	h. Total Quantity	2 No's
2.	Slurry Analysis	
	Slurry to be handled	Limestone slurry
	Maximum solid particle size	200 mesh (75 micron)
	Normal solid particle size, d50	325 mesh (43 micron)
	Solid to be handled	Lime Stone and other impurities
	Chloride concentration	100 ppm (max)
	Hardness of particle	5-7 (Mho scale)
	Slurry concentration	30 wt%
	Sp. Gravity of slurry	1.2
	Sp. Gravity of Lime Stone	2.32 (Avg)
	Viscosity of Slurry	0.03 Pa.S
	pH	5-8
	SiO ₂ Content	4 to 6 g/l
	Temperature	Normal: 45 Deg C Design: 50 Deg C



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TABLE-D- AGITATOR DETAILS FOR DRAIN SUMP

H.	ABSORBER AREA DRAIN SUMP AGITATOR	
S.No	Description	Requirement
1.	Parameters	
	Type	Vertical Type – (Center Mounted)
	Medium to be handled	Gypsum slurry
	Duty	Continuous
	Location	Outdoor
	Operation	Continuous.
	Absorber Area Drain Sump	
	a. Capacity of slurry	56 m ³
	b. Dimensions	4000 mmW X4000 mm LX 4000 mm D (Rectangular Pit)
	c. MOC of Agitator	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be carbon steel rubber lined .
	d. Minimum liquid level in the tank	1.4 m
	e. Normal liquid level in the tank	3.3 m
	f. Maximum liquid level in the tank	3.5 m
	g. Quantity of Agitators per Sump	1 No
	h. Total Quantity	1 No
2.	Slurry Analysis	
	Slurry to be handled	Gypsum slurry
	Maximum solid particle size	6 to 7 mm
	Normal solid particle size, d50	325 mesh (43 micron)
	Solid to be handled	Gypsum along with Lime Stone and other impurities
	Chloride concentration	30000 ppm (max)
	Hardness of particle	5-7 (Mho scale)
	Slurry concentration	30 wt%
	Sp. Gravity of slurry	1.2
	Sp. Gravity of Lime Stone & Gypsum	2.32 (Avg)
	Viscosity of Slurry	0.01 Pa.S
	pH	4-8
	SiO ₂ Content	4 to 6 g/l
	Temperature	Normal: 55 Deg C Design: 70 Deg C



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TABLE-D- AGITATOR DETAILS FOR DRAIN SUMP

I GYPSUM AREA DRAIN SUMP AGITATOR		
S.No	Description	Requirement
1.	Parameters	
	Type	Vertical Type – (Center Mounted)
	Medium to be handled	Gypsum slurry
	Duty	Continuous
	Location	Outdoor
	Operation	Continuous.
	Gypsum Area Drain Sump	
	a. Capacity of slurry	56 m ³
	b. Dimensions	4000 mmW X4000 mm LX 4000 mm D (Rectangular Pit)
	c. MOC of Agitator	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be carbon steel rubber lined .
	d. Minimum liquid level in the tank	1.4 m
	e. Normal liquid level in the tank	3.3 m
	f. Maximum liquid level in the tank	3.5 m
	g. Quantity of Agitators per Sump	1 No
	h. Total Quantity	1 No
2.	Slurry Analysis	
	Slurry to be handled	Gypsum slurry
	Maximum solid particle size	6 to 7 mm
	Normal solid particle size, d50	325 mesh (43 micron)
	Solid to be handled	Gypsum along with Lime Stone and other impurities
	Chloride concentration	30000 ppm (max)
	Hardness of particle	5-7 (Mho scale)
	Slurry concentration	30 wt%
	Sp. Gravity of slurry	1.2
	Sp. Gravity of Lime Stone & Gypsum	2.32 (Avg)
	Viscosity of Slurry	0.01 Pa.S
	pH	4-8
	SiO ₂ Content	4 to 6 g/l
	Temperature	Normal: 55 Deg C Design: 70 Deg C



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TABLE-D- AGITATOR DETAILS FOR DRAIN SUMP

J	LIMESTONE AREA DRAIN SUMP AGITATOR	
S.No	Description	Requirement
1.	Parameters	
	Type	Vertical Type – (Center Mounted)
	Medium to be handled	Limestone slurry
	Duty	Continuous
	Location	Outdoor
	Operation	Continuous.
	Limestone Area Drain Sump	
	a. Capacity of slurry	56 m ³
	b. Dimensions	4000 mmW X4000 mm LX 4000 mm D (Rectangular Pit)
	c. MOC of Agitator	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be carbon steel rubber lined .
	d. Minimum liquid level in the tank	1.4 m
	e. Normal liquid level in the tank	3.3 m
	f. Maximum liquid level in the tank	3.5 m
	g. Quantity of Agitators per Sump	1 No
	h. Total Quantity	1 No
2.	Slurry Analysis	
	Slurry to be handled	Gypsum slurry
	Maximum solid particle size	6 to 7 mm
	Normal solid particle size, d50	325 mesh (43 micron)
	Solid to be handled	Lime Stone and other impurities
	Chloride concentration	100 ppm (max)
	Hardness of particle	5-7 (Mho scale)
	Slurry concentration	30 wt%
	Sp. Gravity of slurry	1.2
	Sp. Gravity of Lime Stone	2.32 (Avg)
	Viscosity of Slurry	0.03 Pa.S
	pH	4-8
	SiO ₂ Content	4 to 6 g/l
	Temperature	Normal: 45 Deg C Design: 50 Deg C



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5.2 POWER SUPPLY DETAILS:

1.	POWER SUPPLY	
	The following voltage levels shall apply:	
	3 phase, 3.3 kV AC ,50 Hz	Voltage for motors equal to / bigger than 200KW and for power distribution within the plant.
	3 phase, 415 V, AC , 50 Hz	Standard voltage for power supplies to electric power consumers and motors Above 0.2 KW and upto 200 kW.
	240V AC / 3 phase 415 V AC, 50 Hz	Standard voltage for power supplies to electric power consumers and motors Upto 0.2 kW.
	1. All equipments shall be suitable for rated frequency of 50 Hz with a variation of + 3% & -5%, and 10 % combined variation of voltage and frequency unless specifically brought out in the specification. 2. Bidder shall design and supply the equipment suitable for satisfactory operation under above mentioned power supply condition.	

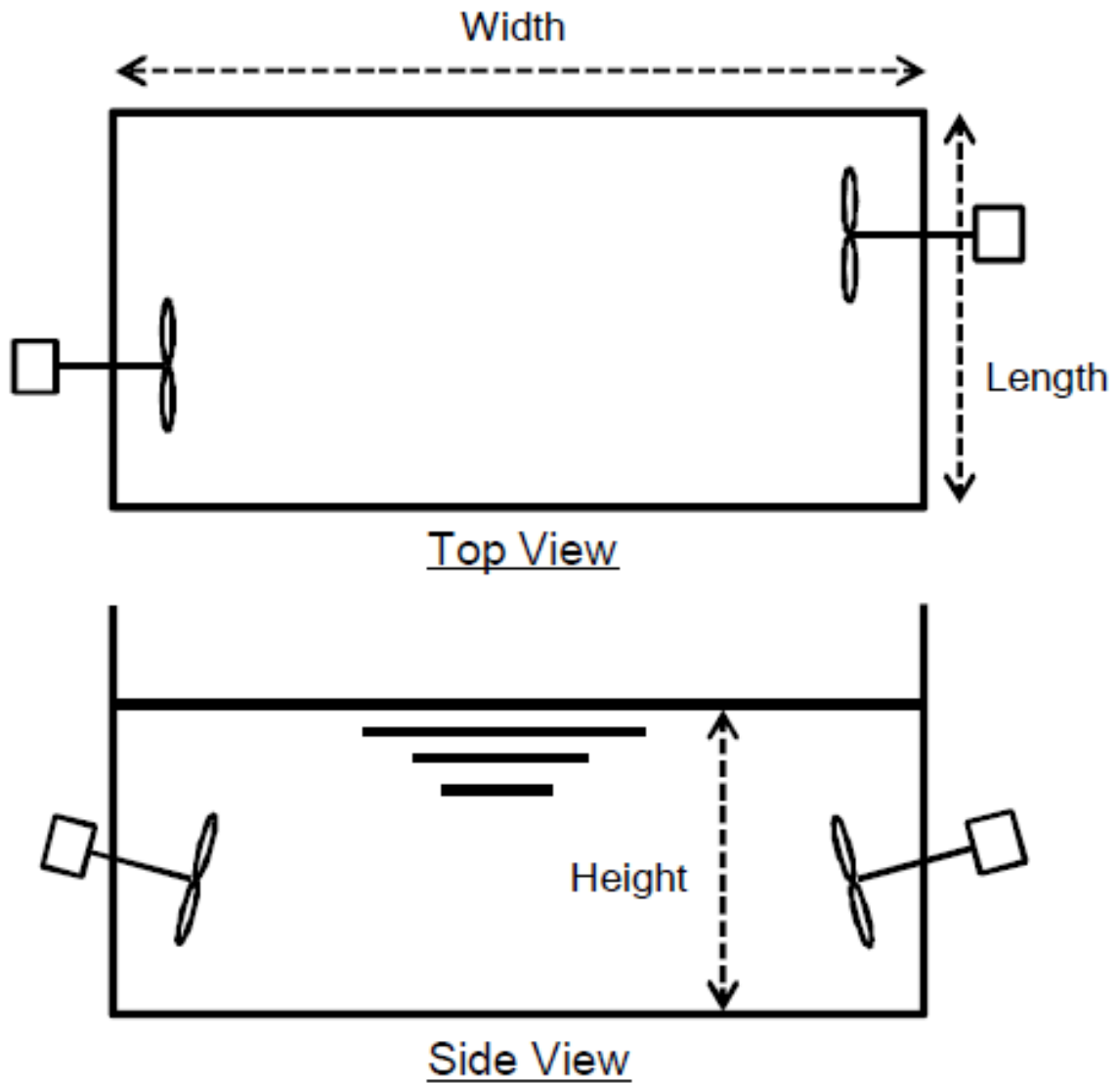
5.3 AGITATOR ARRANGEMENTS:

(1) Absorber Agitators:

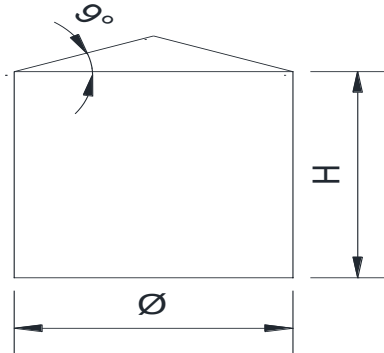
- a. The absorber agitators are Side Mounted / Horizontal type. The Dimensions of Each Absorber bottom tank as per Table A of Clause 5.1.
Dimensions: Width: 21.9 m x Length: 9.9 m x Height: 5.5 m.

The arrangement of Agitators in Absorber as per Sketch-1 shown below.

SKETCH - 1



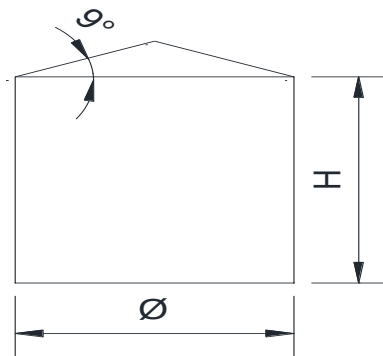
(2)Aux Absorbent Tank Agitators:



Side view

These Agitators will operate continuously when Limestone / Gypsum Slurry is evacuated from Absorber for any Absorber maintenance work. The Aux Absorbent Tank details as per Clause no: 5.1 Table -B.

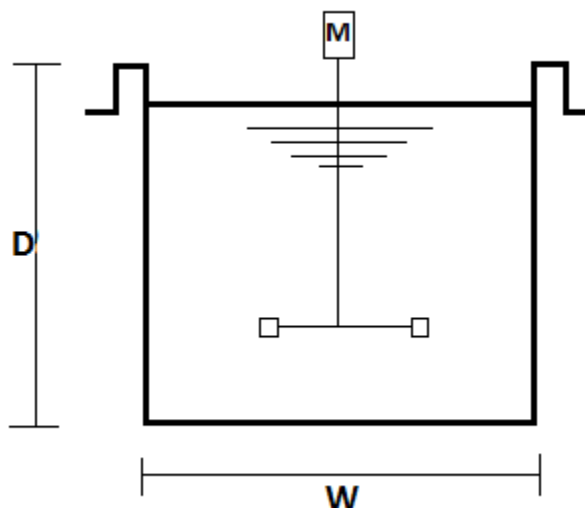
(2) Slurry Tank Agitators:



Side view

These Agitators will operate continuously for FGD system operation. The Slurry Tanks details as per Clause no: 5.1 Table -C.

(3) Drain Pit Tank Agitators:



Side view

These Agitators will operate continuously for FGD system operation. The Drain Pit Tank details as per Clause no: 5.1 Table -D.

6.0 SCOPE OF SUPPLY

Scope for the bidders shall include Design, Manufacturing, Supply, and Supervision of Erection & Commissioning

Design: Includes basic engineering, detail engineering, preparation and submission of engineering drawings/calculations/datasheets/quality assurance documents/field quality plans, storage instructions, commissioning procedures, operation & maintenance manuals, performance guarantee test procedures and assisting BHEL in obtaining time bound approval from UPRVUNL.

Supply: Includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting & packing.

Supervision of Erection & commissioning: Includes supervision of erection & commissioning, supervision of trial operation, training of customer's O&M Personnel.

The scope of supply for AGITATORS shall include but not limited to the following:



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A) ABSORBER TANK AGITATORS:

Sl. No	Scope
1.	AGITATOR complete with
	i. AGITATOR Blades
	ii. AGITATOR Shafts
	iii. Coupling arrangement (Flexible)
	iv. Single Mechanical Seals
	v. Shaft Sleeve
	vi. Lanterns/ Stools (Bearing Housing), Safety Guard
	vii. Bearings
	viii. AGITATOR Mounting Flanges with gaskets and fasteners
	ix. Drive Motor with gearbox arrangement
	x. Supporting arrangement of Side Entry Agitator on Absorber Wall. Vessel Nozzle and mating flange for supporting on the Absorber wall
	xi. Flushing system for start up.
	xii. Foundation plate with foundation bolts, vessel nozzle
	xiii. Painting and Rust Prevention during shipment and construction
	xiv. Supervision of Erection & commissioning at site
	xv. Special tools & tackles as applicable
	xvi. Start-up spares as applicable
	xvii. Installation, operation and maintenance manuals
	xviii. Any other items required for completeness of the equipment except the items covered in the exclusions.



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B) AUXILIARY ABSORBENT TANK, SLURRY TANK & DRAIN PIT TANK AGITATORS:

Sl. No	Scope
2.	AGITATOR complete with
	i. AGITATOR Blades
	ii. AGITATOR Shafts
	iii. Coupling arrangement (Flexible)
	iv. Gland Packing, Seals, O Rings, Glands
	v. Shaft Sleeve
	vi. Lanterns/ Stools (Bearing Housing), Safety Guard
	vii. Bearings
	viii. AGITATOR Mounting Flanges with gaskets and fasteners
	ix. Drive Motor with gearbox arrangement
	x. Vessel nozzle, Mating Flange for Supporting on Slurry Tank Roof
	xi. Painting and Rust Prevention during shipment and construction
	xii. Supervision of Erection & commissioning at site
	xiii. Special tools & tackles as applicable
	xiv. Start-up spares as applicable
	xv. Installation, operation and maintenance manuals
	xvi. Any other items required for completeness of the equipment except the items covered in the exclusions.

6.1	TECHNICAL REQUIREMENTS	Vendor To Confirm
1.	Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the absorber vessel, limestone mill recycle tanks, limestone slurry tank, Auxiliary Absorbent tank, and sumps etc.	
2.	All agitators shall be designed for continuous operation unless otherwise specified. The design of the agitators shall be of proven type.	
3.	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.	
4.	All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.	
5.	The Shaft and blade of the agitators shall be of Alloy 926 or better suitable for the service condition. Alternatively, the blades can also be provided with rubber lining with a minimum life of 2 years.	
6.	Each agitator and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation. It shall be possible to remove the sealing devices of the	



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	Agitators of the absorber vessel without having to drain completely the absorber.	
7.	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.	
8.	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.	
9.	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally.	
10.	All exposed moving parts shall be covered by guards.	
11.	Side entry agitator shall be flange mounted.	
12.	The shape of the impeller blades of side entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s	
13.	Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions	
14.	It shall be noted that all Agitators are meant for keeping the solid particles in suspended mode in liquid with “Full off-Bottom Suspension” of solid particles to 98% of liquid column to virtually “Uniform Solid Concentration”. No chemical reaction will takes place.	
15.	Maintaining a uniform concentration over the 95% of liquid column. Absolute sweeping of solid particle from tank bottom is a must for all Agitators. If speed is required to be increased to guarantee the above requirements; the same can be increased by vendor. Bidder's machines that consume less power will be in an advantageous position.	
16.	It is to be noted that in continuous process any deposit at tank bottom is the loss of material which are not getting converted as per process. Hence, total loss of material by sedimentation is a loss to FGD Process & determines the “In efficiency of the Agitator”.	
17.	Vendor should ensure nil settlement; utilization of solid material shall be a guaranteed parameter and will be assessed in percentage (%) term to net wet of solid mass of inflow or out flow. This is one of the guarantee parameter.	
18.	Agitator and its driver shall perform on the test stand at shop and on the Agitator's permanent location at site within vibration limit the vibration of combined unit will be the responsibility of Agitator manufacturer. Agitator manufacturer is to ensure that Site performance of vibration is one of the “Acceptance Criteria” of the equipment. Please note vibration at test stand can only be taken as for information.	
19.	Every Tank will have a pump whose suction line shall be connected to tank. These pumps are to operate continuously at the lowest operating level which is decided by Process requirement. Hence, the minimum operating level of liquid in every tank for every Agitator is a must to assess the combined operation of Agitator as well as that of pump alone. The Tank water level is indicated as per Clause 5 (Technical Information)	
20.	Agitator must have low-pitch propeller with low solidity ratio and Power Number of 0.3-0.35. The Maximum Input Power at motor terminal shall be considered as a	



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	guaranteed parameter under “Schedule of Guaranteed Parameters” in ANNEXURE -II and the same shall be calculated for maximum liquid level in tank. A calculation of power specifying the hydraulic power of Agitator, Seal loss, Gear box and Motor internal loss must be submitted along with the offer. A characteristics curve showing power versus liquid level should be submitted from the lowest liquid level, required for Agitator to maximum liquid level in the tank. Motor should be selected based on the highest power demand with a 10% margin at maximum liquid level, taking into account frequency variation.	
6.2	CONSTRUCTIONAL FEATURES	
A)	BLADE AND HUB OF PROPELLER	
I)	The blades of the agitators shall be of Alloy 926 or better material suitable to the service conditions. Alternately, the blades can also be provided with rubber lining with minimum life of 2 years. Impeller hub shall be of Alloy 926 or better material.	
II	The Blade design of the Agitator to be of most efficient design in order to offer least power consumption. The Agitator power consumption is part of the guarantee parameters.	
III	Although Agitator will have substantial low speed because of reduction Gear Box, hydraulic unbalance at impeller can cause severe vibration, hence it is mandatory that rotating assembly shall be dynamically balanced to its rated speed.	
IV	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.	
B)	SEAL	
1.	<u>Horizontal / Side Entry Agitators for Absorber Tank</u>	
I.	Agitators should be provided with Single Stage mechanical seal. the mechanical seal should be as per ISO-21049 / API 682	
II.	The Mechanical Seals shall be so arranged that repacking or fitting of replacement seals can be carried out with the minimum of disruption to plant operation.	
III.	Design the mechanical seals chamber to have sufficient room to lubricate and get seal face cool with its own slurry.	
IV.	Provide requirements for periodical flushing to rinse the seal face for leaked slurry.	
V.	All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not be used.	
VI.	Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.	
VII.	Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, it should have a provision of collecting / or discharging back to the tank.	
VIII.	Mechanical seals shall be fitted and installed in the Agitator before shipment and shall be clean. Mechanical seals shall be plugged with screw for shipping.	
IX.	Intention of the specification is not to specify Type of Seal, Seal design, Spring configuration, Seal configuration, Balanced or Unbalance type etc. Agitator manufacturer to decide the same along with seal manufacturer the best seal that is	



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	suitable for the offered Agitator	
X.	Seal life has to be guaranteed, taking into consideration all its components for 25000 hrs. If the seals fail before the completion of guaranteed period, the same should be replaced free of cost by the bidder.	
XI.	The sub-vendor of the seal shall be approved by UPRVUNL during contract execution.	
2.	<u>Vertical Agitators for Auxiliary Absorbent Tank, Slurry Tanks & Drain Pit Tanks</u>	
I	Agitator shall be supplied with stuffing box or any proven equivalent or superior sealing type. Mechanical and hydraulic conditions in the seal chamber, required to maintain a stable film at seal face, including temperature, pressure and flow, shall be jointly established by Agitator manufacturer and seal manufacturer, and shall be noted in data sheet submitted in tender. If mechanical seal is offered by bidder, the mechanical seal should be as per ISO-21049 / API 682.	
C)	SHAFT	
	MOC of Shaft Stainless Steel or nickel Alloy suitable to the service. Use of dissimilar material at flange joint shall be avoided to eliminate any crevice corrosion. Spacing of the shaft joint should not be more than 3.0 m for easy assembly if it is more than 40kg. If welding is used for joining two tubes, welding joint must be 100% radio graphed.	
D)	BEARING & BEARING HOUSING IN GEAR BOX	
	Bearing shall be of rolling type radial and thrust bearing (FAG/SKF/Timken make only) as required. Thrust bearing shall be sized for continuous operation under all specified condition.	
	Thrust bearing shall provide full load capability if the Agitator's normal direction of rotation is reversed. Up-thrust and Down-thrust load must be taken into account in sizing bearing. Life of the every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have L10 of 60,000 hrs (minimum).	
	Bearing housing should be grease/oil lubricated. If bearing is oil lubricated, constant-level sight-feed oiler of 100cc size or bigger capacity is to be provided. Bearing housing should have oil drain, constant oil level indicator. A provision of one(1) number G1/2" thread(ISO-228,Part-1)port is required for remote control of temperature of bearing housing oil bath RTD.	
	If bearing housing requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet.	
	Lubricating oil will be the responsibility of Gear Box manufacturer. Hence, manufacturer has to make arrangement of first fill of oil at installation and at commissioning stage. Quantity of oil and its grade is to be indicated in Drawing and Operation Manual.	
E)	MATERIALS	
	Agitator components designated as "Full Compliance Material" shall meet the requirements of the industry specification as listed for the material in the table as well as in the specification in the respective section.	
	A detail quality plan is to be submitted along with offer for all items marked	



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	"Full Compliance Material".	
	Final acceptance of the quality plan will be approved by ultimate user (hereafter called UPRVUNL). Hence, it is expected that manufacturer to submit quality plan (QAP) along with the offer. The same shall be followed at post order stage also. QAP should be as per the best practice followed internationally to avoid any conflict of interest.	
F)	Driver (Motor)	
1	Driver shall be sized to meet all specified operating conditions including bearing housing, seal, external gear box and coupling loss (if any).	
2	Motor shall be able to accelerate to speed at reduced voltage and frequency as specified in "Site Power Supply Condition" as per Clause: 5.2.	
3	It should meet Motor specification as per Clause No: 22, reference documents.	
G)	GEAR BOX	
	Gear box should be vertical flange mounted solid shaft type (Vertical Agitators), reducing speed type, specially designed for the requirement of Slurry mixing and to be manufactured by the Agitator supplier. Complete up-thrust and down-thrust, developed by Agitator shall be taken by thrust bearing housing of Gear Box. An auxiliary slow drive provision shall be provided in the Gear Box so that slurry is always kept in dynamic condition to avoid settling of slurry at bottom, in the event of Agitator is not operating at its rated speed. Rating of at Gear box shall be at least 1.5 times the rated torque of Agitator.	
H)	COUPLING & COUPLING GUARD	
I.	Coupling and coupling guard should be supplied between driver and driven equipment.	
II.	Coupling should be designed taking into consideration adequate service factor.	
III.	Design rating of the coupling (excluding service factor) should be indicated in data sheet.	
IV.	Coupling must be having locking screw so that it does not slide over shaft in due course operation.	
V.	Vertical Agitators - Coupling between Motor and Gear Box shall be Spacer-type flexible coupling, made of Cast Iron. Spacer length shall be of sufficient length so than Motor and Gear Box shall be able to run independently at no-load condition by detaching the respective coupling.	
VI.	It is desirable that for servicing of seal, coupling half should not be removed. Coupling should be dynamically balanced to Gr: G6.3, ISO-1940.	
VII.	Removable coupling guard shall conform to the requirements of all applicable national, industrial or statutory regulations.	



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I)	PLATE AND FASTENING BOLTS	
I.	Base plate shall be interpreted as the component of Agitator assembly through which the whole load will be transmitted to the Sole Plate/Nozzle over which the equipment will be mounted. The Base plate shall be fabricated with mild steel of structural quality (UTS=42N/sq mm minimum) with anti-corrosive paint of sufficient dry-film thickness.	
II.	Base plate must have provision of leveling on its intended mounting place. Sole plate is not in the scope of supply of Agitator manufacturer. It should be noted that Sole plate will be rubber lined to prevent any leakage of corrosive gases	
III.	Alignment between Gear Head Shaft and Agitator shaft shall be within the permissible limit of Gear Box. Similarly, misalignment between Motor shaft and Gear Box Shaft shall be within 0.050 micron (radial) and 2 degree (angular) or better as per requirement of Motor and Gear Box	
IV.	Sole plate with desired number of hole, will be machined on one side. Sole Plate shall be welded to the structure after leveling, as recommended by Agitator manufacturer and rubber lining is completed before placing the equipment in its desired location.	
J)	OTHER COMPONENTS	
	All fasteners used in wetted condition must be of Alloy 926/SS2205 material so that even if it comes in contact with liquid by swelling of rubber, thread remains unaffected. All fasteners for the non-wetted parts shall be SS304. Raw material of fastener must undergo Inter-granular Corrosion test as per ISO-3651, Part-1 for Nitric Acid test.	
K)	ABSORBER AGITATORS:	
I.	All Agitators shall be designed for continuous operation	
II.	The Absorber Agitators shall be of Horizontal / Side Entry type.	
III.	The Material of Construction (MOC) of Agitators/ Shaft and blade shall be of Alloy 926 or better material . Alternatively, the blades can also be provided with rubber lining with a minimum life of 2 years	
IV.	It should be of Flange mounted type.	
V.	The shape of the impeller blades of side entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design condition.	
VI.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from side. Vendor to provide the nozzle along with the agitator.	
VII.	The Bidder to consider Gypsum Sedimentation during stoppage of Agitator.	
VIII.	<u>The following information to be provided along with the bid:</u> a) <u>Impeller Diameter</u> b) <u>Impeller Speed</u>	



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	c) <u>Agitator Pumping Capacity (m^3/min)</u> d) <u>Volume per Agitator:</u>	
L)	<u>AUXILIARY ABSORBENT TANK , SLURRY TANK & DRAIN PIT Tank AGITATORS:</u>	
I.	All Agitators shall be designed for continuous operation.	
II.	The Material of Construction (MOC) of Agitators/ Shaft and blade shall be of Alloy 926 or better material . Alternatively, the blades can also be provided with rubber lining with a minimum life of 2 years	
III.	It should be roof mounted.	
IV.	Agitators shall be vertical mounted type and shall be driven by motor with reducing speed gear box of rigid type, solid shaft coupling between gear box and agitator and flexible coupling of spacer type coupling between Motor and Gear Box. Both Gear Box and Motor should be vertically/horizontally flange mounted type with a common frame of the whole equipment. The entire thrust load of agitator should be transmitted to the thrust bearing of Gear box.	
V.	Cable entry to the Motor terminal box should preferably be from top when motor is vertically mounted at its position and it should be easily accessible.	
VI.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from top. Vendor to provide the nozzle along with the agitator.	
VII.	In case Bidder provides a Vertical Agitator with hub design the same has to be of Alloy 926 or better material.	
VIII.	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.	
IX.	Operation speed of the Agitator motor shall be at least 25% below the first critical speed.	
X.	Additional to the requirement of the critical speed of Agitator, as specified above. Agitator manufacturer is to analyze the torsional critical speed of combined system of Agitator, Gear Box and Motor to establish that the torsional critical speed is well off the operating speed by 20% from the operating speed.	

6.3 MOTOR

➤ Degree of Protection

Degree of protection for various enclosures shall be as follows:

- a) Outdoor motors : IP 55
- b) Cable box-Outdoor area : IP 55

➤ Codes and Standards

- a) Three phase induction motors : IS325
- b) Single phase AC : IEC 60034



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➤ **Painting**

Paint shade shall be as per RAL5012 (tentative)

6.3.1 AC Motors Type

AC Motors:

All AC motor shall be Squirrel cage induction motor and, shall be suitable for direct –on-line starting. Rating of the motor should be of Type S1 (Continuously rated) as per ISO-60034, Part-1. Rating of motor must be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation.

- a. All motors, the maximum temperature rise shall be 70⁰ C by resistance method for both class B & F insulation.
- b. For motors with starting time up to 20secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be 3 second more than the starting time at minimum rated voltage(85%). For motors with starting time more than 20secs and up to 45secs at minimum voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5secs more than starting time at minimum rated voltage(85%). For motors with starting time more than 45secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at high voltage limit shall be more than starting time at minimum rated voltage(85%) by at least 10% of the starting time. Speed switch mounted on the motor shall be provided in cases where above requirements are not met.
- c. Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. Pull-out torque at rated voltage shall not be less than 205%of full load torque.
- d. Starting voltage requirement will be 85% of rated voltage up to 1500kw rating motor.
- e. Single phase space heaters suitable for 240 v AC shall be provided on motors rated 30kw and above to maintain winding in dry condition when motor is standstill. Separate terminal box for space heater (As per clause no: 6.0.2) and RTDs shall be provided.
- f. All motors shall be Totally Enclosed Fan Cooled (TEFC), for Motors below 30 kw, winding shall be suitable for heating at 24v, 1 phase AC.
- g. Winding and Insulation shall be of type Non-hygroscopic, Oil and Flame resistant. It shall be capable two hot starts in succession with initially at normal running temperature. The insulation shall be Class B or better.



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- h. Noise level of all motor shall be limited to 85 dB(A). Vibration shall be limited within the limit prescribed by IS12075, Part-14. Motor shall withstand the vibration produced by driven equipment. Combined vibration of the equipment at site shall only be accepted as per the Schedule of Guarantee Clause, as mentioned in the data sheet.
- i. Motor body shall have two earthing points on opposite side.
- j. inside the terminal box to suit the conductor size
 - Motors up to 1 kw - 8 SWG wire
 - 1kw - 30 kw - 25x3 mm GI flat
 - 30 kw - 60 kw - 25x6 mm GI flat
 - 60 kw & above - 30x 6 mm GI flat

6.3.2 Terminal Box

Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
UP to 3 KW	As per manufacturer's practice
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	203

Terminal boxes of LT motors 160 KW (& above) shall be capable of withstanding system fault level of 31 MVA for 0.12 second.

Ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any tolerance)

- Upto 110KW : 11.0
- Above 110KW & upto 1500KW : 10.0
- Above 1500KW & upto 4000KW : 9.0
- Above 4000KW : 6 to 6.5

6.3.3 Testing of LT Motors

- a. LT Motors shall be of type tested quality. For each type and rating of LT Motors, rated above 50KW, the vendor shall submit for Owner's approval the report of all type tests as per relevant standards and carried out within last five (5) years from the date of Purchase Order(PO). These reports should be for the test conducted on the equipment's similar to those proposed to be supplied under this contract, and the tests should have been either conducted at an independent laboratory or should have been witnessed by client.



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- b. In case vendor is not able to submit the report of the type tests, conducted within last five (5) years from the date of PO or in case the type tests report are not found to be meeting the specification requirements, the vendor shall conduct all such tests under this contract free of cost to the ultimate purchaser (UPRVUNL in this case) and submit the reports for approval.
- c. All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
- d. All Motors shall be so designed that maximum inrush currents and locked rotors and pull-out torque developed at extreme voltage and frequency variation do not endanger the motor and driven equipment's.
- e. Terminal boxes of breaker operated LT Motors above 160kw shall be capable of withstanding system fault level 31MVA for 0.12 second.
- f. The size and number of cables to be intimated to successful bidder during detail engineering and the contractor shall provide terminal box suitable for the same.

7.0 GENERAL REQUIREMENTS:

S.No	Description	Vendor to confirm
1.	Metric unit shall be used in the drawings and in the any displays on the equipment's. Special attention should be taken that the unit of pressure shall be in dual scales of kPa and kg/cm ² G. For instance the pressure gauges should have dual unit's indication.	
2.	Descriptions in the drawings, in the documents, and in the displays shall be in English	
3.	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type.	
4.	The equipment shall be designed to withstand the corrosive and moist environment in which these are proposed to operate.	
5.	Noise level produced by any rotating equipment individually or collectively shall not exceed 85 dB measured at a distance of 1.0 meters from the source in any direction and 1.5m above operating floor.	
6.	The overall vibration level shall be as per ISO 10816.	
7.	Suitable drain connections shall be provided.	
8.	The equipment shall be suitable for stable operation continuously.	
9.	Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable Indian / International standard.	



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S.No	Description	Vendor to confirm
10.	Unless otherwise specified , flanges shall be in accordance with ANSI B16.5 Class 150	
11.	Name plate: All equipment shall be provided with nameplates indicating the item number and service name. Name plates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase. Stainless steel nameplates for all instruments and valves shall be provided.	
12.	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.	
13.	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be minimum 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.	
14.	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.	
15.	If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.	
16.	Bidder shall provide the necessary gaskets.	
17.	All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.	
18.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.	
19.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.	
20.	Quality Plan to be submitted along with the offer.	
21.	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.	
22.	Material of construction for all equipment/components shall be subject to UPRVUNL / BHEL approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component as per best engineering practice, global standard and global references.	
23.	Bidder to provide sub vendor list and Bidder shall strictly adhere to UPRVUNL	



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S.No	Description	Vendor to confirm
	approved vendor list. In case bidder proposes an additional vendor for an item or vendor approval is required for any new item, acceptance shall be subject to approval by UPRVUNL/ BHEL before placing order and bidder shall submit relevant documents as per Attachment-VI-Sub-Supplier Questionnaire .	
24.	It shall be the complete responsibility of the successful bidders to obtain “Sub Vendor Approval” from BHEL / UPRVUNL for all equipment’s & components. Any delay in sub vendor’s approval should not affect the project schedule. If any of the sub vendors does not have the approval of UPRVUNL/ BHEL, the same may be replaced with another UPRVUNL/BHEL approved sub-vendor only, without any price implications to BHEL.	
25.	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the BIFPCL/ BIFPCL’s consultant and BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP. - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: b. Relevant Standards c. Specifications d. Approved drawings e. Data Sheets f. Calibration certificate for all the measuring instruments g. Bidder should also coordinate in getting the MDCC’s (Material Dispatch clearance certificate) and all types of IC’s (Inspection Certificates) from the UPRVUNL along with BHEL.	
26.	During detail engineering, bidder to strictly adhere to BHEL/UPRVUNL drawing formats, document numbering, quality plan & FQP formats	
27.	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with reference Designation System for Power Plants - KKS system.	
28.	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/UPRVUNL during detail engineering	



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S.No	Description	Vendor to confirm
29.	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word /Excel format.	
30.	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/UPRVUNL should be addressed timely by the bidder.	
31.	Bidder to note that list above is not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user shall also be in the scope of the bidder.	
32.	Bidder shall submit the signed and stamped copy of all the pages which constitutes this technical enquiry specification signed by authorized signatory and clearly mentioning each clause under following two categories to avoid any ambiguity in scope understanding & the scope division along with technical offer. a. "Accepted without deviation and considered in scope of work" b. "Not considered in scope of work"	
8.0	PACKING AND FORWARDING	
1.	Proper packing to be ensured. Indigenous Supply: Agitator & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the Agitator internals during storage in the outer yard of power plant. Imported Supply: All imported supply should be packed as per Sea worthy packing standards Annexure - VII. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages.	
2.	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.	
3.	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.	
4.	Crates and packing material used for shipping will become the property of	



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S.No	Description	Vendor to confirm
	owner.(UPRVUNL)	
5.	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship will be used. It shall be the bidder's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.	
6.	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.	
7.	Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: a. Destination b. Package Number c. Gross and Net Weight d. Dimensions e. Lifting places f. Handling marks and the following delivery marking	
8.	Each package or shipping units shall be clearly marked or stenciled on at least two sides as follows. BHEL SITE OFFICE UPRVUNL PANKI, 1 X 660 MW. UP, INDIA. EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, INDIA" In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.	
9.	Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.	
10.	Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.	

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11.	The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.	
12.	Wherever necessary besides usual inscriptions the cases shall bear special indication such as “Top”, “Do not turn over”, “Care” , “Keep Dry” etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks)	
13.	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category d. Fragile components (to be marked properly with a clear warning for handling)	
14.	Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.	
15.	The packing slip shall contain the following information: - Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of Agitator, BHEL item Code, Gross Weight and Net weight of Supplied items.	
16.	Prior to transport from manufacturer’s work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.	
17.	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as “very severe” during final finishing/shipping.	
18.	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering.	



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	Also, complete billing break-up with above mentioned details shall be submitted within 10days of LOI.	
19.	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).	
20.	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.	
9.0	SUPERVISION OF ERECTION, TESTING AND COMMISSIONING	
1.	The erection of Agitators will be done by owner as per Erection Manual and check List. However, the bidder shall make one visit for the supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply.	
2.	The bidder will be informed well in advance for the visit. Bidder shall include 15 working days for the visit in the offer.	
3.	TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in supply portion.	
10.0	EXCLUSION	
	The following work associated with the Agitators will be by others: a. Walkways, platforms and ladders b. Element handling hoists.	
11.0	INSPECTION AND TESTING	
	The General inspection requirements to be considered are as below:	
1.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used on the Agitators for review by BHEL/UPRVUNL prior to manufacture.	
2.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/UPRVUNL.	
3.	Since there is no standard for “Acceptance Test Procedure” for Agitator, Agitator manufacturer is to submit a test procedure and Quality Plan, clearly indicating that equipment will meet the desired parameter.	



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4.	Power consumption at motor terminal and vibration of equipment will be conducted at site. Vendor to indicate other material tests that are to be conducted as per their practice in their Quality plan.	
5.	No liquid should enter the tube through any flange joint. “O”-ring used in the flange joint will deteriorate at a highly chlorinated and acidic environment of medium at a maximum operating temperature unless right quality of rubber is used. Hydrostatic testing of tube assembly is required at a pressure of twice that of maximum liquid column in any tank or 30m whichever is higher. The hydro test duration will be for a minimum of 1 hr to check sweating at any flange. Hydrostatic test is meant in part for a check of equipment joint at new condition only. It is cannot be considered as a guarantee of functional objective of rubber used.	
6.	DYNAMICS Impeller shall be tested for dimensional and balancing check.	
7.1	CRITICAL SPEED	
7.1.1	Operation speed of the Agitator motor shall be at least 25% below the first critical speed	
7.1.2	Additional to the requirement of the critical speed of Agitator, as specified above. Agitator manufacturer is to analyze the torsional critical speed of combined system of Agitator, Gear Box and Motor to establish that the torsional critical speed is well off the operating speed by 20% from the operating speed.	
7.1.3	Gear Boxes shall be tested for run test as per standard practice.	
7.2	VIBRATION SEVERITY	
7.2.1	During performance test, unfiltered vibration measurements shall be made with running of Agitator in Air. Measurement shall be taken on the Gear Box thrust bearing housings as well in motor top.	
7.2.2	Guaranteed Site vibration of the equipment on its own pedestal, at commissioning with normal level of liquid and with maximum liquid at respective tank, Vibration limit at site will be as per ISO-10816, 1.5-2.3mm/sec even if Motor rating falls below 15kw.	
7.2.3	Vibration measurements of bearing housing shall be made in root mean square (RMS) velocity.	
7.2.5	Vibration levels measured on the non-rotating parts shall not exceed the zone limit “B” as defined in ISO 10816 at steady conditions and shall not exceed the zone limit “C” as defined in ISO 10816 at transient conditions.	



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8.	For surfaces with rubber lining Welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate adherence of rubber. The acceptance criteria shall be as per latest standard.	
9.	Hardness of the rubber lining to be inspected.	
10.	For surfaces with rubber lining, degree of cleaning shall be visually checked before the application of the coating. There must be no area with oxidation, dirt or partially or generalized corrosion defects.	
11.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.	
12.	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify the absence of air packets (or) surface without adherence.	
13.	For surfaces with rubber lining, Coating thickness shall be checked at 100%. A High voltage porosity test will be conducted on 100 % of the coated surface.	
13.	Out of all Agitators One Number of each type will be inspected at the Bidder's works before dispatch or where the test facilities are available.	
14.	The Bidder shall conduct performance test for the remaining Agitators and submit the reports.	
15.	Contract shaft mechanical seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition, if applicable.	
16.	Agitators shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.	
17.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.	
18.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.	
19.	Bidder to arrange all calibrated gauges, Instruments during inspection.	
20.	Mechanical running and the performance test shall be carried out. Bidder to arrange Motor of same / higher rating for the shop test and inspection.	



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S.No	Description	Vendor to confirm
12.0	PAINTING	
1.	Painting details for agitator support :- Surface Preparation: Blast Cleaning SA 2.5 PRIMER COAT: a. Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ± 2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70μ Intermediate : One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%± 2) DFT- 100μ . FINISH COAT: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%± 2) DFT- 35μ/ coat With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E) COLOUR CODE Base: To be informed during contract stage Lettering: To be informed during contract stage The above details are tentative and actual painting will be as per QAP approved by end customer.	
2.	Rust preventive paint after inspection at shop floor before dispatch shall be in bidder's scope	
3.	Corrosion protection, coating and galvanizing, painting shall be taken care by the bidder. Bidder shall submit the painting scheme during detail Engg in line with the specification and shall be subject to approval of BHEL / UPRVUNL.	
13.0	SPARES, TOOLS & TACKLES	
	Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools.	
13.1	START UP & COMMISSIONING SPARES Start-up & Commissioning Spares shall be part of the main supply of the Agitators. Start-up & commissioning spares are those spares which may be required during the start- up and commissioning of the equipment/system. All	



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S.No	Description	Vendor to confirm										
	spares required for successful operation till commissioning of Agitator shall come under this category. Bidder shall provide an adequate stock of such start up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at site before the equipment's are energized. The List of such spares to be provided during bidding stage											
13.2	FINAL SPARES(RECOMMENDED SPARES)											
	Bidders shall also furnish the Final Spares Part List (i.e. recommended spares list) along with the offer required for 3 years of normal operation of the plant and should be independent of the list of the mandatory spares. Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment.											
13.3	INITIAL SPARE PARTS (MANDATORY SPARES):											
	Bidder to quote for below mentioned mandatory spares with break up price: <table><tr><td>1. Impeller Assembly</td><td>1 nos. of each type</td></tr><tr><td>2. Bearing Assembly</td><td>1 nos. of each type</td></tr><tr><td>3. Motor</td><td>1 no. of each type</td></tr><tr><td>4. Belt and Pulley (If applicable)</td><td>1 no. of each type</td></tr><tr><td>5. Gear Box Assembly (If Applicable)</td><td>1 no. of each type</td></tr></table> Bidder shall quote for the "Initial Spares Part List", and it will be considered for L1 evaluation. Initial spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes. All boxes/containers are to be distinctly marked in red color with boldly written "S" mark on each face of the containers. Spares shall not be dispatched before dispatch of corresponding main equipment's. Each item shall be labelled in English and be packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 10 years' storage in a dry weatherproof building. All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the Initial spares shall be manufactures along with the main equipment components as a continuous operation as per same specification and quality plan. Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to	1. Impeller Assembly	1 nos. of each type	2. Bearing Assembly	1 nos. of each type	3. Motor	1 no. of each type	4. Belt and Pulley (If applicable)	1 no. of each type	5. Gear Box Assembly (If Applicable)	1 no. of each type	
1. Impeller Assembly	1 nos. of each type											
2. Bearing Assembly	1 nos. of each type											
3. Motor	1 no. of each type											
4. Belt and Pulley (If applicable)	1 no. of each type											
5. Gear Box Assembly (If Applicable)	1 no. of each type											



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S.No	Description	Vendor to confirm
	indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools.	
14.0	PERFORMANCE GUARANTEE	
	All performance tests for Agitators shall be carried out in accordance with any latest international codes/standards. Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Agitators and its accessories The Bidder shall ensure a design of the equipment to achieve an average target availability of 98% for 120 days and average target availability of 95% for 1 year. Noise level ≤ 85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions. Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ UPRVUNL approval. In the event that the performance test is unsuccessful, bidder shall take necessary remedial action at his cost and the performance test shall be repeated.	
15.0	BID EVALUATION CRITERIA FOR POWER CONSUMPTION:	
1.	POWER GUARANTEE Bidder to specify the total guaranteed power per Agitators operating at the rated capacity in their offer	
2.	BID EVALUATION CRITERIA FOR POWER CONSUMPTION: The following agitators will be considered for power consumption: 1) Filtrate Water Tank Agitator 2) Waste Water Hydrocyclone Feed Tank Agitator 3) Waste Water Tank Agitator 4) Limestone Slurry Storage Tank Agitator The best of the parameter for auxiliary power consumption quoted by any qualified bidder shall be taken as the base or ceiling value. Bid prices of other bidders will be loaded for every KW excess over the ceiling value as per the formula given below. Adjustment factor for excess power consumption = $(GPC-CV) \times PL \times \text{No's of}$	



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S.No	Description	Vendor to confirm
	Working Agitators GPC- Guaranteed Power Consumption quoted by bidder in KW CV- base Value i.e. lowest quoted power consumption in KW PL- Power Loading @ 2,46,000 INR per KW Exchange rate as a bid opening date will be considered for evaluation	
16.0	LIQUIDATED DAMAGES FOR POWER CONSUMPTION	
	If actual Power Consumption during prove out (or) PG Test operating at the duty point exceeds the value guaranteed by the bidder, liquidated damages for shortfall in performance shall be deducted from contract price as per the formula given below Liquidated damage deductible in USD = (APC-GPC) X P X Total no of agitators Where GPC- Guaranteed Power Consumption quoted by bidder in KW APC- Actual Power Consumption in KW N- Total Number of Agitators P- Penalty @ 5,84,000 INR per KW	
17.0	DEFECT LIABILITY/WARRANTY	
1.	The Bidder warrants that the equipment's/items shall be free from defects in the design, engineering, materials and workmanship of the Plant and Equipment supplied and of the work executed. The Warranty Period shall be thirty six (36) months from the date of supply or twenty four (24) months from the date of commissioning whichever first occurs. If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and Equipment supplied or of the work executed by the Bidder, the Bidder shall promptly, in consultation and agreement with BHEL regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Bidder shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect.	
2.	In case of failure of the equipment to meet the guarantee, UPRVUNL/BHEL reserves the right to reject the equipment. However, UPRVUNL/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement .	



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S.No	Description	Vendor to confirm
18.0	FIRST FILL OF CONSUMABLES:	
1.	Bidder's scope shall also include supply and filling of all chemicals, reagents, resins, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.	
2.	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the UPRVUNL/BHEL's approval herein shall be furnished within 2 months of placement of Order. On completion of erection complete list of bearings/equipment giving their location and identification marks shall be furnished to BHEL along with lubrication requirements. All types of consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.	
19.0	TRAINING	
	Successful bidder shall provide comprehensive training for UPRVUNL/BHEL Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the Agitators - Operation & Maintenance, Troubleshooting etc.	
20.0	CONFLICT	
	Bidder's equipment shall be designed for and shall meet the service, performance and minimum level of quality requirements specified. Bidder shall be solely responsible for advising BIFPCL in writing of any conflicts between the specifications and Bidder's design, including performance and levels of quality. Bidder agrees that its obligations, liabilities and warranties shall not be diminished or extinguished due to its meeting the requirements of the Specification.	
21.0	DOCUMENTATION	
A	DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER	
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial evaluation as per Annexure VI. Annexure VI documents are required for proper evaluation purpose and vendors are requested to comply with above in all respect.	

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S.No	Description	Vendor to confirm
B	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT	
	The Successful bidder shall submit necessary data, documents and drawings for review, approval as specified under Annexure VI. Drawings that are reviewed by the UPRVUNL/ BHEL will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must be resolved before a resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or questions, bidder shall place a “hold” on those items or areas of design. UPRVUNL/ BHEL reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions. All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub components and necessary set of operation & maintenance manual as asked by UPRVUNL must be furnished by bidder in soft and hard copy forms. For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract. Unless agreed otherwise, Ten (10) hard copies and eight (08) sets of electronic copies of all documents are to be submitted in the English language. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per UPRVUNL requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team.	



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22. REFERENCE DOCUMENTS

UPRVUNL MOTOR SPECIFICATION



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23.0 ANNEXURES

ANNEXURE-I Qualification requirement

The Bidder is required to meet the provenness criteria and/or qualification requirement for critical equipment and bought out items as per criteria stipulated below:

Agitators for the Wet Limestone based Flue Gas Desulphurization (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previous experience of manufacturing and supplying the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year prior to 02nd Nov 2015.

Name of Equipment	Type of Equipment	Application	Equipment Rating
Agitators	Vertical / Horizontal	Wet Limestone based FGD application in Coal fired power plant	Agitator rating not less than that supplied for 500 MW or higher unit for similar application

Bidder shall offer and supply only the type of the above equipment(s) for which he is qualified.

Performance certificate from End user has to be provided meeting the Qualification Requirement.



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ANNEXURE – II- TECHNICAL DATA SHEET (To Be filled for each type of Agitator)

Sl.no	General	Units		Description
1.1	Project		:	Panki 1x660 MW, Uttar Pradesh
1.2	Ultimate Customer		:	UPRVUNL
1.3	Location		:	Flue Gas Desulphurization (FGD) Plant
1.4	Order Number/Enquiry No		:	
1.5	Agitator Name		:	
1.6	Service		:	
1.7	Installation		:	
1.8	No. of Agitator per Tank		:	
1.9	Total No's of Agitator for the unit.		:	
1.10	Type of Agitator		:	
1.11	Model Number		:	
1.12	No of Stage(No of propeller per Agitator)		:	
1.13	Mounting of Agitator		:	
1.14	Mounting of Gear Head		:	
1.15	Mounting of Motor		:	
2	Performance Details			
a.	Input power at Motor terminal at highest frequency and Maximum liquid level in tank	KW	:	
b.	Input power at Motor terminal at Normal frequency (50Hz) and Normal liquid level in tank	KW	:	
c.	Motor rating	KW	:	
d.	Rated speed	rpm	:	
e.	Direction of rotation of Motor and Gear box viewed from Motor non-driving end		:	Motor (CW/CCW) & GH(CW/CCW)
f.	Direction of rotation of Agitator viewed from Gear head end		:	(CW/CCW)
g.	Minimum submergence required over blade center line for continuous operation	mm	:	
h.	Impeller diameter	mm	:	
i.	Minimum clearance required below impeller center line	mm	:	
j.	Maximum liquid level over propeller center line up to which Agitator can work without overloading of motor at 50Hz	mm	:	
3	Construction Features			
3.1	Impeller			



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	a) Type		:	
	b) Diameter(tip to tip)	mm	:	
	c) Hub diameter	mm	:	
	d) No of blade per Impeller		:	
	e) Thickness of blade	mm	:	
3.2	Tube thickness, if any	mm	:	
3.3	Shaft diameter at coupling (GH-Agitator)	mm	:	
3.4	Length of Top shaft	mm	:	
3.5	Connection Details			
	• Blade to Hub:		:	
	• Hub to Shaft/Tube		:	
	• Line Shaft to Line shaft		:	
	• Line shaft to top shaft		:	
3.6	Bearings in Gear Head			
	Thrust bearings Housing			
	a) Type		:	
	b) Make		:	
	Bearing Number			
	• Radial Bearing		:	
	• Radial Bearing		:	
	• Thrust Bearing		:	
	c) Type of lubrication		:	
	d) Lubricator		:	
3.7	Coupling between Agitator & Gear Head			
	a) Type		:	
	c) Rating	KW/rp m	:	
3.8	Stuffing Box/Mechanical Seal			
	a) Type		:	
	b) Details of gland packing		:	
	c) No of packing		:	
	d) Cooling water		:	
	e) Lubrication type		:	
	f) Qty of grease and interval of lubrication.		:	
4	Material of Construction			
a.	Blade of Impeller		:	
b.	Hub of Impeller		:	
c.	Base Plate/Gear head Stand		:	
d.	Line Shaft & Line shaft Coupling		:	
e.	Impeller Shaft		:	
f.	Top Shaft		:	
g.	Gland Sleeve		:	
h.	Location of Thrust bearing		:	
i.	Coupling guard		:	



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j.	Fasteners in Wet region		:	
k.	Fasteners in Dry region		:	
l.	Stuffing Box		:	
m.	Gland		:	
n.	Gland packing		:	
5	Weight			
	a) Bare Agitator weight	Kgs	:	
	b) Rotating Assembly weight	Kgs	:	
	c) Motor weight	Kgs	:	
	d) Gear Head weight	Kgs	:	
	e) Wt. of the equipment, (a+c+d)		:	
	f) Heaviest single piece component of Agitator to be handled.	Kgs	:	

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

BIDDER SIGN WITH SEAL AND DATE:



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

ANNEXURE III- SCHEDULE OF GUARANTEES TO BE FILLED INDEPENDENTLY FOR EACH TANK'S (AGITATORS)

Sl. No.	Description	Unit	Data
1	Rated Input Power at Motor Terminal at Normal water level and at Normal voltage and Frequency (*)	KW	
2	Possible Rate of deposit of solid particles at tank bottom of total solid particle inflow/outflow	%	
2	Noise level at a distance of 1.0 meter from the equipment at site	dB(A)	85
3	Maximum vibration velocity at site) (RMS)	mm/sec	2.3
4	Life of Agitator components parts from the date of Commissioning for continuous operation		24 months
	Anti-friction Bearing		25000 hrs.

Note:

- (*) -Any excess KW at motor terminal will be liable to charge (Power Loading) @ 3275 USD/KW (###)
–Data to be filled up by vendor

SIGNATURE OF VENDOR _____

NAME _____

DESIGNATION _____



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

ANNEXURE IV- VENDOR TO PROVIDE THE LIST OF COMMISSIONING SPARES

Sl. No.	Description	Quantity
1.		
2.		
3.		
4.		
5.		

Qty will be Number or Set as applicable

- Vendor to identify each and every item which they consider as commissioning spares. Each and every part that is considered to fall under guarantee clause shall be indicated in this list.
- Rubber items which are having a **Shelf-Life** will also be considered as wear item.

SIGNATURE OF VENDOR _____

NAME _____

DESIGNATION _____



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

ANNEXURE – IV

a) REFERENCE LIST as per format shown below. (Atleast two reference plant details)

S.No	Project Name , Customer & Plant capacity	Coal fired Yes/No	Wet Limest one Based FGD Yes/No	Model	Size of Tank	Type / Hor / Vertical	Speed rpm	Year of Commg	Qty

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

BIDDER SIGN WITH SEAL AND DATE:



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

ANNEXURE – V- LIST OF DEVIATIONS/EXCEPTIONS TO THE ENQUIRY DOCUMENT

Sl No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER

NAME

DESIGNATION

BIDDER SIGN WITH SEAL AND DATE:

**TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)****PANKI:FGD:AGITATORS:R00****ANNEXURE -VI****A) DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER / AWARD OF CONTRACT:**

Sl. No.	Description	With Proposal	After Award Of Contract
1.	Compliance of specification	yes	--
2.	Deviation List	Yes	--
3.	Performance Curve	yes	Yes
4.	General Assembly Drawing	Yes	Yes
5.	Motor Sizing Calculation	Yes	--
6.	Cross-sectional Drawing	Yes	Yes
7.	Data Sheet	Yes	Yes
8.	Sub-Vendor List	yes	Yes
9.	Material Test Certificates	--	yes
10.	Erection check list	--	yes
11.	Pre Commissioning Check List	--	yes
12.	Scope of Supply	Yes	--
13.	Quality Plan	yes	Yes
14.	Operation & Maintenance Manual	--	10 copies + CD
15.	Spare List (Mandatory., Recommended)	Yes	Yes
16.	Start-up & Commissioning Spare	yes	Yes
17.	List of Special Tools	Yes	Yes
18.	Delivery Schedule	yes	yes
19.	Test Arrangement	Yes	Yes
20.	T-N curve	Yes	Yes
21.	Motor Drawing	Yes	Yes
22.	Curve of Motor (T-N, Efficiency, time etc.)	Yes	Yes
23.	Catalogue	Yes	--

SIGNATURE OF VENDOR

NAME

DESIGNATION



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

ANNEXURE-VII

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING (Applicable for supplies from outs

Refer to Specification No: PE-TS-888-100-A001 for detailed specification on Seaworthy packing.

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

BIDDER SIGN WITH SEAL AND DATE:



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

ANNEXURE-VIII

INSPECTION & TESTING

Refer to all clauses for Inspection & testing requirements. Sample QP enclosed.

Sl. no.	Item	Category	Unit of Quantity	Quantity	Component
1	Material Test	Shop Inspection	Set		
2	DP Test	Shop Inspection	Set		
3	Radiographic	Shop Inspection	Set		
4	Magnetic Particle Test	Shop Inspection	Set		
5	Ultrasonic	Shop Inspection	Set		
6	Hydro test	Shop Inspection	Set		
7	Inter Granular Corrosion Test	Shop Inspection	Set		
8	Dynamic Balancing Test	Shop Inspection Testing	Set		
9	Performance Test (Internal)	Shop Testing	Set		
10	Power measurement at site	Site Testing	Set		
11	Vibration Test	Shop Testing	Set		
12	Vibration Test	Site Testing	Set		
13	Noise Test	Shop Testing	Set		
14	Noise Test	Site Testing	Set		

Note:

- Enlarge the table to incorporate items
- Set to be interpreted as a complete unit

Quality plan will be as per approval given by end customer. This will be given during contract stage.

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

ANNEXURE-IX

LT MOTOR DATASHEET

UPRVUNL format- LT motor Data sheet

DE-1	LT MOTORS	
A.	GENERAL	
1.	Manufacturer & Country of origin.	
2.	Equipment driven by motor	
3.	Motor type	
4.	Quantity	
B.	DESIGN AND PERFORMANCE DATA	
1.	Frame size	
2.	Type of duty	
3.	Type of enclosure /Method of cooling/ Degree of protection	
4.	Applicable standard to which motor generally conforms	
5.	Efficiency class as per IS 12615	
6.	(a)Whether motor is flame proof	
	(b)If yes, the gas group to which it conforms as per IS:2148	
7.	Type of mounting	
8.	Direction of rotation as viewed from DE END	
9.	Standard continuous rating at 40 deg.C. Ambient temp. as per Indian Standard (KW)	
10.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)	
11.	Maximum continuous load demand of driven equipment in KW	
12.	Rated Voltage (volts)	
13.	Permissible variation of :	
	a. Voltage (Volts)	
	b. Frequency (Hz)	
	c. Combined voltage and frequency	
14.	Rated speed at rated voltage and frequency(RPM)	
15.	At rated Voltage and frequency:	
	a. Full load current	
	b. No load current	
16.	Power Factor at	



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

	a. 100%/75%/50% load	
	b. NO load	
	c. Starting.	
17.	Efficiency at rated voltage and frequency,	
	a.100% load	
	b. 75% load	
	c. 50% load	
18.	Starting current (amps) at	
	a. 100 % voltage	
	b. 85% voltage	
	c. 80% voltage	
19.	Minimum permissible starting Voltage (Volts)	
20.	Starting time with minimum permissible voltage/80%/ 100%/ 110%	
	a. Without driven equipment coupled	
	b. With driven equipment coupled	
21.	Safe stall time with 100% ,110% & 80% of rated voltage	
	a. From hot condition	
	b. From cold condition	
22.	Torques :	
	a. Starting torque at min. permissible voltage(kg-mtr.)/ rated voltage	
	b. Pull up torque at rated voltage.	
	c. Pull out torque	
	d. Min accelerating torque (kg.m) available at lowest permissible starting voltage	
	e.Rated torque (kg.m)	
23.	Stator winding resistance per phase (ohms at 20 Deg.C.)	
24.	GD ² value of motors	
25.	No of permissible successive starts when motor is in hot	
26.	Locked Rotor KVA Input	



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

27.	Locked Rotor KVA/KW	
28.	Vibration limit :Velocity (mm/s)	
29.	Noise level limit (dBA)	
C.	CONSTRUCTIONAL FEATURES	
1.	Stator winding insulation	
	a. Class & Type	
	b. Winding Insulation Process	
	c. Tropicalised (Yes/No)	
	d. Temperature rise over specified maximum ambient temperature of 50 deg C	
	e. Method of temperature measurement	
	f. Stator winding connection	
2.	Main Terminal Box	
	a. Type	
	b. Location(viewed from NDE side)	
	c. Entry of cables(bottom/side)	
	d. Recommended cable size(To be matched with cable size envisaged by owner)	
	e. Fault level (MVA),Fault level duration(sec)	
	f. Cable glands & lugs details (shall be suitable for power cable)	
3.	Type of DE/NDE Bearing	
4.	Motor Paint shade	
5.	Weight of	
	a. Motor stator (KG)	
	b. Motor Rotor (KG)	
	c. Total weight (KG)	
D.	List of accessories.	
1. 3.	Space Heaters (Nos./Power in watts/supply voltage)	
2.	Terminal Box for Space Heater (Yes/No)	
3.	Speed switch (Yes/No) No of contacts and contact ratings of speed switch	



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

4.	Insulation of bearing (Yes/No)	
5.	Noise reducer(Yes/No)	
6.	Grounding pads	
	i) No and size on motor body	
	ii) Nos on terminal Box	
7.	Any other fitments	
E.	List of curves.	
1.	Torque speed characteristic of the motor	
2.	Thermal withstand characteristic	
3.	Starting. current Vs. Time	
4.	Starting. current Vs speed	
5.	P.F. and Effi. Vs Load	

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

BIDDER SIGN WITH SEAL AND DATE:



TECHNICAL SPECIFICATION OF AGITATORS – Panki (1 X 660 MW)

PANKI:FGD:AGITATORS:R00

ANNEXURE-X

APPROVED LT MOTOR VENDORS

CHAPTER 17 : AC & DC MOTORS**1.00 MOTORS****1.1 SCOPE**

This specification is intended to cover design, manufacture, assembly and testing of AC Squirrel Cage Induction Motors for use in Thermal Power Plants and is supplement to the driven equipment specifications under which these motors are being procured for the project.

SITE CONDITIONS

Site conditions are covered in 'Project Data', contained in specification of the driven equipment.

1.2 Gases, Fumes & Dust Particles

1.2.01 General - Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical, conducive to fungus growth.

1.2.02 Dust Particles

- 1 Outdoor locations - Heavily dusty with abrasive dust and coal particles of size five (5) to hundred (100) microns present in atmosphere in large quantity.
- 2 Indoor Locations.
 - 2.1 Coal conveyors - As for outdoor as per clause 1.02.02.1 above.
 - 2.2 Other locations - Lightly dusty with abrasive dust and coal particles of size five (5) to twenty (20) microns present in atmosphere.

1.2.03 Special Fumes

- 1 Water treatment plant and acid cleaning room - Acid and alkali fumes present.
- 2 Fuel oil pumping areas & Hydrogen generation plant - Explosive fumes (flameproof motors required).

1.2.04 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.3 LOCATION OF MOTOR - As required

1.4 **SPECIFICATIONS & STANDARDS**.....Motors shall comply with the latest revisions of all relevant standards of BIS (IS-325, IS-900, IS-996, IS-1231, IS-1885, IS-2148, IS-2223, IS-2253, IS-2254, IS-2848, IS-3202, IS-4029, IS-4691, IS-4722, IS-4728, IS-4889, IS-6362, IS-7816, IS-8223, IS-8789, IS: 12615, IS:3177 and IEC : 60034 3Φ Induction motor) except as modified herein or in driven equipment specification.

Motors conforming to BS or IEC Publications, which ensure equivalent quality shall also be acceptable. In case of any difference between IS Specification/International Standards (IEC; NEMA etc.), this motor specification prevails.

1.5 TYPE

1.5.1 AC Motors:

- a) Squirrel cage induction motor suitable for direct-on-line starting.
- b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg. C ambient temperature), shall be **Efficiency class-IE2**, conforming to IS 12615, or IEC:60034-30.
- c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

1.5.2 DC Motors Shunt wound.

1.6 VOLTAGE (NOMINAL)

1.6.1 LV Motors

For motors upto and including 200 KW - Four hundred fifteen (415) V.

1.6.2 MV MOTORS

For motors above 200kW upto and including 1500kW, Three point three (3.3) kV.

For CHP conveyors motor above 160 kW, 3.3 kV, AC supply is to be used. However all the motors on stacker reclaimer shall be on 415 V AC only.

1.6.3 HV Motors

For motors above 1500kW - eleven(11) KV

1.6.4 All motors are to be designed for system grounding described in "System Particulars" under site information of the Driven Equipment Specification.

1.7 **FREQUENCY (NOMINAL)** - fifty (50) Hertz

1.8 NUMBER OF PHASES - Three (3)

1.9 SPEED - As required by the driven equipment

1.10 TYPE OF STARTING :

Direct on-line (VFD/Soft-starter/star/delta starting in special cases)

1.11 DUTY

1.11.1 Continuous motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment,

whichever is higher, considering highest system frequency and voltage variation. Crane motors shall be rated for S4 duty, 40% cyclic duration factor. If however, a higher margin is stipulated in the accompanying driven equipment specification, the higher stipulated margin shall prevail.

- 1.11.2 All HT motors shall have vibration pads for mounting vibration detectors.
- 1.11.3 All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.
- 1.11.4 Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range.
- 1.11.5 All LV motors rated 0.37kW and higher with S1 duty shall be compulsorily be of energy efficiency level IE 2 as per IS 12615:2011.

Motors rated above 37kW shall have efficiency higher than 0.92 and high power factor of atleast 0.88.

1.12 **SUPPLY VARIATIONS**

Motors shall be capable of running continuously at full load under following variations in power supply:

- 1.12.1 All equipments shall be suitable for rated frequency of 50 Hz with a variation of (+) 3% and (-)5%, voltage variation of ($\pm$) 6% for 11 kV & 3.3 kV and ($\pm$)10% for 415V and 10% (absolute sum) combined variation of voltage and frequency unless specifically brought out in the specification.

1.13 **ABNORMAL CONDITIONS CAPABILITY**

Motor shall have following capabilities as specified design ambient temperature:

- 1.13.1 The motors shall also be capable of running up again after voltage collapse to about 40% for approximate duration of 0.5 sec. Subsequent rise in voltage to 70% and further to 80% and 100%, the total duration not exceeding 20 sec.

1.13.2 Low Voltage Running :

Motor shall be capable of running satisfactorily at seventy five (75) percent nominal voltage for five (5) minutes.

1.13.3 Momentary Low Voltage Withstanding :

Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.

1.14 **STARTING CAPABILITY**

1.14.1 Low Voltage Starting :

Motor shall be capable of starting and accelerating to full speed at full load (including loaded equipment e.g. mills and conveyors etc) at eighty (80)

percent nominal voltage at motor terminals. Mill motors may be permitted to start with terminal voltage not below 90%.

- 1.14.2 Cold Motor Starting Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.
- 1.14.3 Hot Motor Starting Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.
- 1.14.4 Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.
- 1.14.5 Break-away Starting Current Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:
- 1.14.5.1 Motors above 1500 KW upto 4000kW 600% without any positive tolerance except for ID Fan Motor.
- 1.14.5.2 Motors above 4000 KW 450%. Not subject to any positive tolerance.
- 1.14.5.3 For D.C. Motors the starting current shall be limited to 2 times full load current.

1.14.5.3 **Starting voltage requirement**

- a) All Motors (except Mill Motors)
- 80% of rated voltage for Motors upto 4000 kW
 - 75% of rated voltage for Motors above 4000 kW
- b) For Mill Motors:
- 85% of rated voltage for Motors above 1000 kW
 - 90% of rated voltage for Motors below 1000 kW

Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.

1.14.5.4 **Starting Time**

- 1.14.5.4.1 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.
- 1.14.5.4.2 For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.
- 1.14.5.4.3 For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.



1.14.5.5 Torque Requirements:-

1.14.5.5.1 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% of motor full load torque.

1.14.5.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty Motors.

1.15 SAFE STALL TIME

1.15.1 To avoid problem in selecting standard protective relays without using speed switches, safe stall time under hot conditions (corresponding to 110% nominal voltage at motor terminals) shall be more than the accelerating time (corresponding to 80% nominal voltage at motor terminals) by the following minimum values :

1.15.1.01 Two (2) seconds, where accelerating time (at 80% nominal voltage) does not exceed 20 seconds.

1.15.1.02 Three (3) seconds, where accelerating time (at 80% nominal voltage) exceeds 20 seconds.

1.15.1.03 At no stage, speed switch shall be provided to achieve the above requirements mentioned under Clause No. 1.14.5.4

1.16 CLASS OF INSULATION

1.16.1 LV Motors Class F.

1.16.2 MV & HV Motors Class F

1.16.03 However temperature rise shall be restricted to limits corresponding to Class 'B' insulation for both HT & LT motors. The temperature under abnormal running conditions shall be limited to 5°C above class 'B' limits.

1.16.04 The value of the polarization index for motors above 200kW should not be less than 2 when determined according to IS: 7816.

1.17 **TEMPERATURE RISE UNDER NORMAL CONDITIONS**..... Temperature rise over specified design ambient temperature when motor is running with full load at nominal supply voltage & frequency shall not exceed the values given below:

S.No.	Specified Design Ambient Temperature	Thermometer Method	Resistance Method
1.17.01	50°C	60°C	70°C
1.17.02	45°C	65°C	75°C
1.17.03	40°C	70°C	80°C

1.18 BUS TRANSFER WITHSTAND CAPABILITY

Motors will be connected to an automatic bus transfer system and hence may be subjected to one hundred and fifty (150) percent of the nominal voltage during changeover of buses due to the vector difference between the residual voltage and incoming supply voltage and the duration of this condition may be one second. Motors shall be capable of withstanding the voltage and torque stresses developed under such conditions without damage. The manufacturer/vendor shall indicate the special precautions taken to meet the above requirements and confirm.

- 1.18.01 That about 5000 bus transfers, in lifetime of motor, shall not puncture its insulation.
- 1.18.02 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.
- 1.18.03 That the motor windings shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.
- 1.18.04 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

1.19 TYPE OF ENCLOSURE

- 1.19.01 Outdoor Motors IP 55 (Additional canopy to be provided by EPC contractor.
- 1.19.02 Indoor Motors IP 55
- 1.19.03 IP-55 degree of protection shall be achieved without application of any compound, putty etc.
- 1.19.04 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv. as detailed below:
- a) Fuel Oil area : Group IIB
 - b) Hydrogen generation plant area : Group IIC (or Group-I, Div-II as per NEC or Class-1, Gr-B, Div-II as per NEMA/IEC60034).

1.20 METHOD OF COOLING

- 1.20.1 Method of cooling shall be IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA). However, motors rated 3000kW or above can be closed air circuit water cooled (CACW).
- 1.20.2 Large capacity motors not available with above types of cooling may be accepted with IC 81 W for IC 91 W (CACW) cooling subject to the approval of the Owner.

1.21 TYPE OF MOUNTING As required for the driven equipment.**1.21 MAXIMUM MECHANICAL VIBRATIONS**

- 1.21.01 Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits

prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

1.21.02 Noise level

The noise level of motors shall not exceed 85 db (A) at 1m from operating motor measured in accordance with IS: 10265.

1.21.03 Motor body shall have two earthing points on opposite sides.

1.21.04 11 KV motors shall be offered with Separate Insulated Connector (Elastimould or Equivalent make) as per IEEE 386. The offered Elastimould terminations shall be provided with protective cover and trifurcating sleeves. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.

1.21.05 3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

1.21.06 The spacing between gland plate & centre of terminal stud shall be as per Table-I.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
UP to 3 KW	As per manufacturer's practice.
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331

Above 125 KW-upto 200 KW

203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

1.21.07 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

1.21.08 For motors rated 1500 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

1.21.09 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.

(a)	Below 110KW	:	10.0
(b)	From 110 KW & upto 200 KW	:	9.0
(c)	Above 200 KW & upto 1000KW	:	10.0
(d)	From 1001KW & upto 4000KW	:	9.0
(e)	Above 4000KW	:	6 to 6.5

1.22

WINDING & INSULATION

- (a) Type : Non-hygroscopic, oil resistant, flame resistant
- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature.
- (c) 11kV & 3.3 kV : Thermal class 155 (F) insulation.
AC motors
The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15
- (d) 240VAC, 415V : Thermal Class(B) or better
AC & 220V
DC motors

1.23

DIRECTION OF ROTATION

1.23.1

As needed by driven equipment.

1.23.2

The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

1.23.3

If, in the case of HT motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.

1.24

BEARINGS

- 1.24.1 General Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 20,000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.
- Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.
- If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.
- Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
- For MV & HV motors, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.
- When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.
- Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.
- Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.
- Bearings shall be of reputed make subject to the approval of the Owner/Consulting Engineer.
- 1.24.2 Large motors Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.
- 1.25 **SHAFT EXTENSION** Key slotted bare shaft extension of required length with key on driving end.
- 1.26 **DRAIN HOLES** Two (2) drain holes with plugs, one (1) on either end of motor at the bottom most point.
- 1.27 **LIFTING DEVICES** Motors shall be provided with eyebolts, lugs or other means to facilitate safe lifting.
- 1.28 **DOWEL PINS**..... It shall be possible to drill holes vertically inclined through motor feet or mounting flange for installing dowel pins after assembling motor and driven equipment, before despatch (for completed driving + driven

equipment assembly) or at site after erection (for separate supplies of above equipment).

1.29 **CENTERING SPIGOT**..... Flange mounted motor shall have centering spigot to match driven equipment socket.

1.30 **EASE OF MAINTENANCE**..... Motor shall be so constructed that it can be de-assembled and reassembled with ease.

1.31 **NAMEPLATES**..... Motor shall have nameplate(s) showing diagram of connections, all particulars as per IS: 325 and following additional information:

In addition, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate direction of rotation of motor.

1.31.1 Temperature rise under normal/abnormal conditions.

1.31.2 Type of bearing and recommended lubricants.

1.32 **FINISH**..... Motor shall have glossy, light grey finish No. 631 as per IS: 5 for withstanding site conditions as per Clause 1.00 above.

All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, de-rusted and given two (2) coats of primer and two (2) coats of finish paint. It is preferred that a phosphate coat is given to motor prior to application of primer coat. Motors for water treatment plant shall have Zinc Chromate base with acid resistant Epilex 4 paint.

1.33 **TERMINAL BOXES**

1.33.1 GeneralMotors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight conforming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Owner /Consulting Engineer. All terminal boxes shall be suitable for proper termination of the type and tentative size of cables specified in Clause 1.34 below, however, exact size of cables shall be furnished by Owner during engineering stage.

The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core cables are to be terminated. All HT motors shall be provided with phase segregated terminal box.

Terminal bushings and clamps shall be non-absorbent, non- inflammable, insulated material for connecting with cable.

1.33.2 **Main Terminal Box**



1.33.2.1 LV Motors Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.

1.33.2.2 MV & HV Motors Motor shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. These should be interchangeable to facilitate cable routing.

Neutral terminal box for HT motors rated above 1500 KW shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These transformers shall be supplied and mounted in the motor terminal box. In addition to above, 3 Nos. of identical current transformers shall be supplied loose for mounting in the switchgear. Stator phase terminal box may either be phase segregated or standard terminal box suitable for both top and bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable or push on type terminating Kit. Terminal leading shall be stud type or leading wire type.

1.33.2.3 Cable End Boxes.....Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables of sizes as specified in Clause 1.34 below.

Cable box shall be suitable for glanding the cables; and shall have adequate space between cable glands terminating studs to allow suitable bends of cable inside the cable box for all 3 phases of relevant cable sizes specified.

1.33.2.4 The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.

Min. fault level for MV Motors - 40 KA

Min. fault level for LV & HV Motors - 50 KA

1.33.2.5 **PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:**

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

1.33.2.6 Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes as specified in Clause 1.34 below.

1.34 **TYPE AND SIZE OF CABLES**

1.34.1 **Space Heaters**



- 1.34.1.1 For LV Motors: Two point five (2.5) mm², two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).
- 1.34.1.2 For MV & HV Motors: Six (6) mm² two core aluminium conductor PVC insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).
- 1.34.2 For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm² ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm², ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).
- 1.34.3 Bearing Temperature Indicators - For each indicator, 0.5 mm² six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.
- 1.34.4 For Moisture Detectors.....As for space heaters as per Clause 33.01.01 above.

1.34.5 **For Main Terminals**

LT Motors

1. Three (3) core cablesStranded aluminium conductor, XLPE insulated, colour coded, laid up, PVC sheathed, GI wire / strip armoured, FRLS PVC jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).
2. Single core cablesStranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC jacketed overall, 650 / 1100V grade, heavy duty cable as per IS: 1554 (Part-I).

HT Motors

1. Three (3) core cables stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, PVC sheathed, GI wire/strip armoured FRLS PVC jacketed overall, 6.6 KV / 11 KV grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

The size and no. of cable to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box, cable gland and lugs suitable for the same.

Cable size may be increased in some cases because of large number of cables in under-ground ducts or because of voltage drop consideration. The supplier shall supply with terminal box and cable accessories suitable for higher size of cable at no extra cost.

1.35 **EARTHING**

- 1.35.01 General..... Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.



- 1.35.02 LV Motors.....At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.
- 1.35.03 MV & HV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.
- 1.36 **EMBEDDED TEMPERATURE DETECTORS**.....HT motor shall be provided with six (6) Nos. duplex resistance temperature detectors (RTDs) embedded in stator winding at locations where high temperatures are expected. In addition one (1) duplex type RTD shall be provided in each bearing. The RTDs shall be 3 wire duplex platinum resistance type having a value of 100 ohms at 0 Deg.C
- 1.37 **BEARINGS TEMPERATURE INDICATORS**..... HT motors shall be provided with dial type two (2) bearing temperature indicators and will have two (2) sets of contacts, each set having 2 NO + 2 NC contacts rated for 5A at 240V AC and 0.5A at 220V DC. One set will be set to operate at lower value to give alarm and other set at a higher value to trip the motor.
- 1.38 **SPACE HEATERS**.....Valve / Damper actuator motors; and Motors above 30 KW shall be provided with one (1) or two (2) space heaters suitable for 240V, 50 Hertz single phase AC supply and of adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation or deterioration of insulation during shut down. Heaters shall be mounted inside the motor in accessible locations so that their removal and replacement is simple. Motors upto 30 kW shall have stator windings suitable for connections to 24V, 50 Hz AC supply for space heating.
- Motors upto 30 kW shall have stator windings suitable for connection to 24V, 50 Hz ac supply for space heating
- The terminals of space heaters shall be brought out to a separate totally enclosed dust proof and weatherproof terminal box.
- 1.39 **HOT AIR TEMPERATURE DETECTOR**
- If the motor is of CACA or CACW enclosure, a thermometer with alarm contracts in hot air circuit shall be provided.
- 1.40 **WATER FLOW INDICATOR**
- If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits.
- 1.41 **MOISTURE DETECTORS**.....Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

1.42 **BED PLATE**.....Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.

1.43 **OTHER ACCESSORIES**..... Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.

1.44 **TYPE TEST**

1.44.01 **HT MOTORS**

- a) The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract.
- b) The type tests shall be carried out in presence of the Purchaser's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Purchaser's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
- c) In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Purchaser's for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Purchaser's reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
- d) Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Purchaser's either at third party lab or in presence of client representative and submit the reports for approval.

e) **LIST OF TYPE TESTS TO BE CONDUCTED**



The following type tests shall be conducted on each type and rating of HT motor

- i) No load saturation and loss curves upto approximately 115% of rated voltage
- ii) Measurement of noise at no load.
- iii) Momentary excess torque test (subject to test bed constraint).
- iv) Full load test(subject to test bed constraint)
- v) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

f) LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

The following type test reports shall be submitted for each type and rating of HT motor

- i) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- ii) Terminal box-fault level withstand test for each type of terminal box of HT motors only.
- iii) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15
- iv) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

1.44.02

LT Motors

- a) LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Purchaser's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
- b) However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Purchaser's shall conduct all such tests under this contract at no additional cost to the Purchaser either at third party lab or in presence of client representative and submit the reports for approval.

1.44.03

LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

1 x 660 MW – Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only

- i) Measurement of resistance of windings of stator and wound rotor.
- ii) No load test at rated voltage to determine input current power and speed.
- iii) Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
- iv) Full load test to determine efficiency power factor and slip .
- v) Temperature rise test.
- vi) Momentary excess torque test.
- vii) High voltage test.
- viii) Test for vibration severity of motor.
- ix) Test for noise levels of motor(Shall be limited as per clause no 1.21.01 of this section)
- x) Test for degree of protection and
- xi) Over speed test.
- xii) Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

1.44.04 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

1.45 INFORMATION WITH PROPOSAL

1.45.1 AC Motor Data Sheet.

1.45.2 Dimension Drawing/Foundation load details of motor and driven equipment.
1.45.03 Manufacturer's catalogue showing constructional details.

1.46.00 **INFORMATION ON AWARD OF CONTRACT**.....Within six (6) weeks from the date of award of the Contract, following shall be furnished:

1.46.01 Motor Data Sheet.

1.46.02 Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.

1.46.03 Following characteristics curves:

1.46.03.01 Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment.

1.46.03.02 Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage

1.46.03.03 Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.

1.46.03.04 Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.



- 1.46.03.05 Efficiency, power factor, current and speed versus power output curves.
- 1.46.03.06 Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage.
- 1.46.03.07 Negative phase sequence current withstand characteristics.

1.47 COMMISSIONING CHECK LIST (HT MOTORS)

A PRELIMINARY CHECKS

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box
6. Checking stator (motor air gap) Check – Grease lubrication (for ball or roller bearing) is adequate if the motor was in storage for very long period replace the grease, by fresh grease after flushing the bearing clean. Excess grease in the bearing (housing ... is overheat of bearings) Check the free rotation of the rotor in decoupled condition. Check the air gap between stator and rotor at four positions 90° apart at driving and non-driving end. Compare the recorded values with factory results. For slip ring motors : with starting resistances.
 - a) Check the variation of resistance
 - b) Check brush lifting and slip ring short.

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Measure resistance of motor winding (in case of large motors)
4. Control and interlocks should be checked
5. Motor protection relay to be calibrated
6. Phase sequence and direction of rotation
7. Other than DOL scheme to be checked example trafo starts
9. Measure starting current starting timer and no load current
10. On load operations starting and running currents (observed vibrations, temperatures of bearings and body)
11. On load operation, starting and running currents (observed vibrations, temperatures of bearings and body)
12. In case of forced water cooling of start or check winding temperatures as ready by built in RTDs.
13. Water level (start up cooling) low to be checked for limit switch operation.

1.48 COMMISSIONING CHECK LIST (LT MOTORS)**A PRELIMINARY CHECKS**

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Over load and short circuit relay tests and settings
4. Control and interlocks should be checked
5. Phase sequence and direction of rotation
6. Operation of timer in case of star delta starting
7. Measure starting current starting timer and no load current
8. On load operations starting and running currents

1.49 DC MOTOR SPECIFICATION

DC Motor will be of continuous duty type totally enclosed fan cooled (TEFC) having IP-54 degree of protection suitable for 220 V DC supply. DC motor will be shunt wound type having high torque characteristic suitable for Bi-directional rotation at rated speed and output. The general constructional features and details of DC motor will be in line with details/ particulars stipulated in the specification for AC squirrel cage induction motors.

Contractor will furnish the data in respect of DC motors.

DATASHEET

Auxiliary power supply		
1.1	HV supply	
	11kV, 3 Φ , 3W, 50 Hz non effectively earthed	Motors rated above 1500 kW
	Fault level	50 kA for 1 second
1.2	MV supply	
	3.3kV, 3 Φ , 3W, 50 Hz non effectively earthed	Motors above 200kW upto and including 1500kW
	Fault level	40 kA for 1 second
1.3	LV supply	
	415V, 3 Φ , 3W, 50 Hz effectively earthed	Motors below and including 200kW
	Fault level	50kA for 1 second
	110V, 1 Φ , 2W, 50 Hz effectively earthed	Lighting, space heating, AC control and protective devices
1.4	DC supply	
	220V, 2W, unearthed	DC alarm, control and protective devices.
	Fault level	25 kA for 1 second
2	Range of variation	As indicated in the specification
2.1	AC supply	
	voltage	-----
	Frequency	-----
	Combined voltage & frequency	-----
2.2	DC supply	198 to 240 V
Note: During starting of largest motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.		

SL. NO.	ITEM	NTPC APPROVED VENDORS	PLACE	QP CATEGORY	NTPC Type Test Requirements & Quality Plan/Check Lists Requirement	Remarks
04	LT MOTORS	a) KEC c) CGL b) SIEMENS c) ABB a) BBL b) NGEF c) Marathon d) Jyoti e) LHP (For other PMD vendors except above NTPC approved vendors, pl refer Sln. 4 under important notes in page no:11)	Bangalore/ Hubli (Up to 90KW) Ahmednagar Mumbai Faridabad up to 55KW/ Bangalore above 55KW Mumbai Hubli (up to 15KW) Kolkata Vadodara Solapur	Please refer remark column for Categorization Please refer remark column for Categorization	BAP/QR/ G501 & G502 /LTM:012 Rev NO: 00 dt 17 05 2018 ** Acceptance of Motor rating between 30KW to 50 KW is based on NTPC Review of Routine Test Inspection report as per IS 325 Witnessed by BHEL/BHEL AIA ie Main contractor along with COC of the manufacturer and the contractor confirming as follows: "It is hereby confirmed that the above mentioned motor was /motors were manufactured taking care of NTPC specific requirements regarding ambient temperature, voltage and frequency variation, hot starts , pull out torque, starting KVA/KW, temperature rise, distance between centre of stud and gland plate, space heater and in accordance with approved drawing /data sheets" ##Acceptance of Motor less than 30KW is based on COC of the manufacturer and the contractor conforming as follows: "It is here by confirmed that the above mentioned motor/motor was / were manufactured taking care of NTPC specific requirements regarding ambient temperature, voltage and frequency variation, hot starts , pull out torque, starting KVA/KW, temperature rise ,distance between centre of stud and gland plate and tested in accordance with approved drawing /data sheet".	Cat I Above 50 KW and up to 200KW NTPC insp as per appd RQP/MQP Cat-II **From 30KW to 50KW BHEL Inspection # Cat-III Up to 30KW

Prepared by: 
(Ch. Anil Singh)
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(S. Sheela)
Dy. Manager/QA (Electrics) & System

Approved by: 
(K. Gandhi Parimalam)
DGM / QA (Electrics)

VOLUME IIB

**TECHNICAL SPECIFICATION
FOR
SEAWORTHY PACKING FOR EXPORT JOBS**

SPECIFICATION NO. PE-TS-888-100-A001



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI, INDIA**



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
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1.0 Purpose

The purpose of this specification is to describe minimum packing requirements for the different items/equipment for all export Project and also to define marking and shipping requirements during transportation by ship, road and air for all export jobs.

2.0 SCOPE

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required. Workmanship and materials used shall be of high standard meeting the technical requirements and in accordance with best commercial export packing practices. Vendor shall be responsible for sea worthy export packing, however it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the BHEL/Purchaser. Vendor shall submit the packing procedure for its equivalent for purchaser's approval during detailed engineering.

The scope this specification is to define VENDOR's responsibilities in terms of:

- Preservation of the GOODS/items/equipments before packing.
- Packing of the GOODS for road, rail, sea and/or air transportation to desired destination i.e. project site
- Making cases/crates
- Chemical Treatment/Fumigation before packing to prevent fungus, damage due to termite, borer, rats, etc.
- Marking of cases/crates.
- Other Services required.

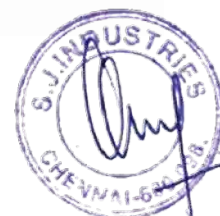
3.0 Application

This specification is applicable to all the goods to be transported to project site and requires to be in transit for longer duration. *However, for "Misc cable erection items", "Fire sealing system" & "Exothermic welding material", the packing requirements shall be as per the procurement specification.*

4.0 Definitions

- "BHEL" : Main EPC vendor
- "OWNER" : Customer for a particular export project.
- "VENDOR" : Company(ies)/VENDOR(s) to whom the BHEL has placed Purchase Order for GOODS/ items/system/package.
- "GOODS": means all or part of the articles, material, equipment supplies including technical documentation, as described in the Purchase Order, to be supplied by VENDOR.
- "PACKER": Packaging Company to whom VENDOR intends to sub-contract the packing in case they do not have own packing capability/facilities .
- "FREIGHT FORWARDER" : Means the Company responsible for performing freight forwarding activities.

5. General Information



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
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The following requirements are intended as minimum requirements, and compliance to these requirements in no way absolves or relieves VENDOR of any responsibility or obligation outlined in the Purchase Order. In all circumstances, the packing will be designed and constructed in order to support GOODS during transportation as well as to prevent the Goods from damage due to impact, extreme climatic conditions, sun and rain. It must be ensured that the delivery of the GOODS to the jobsite by sea, road or air, in good condition.

GOODS shall be export packed in compliance with the best-established practices for international projects, in accordance with the following instructions. In the event of any conflict between these specified requirement and the established practices, specification requirement shall govern.

Due to climatic conditions and the complex transport operation(s), it is essential that protection and packing is of the highest standard. Packing means to efficiently protect the GOODS during the total transport operation; from the moment they leave the factory until they are delivered to the jobsite, including handling operations (loading/unloading) and storage.

When VENDOR do not have packing capabilities/facilities of their own and therefore intends to sub-contract, VENDOR have to inform BHEL/Purchaser of the name and address of proposed PACKER(s) for approval.

6.0 Criteria for Selection of Packaging

Packages are to be made according to categories, described in articles 8.1 to 8.5, depending on the type of materials, their fragility and size.

These categories have been established for the protection of equipment and material during multi-mode transports, i.e.: combination of overland and sea transport; containerization, air transportation.

In a general manner, the GOODS have to be packed in such a way that crates, bundles, pallets can be stored into General Purpose containers, wherever possible.

If VENDOR has any doubt about the correct method of protection or packing, he should contact BHEL/Purchaser in order to mutually agree on the adequate type of packing to be used.

Materials can be classified in following categories

- Hazardous Material
- Non-Hazardous Material
-

Further to above categorisation, non-hazardous materials can be sub- categorised for selection of packing.

6.1 Hazardous Materials

Though handling of hazardous material may is not applicable in the scope of this specification. All hazardous material must be packed in adherence to the detailed requirement relating to packing, marking and labelling set out in the most recent report of the Board's Standard Advisory Committee on the Carriage of Dangerous Goods in Ships for sea freight, and the Restricted Articles Regulations, laid down by the International Air Transport Association for airfreight.

6.2 Non-Hazardous GOODS

The scope of this specification is to provide necessary guidelines for packing for power plant equipment, components, Pipings & Valves, Fittings, other structural items, electrical items, spare parts and erection materials. The procedure is defined in subsequent paragraphs in details in clause no. 8.0.



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7.0 Marking Instructions & Despatch details, Storage Code

7.1 Marking Instructions & despatch details

Packages and crates will be marked with indelible black paint, resistant to seawater. Marking must be perfectly legible.

The shipping marks, which will be as per fig-13, shall be stencilled on two sides and one end in clear characters at least 5 centimetres high (where crate size permits, otherwise use optimum size for each package dimension).

When the GOODS are to be shipped in containers then marking may be stencilled on one end only. However, packages must be stowed in a manner that shows these marks.

Crates containing fragile articles must be packed with special precaution against risk of breakage and must be stencilled on all sides "FRAGILE - HANDLE WITH CARE". Where crates are not to be overturned, VENDOR must show on the crates, clear and readily visible identification as per fig-12, to ensure they are kept in the correct position.

Packages/equipment of 2,000 kg or more must be marked with slinging points on all sides, in addition to the centre of gravity marks.

Number packages consecutively i.e. 1 of 10, 2 of 10, etc. Do not duplicate package numbers. VENDOR is responsible for any loss or damage caused by incorrect marking.

All cases/crates shall also be marked with the appropriate international standard graphic symbols for handling as shown in Fig 12.

As a minimum, all cases/crates are to be marked clearly on all four sides with:

- "HANDLE WITH CARE"
- "RIGHT SIDE UP"
- "KEEP DRY"

In the case of packages with a single gross weight totalling 2,000 kg and/or a height of more than 1m, the centre of gravity shall be clearly marked with the symbol on two adjoining sides. For all items of equipment with an eccentric centre of gravity this symbol shall be marked at the bottom, side and top of the package.

The slinging and lashing points shall be marked with a chain symbol.

When packing in cases/crates, these packages shall also have metal corners at the slinging points. (Fig-11)

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consigner/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one side of the boxes. An anodized aluminum plate as per details and specifications given in fig-13 shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminum packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag is to be kept inside the box at the pertinent place.



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7.2 Storage Code

The type of storage required is required to be specified, it will be shown on each packaging in **RED colour**.

- X Crates or packages to be stored outdoor without covers
- XX Crates or packages to be stored under tarpaulin
- XXX Crates or packages to be stored in covered or enclosed premises
- XXXX Crates or packages which must be stored in air-conditioned premises

8.0 GUIDELINES FOR PACKING GOODS

8.1 In the subsequent paragraphs details of different types of packings for different types of GOODS are defined. Vendor shall make packing details/procedure based on the guidelines and submit for approval.

8.1.1 Packing for Pipe, Fittings, Flanges and Valves, Structural Steel

Particular attention should be brought to pipe, fittings, flanges, valves and structural steel. Packing categories for piping and fittings will differ according to the diameter and wall thickness of these products. VENDOR shall comply with the following established practice.

IMPORTANT NOTE:

Depending on the project schedule and availability of ocean vessels, the piping and structural steel may be shipped in containers. In this event, VENDOR has to arrange the packages in such a way it allows the stuffing into Open Top in gauge containers.

8.1.2 Pipe

Where practicable, pipe lengths shall be limited to 11.8 meters.

All pipes 2" included and below shall be packed in crates. All pipes to be capped and ends sealed with waterproof tape.

Pipes over 2" up to 6", shall be bundled and banded in bundles of uniform length. Bundling is carried out with U-IRON or traversal planks, joined with threaded connecting rods with locknuts. Quantities and strapping positions depend on the lengths, with a 120 cm spacing to prevent distortion. Bundle weight shall not exceed 2,000 kg. All pipes are to be capped and ends sealed with waterproof tape (tape is not necessary if end caps are of the pre-shrunk or self-sealing type).

Pipes larger than 6" shall be shipped as single lengths with the ends capped. End caps are to be of the recessed type to enable the use of soft faced hooks, but still completely sealing the end and also protecting the weld.

All stainless steel piping must be packed separately in wooden crates. Any banding of bundles is to be with the same material.

8.1.3 Pipe Fittings, Flanges and Valves

All pipe fittings, flanges and valves up to 6", are to be packed in cases/crates. For items over 6", these may be fixed securely to a pallet base and enclosed in a crate, for protection. Where valves have actuators attached, rigidity must be ensured for the valve and actuator. The vulnerable parts of the actuator are to be completely protected within a wooden crate.

All stainless steel fittings, flanges and valves of all sizes, must be packed separately in wooden crates. Any strapping is to be with the same material.

8.1.4 Structural Steel



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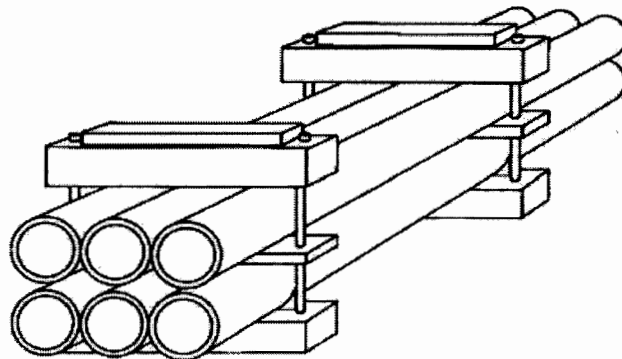
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long bolting to secure the load.

8.2 Bundling – Packing Category I

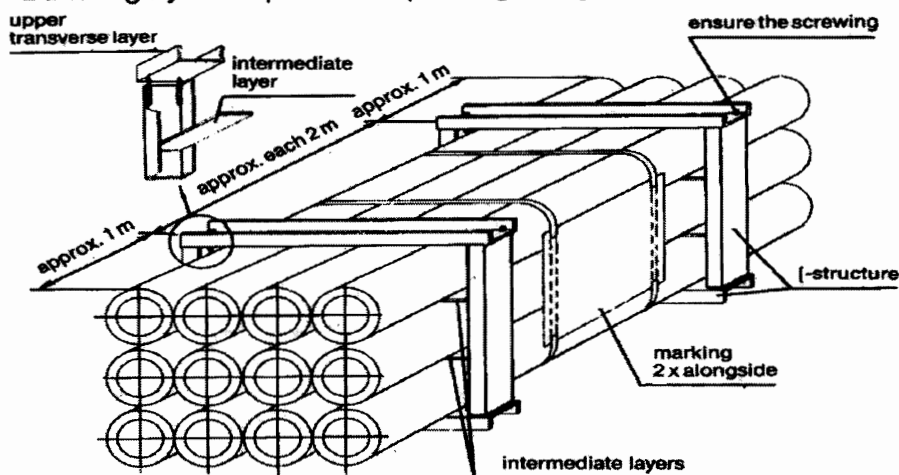
8.2.1 Type of Equipment

Equipment which is not subject to damage by corrosion or mechanical effect, i.e. pipes, piping, structural steel.

Packing category I



Bundling by U-shaped iron – packing category I A



8.2.2 Type of Construction



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- Bundling has to be effected
- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

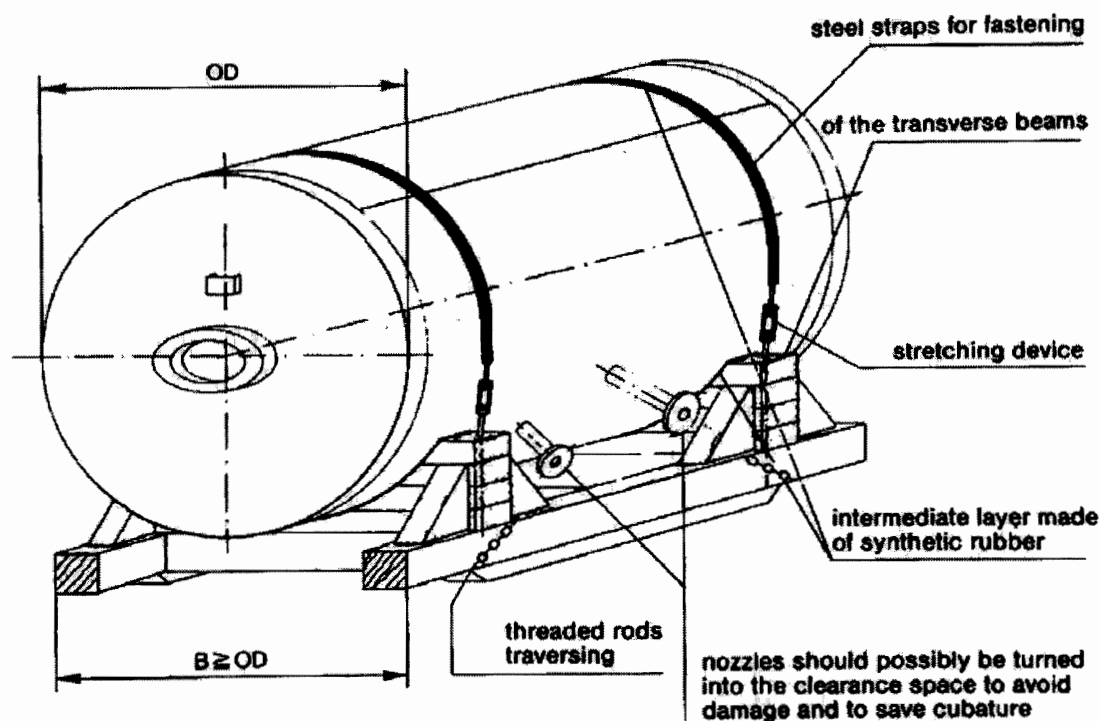
8.3.1 Type of Equipment

Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.

8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

PACKING CATEGORY-II



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8.4 Packing of GOODS in Wooden Crates/Cases/Boxes

The construction of wooden crate/cases/boxes shall be as per the details indicated in clause 9.0 & Fig 1 to 11. Details indicated in the sketches for different categories Packing crates/boxes are only for a typical equipment considered for illustration.

8.4.1 Packing Category III

8.4.1.1 Type of Equipment

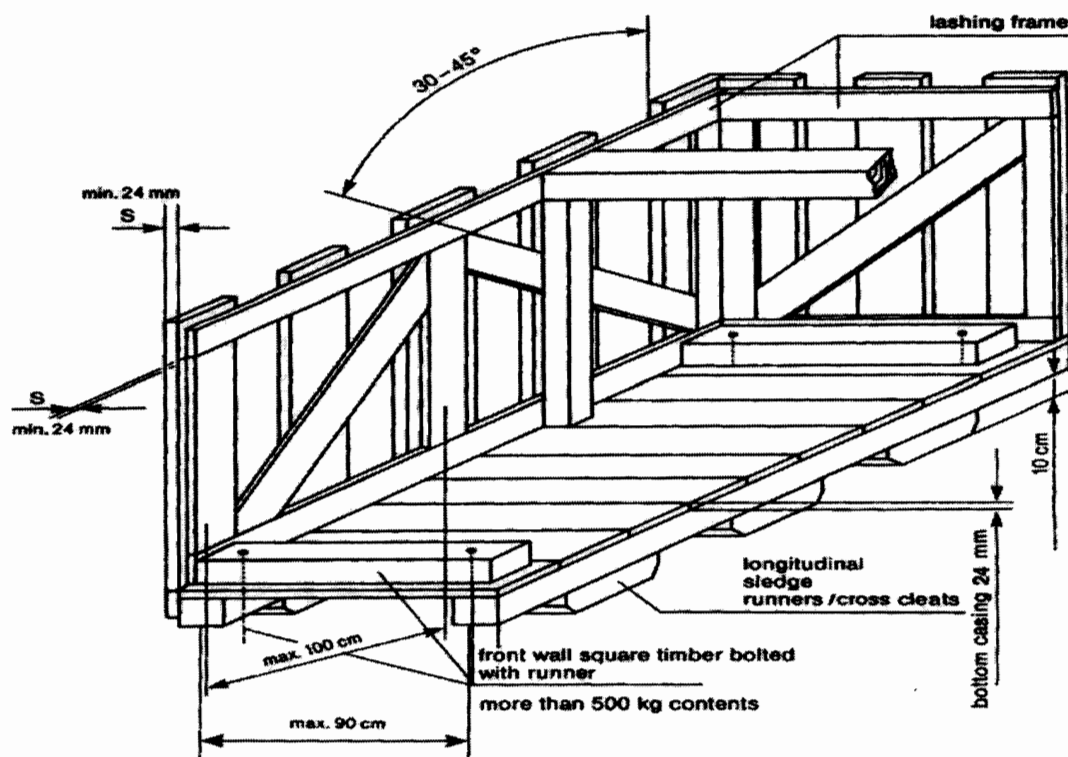
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

8.4.1.2 Type of Construction

The equipment must be safely fastened to the bottom with bolts, possibly by the runners or to be spread in such a manner that no protruding parts are possible. For parts, sensitive to rainwater and/or debris, a protection has to be made by a foil cap.

If it is possible that single part could protrude through the front/back side wall, they shall be closed completely. The marking of the package shall be done on plywood plates at the prescribed sides.

Packing Category III



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8.4.2 Cases with Lining – Packing Category IV

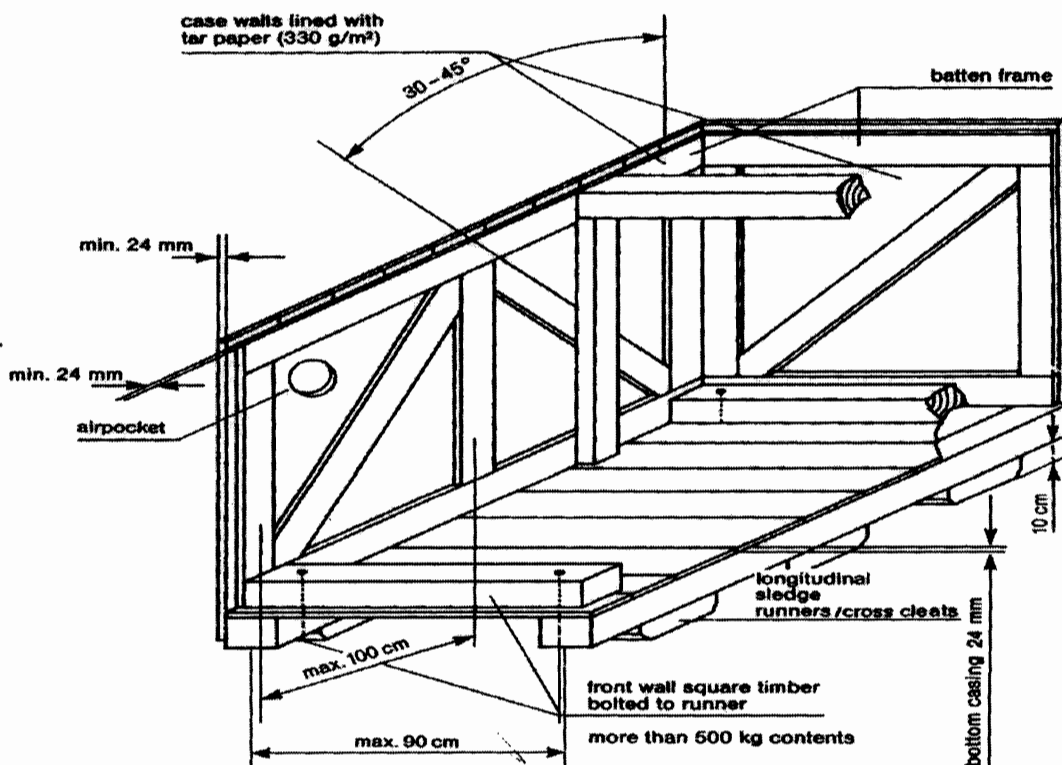
8.4.2.1 Type of Equipment

Recommended for equipment and mechanical parts Equipment sensitive to mechanical damage or parts and components that are particularly at risk of theft or loss; pumps, elbows, flanges, fittings, tools, erection materials, etc.

8.4.2.2 Type of Construction

The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed under the lid cover to avoid penetration of water. At weights of more than 500 kg the longitudinal runner must be bolted to the front all square timber. For ventilation inside the case, an opening in the waterproof lining must be placed between the diagonal battens and diagonal joists.

Packing Category IV

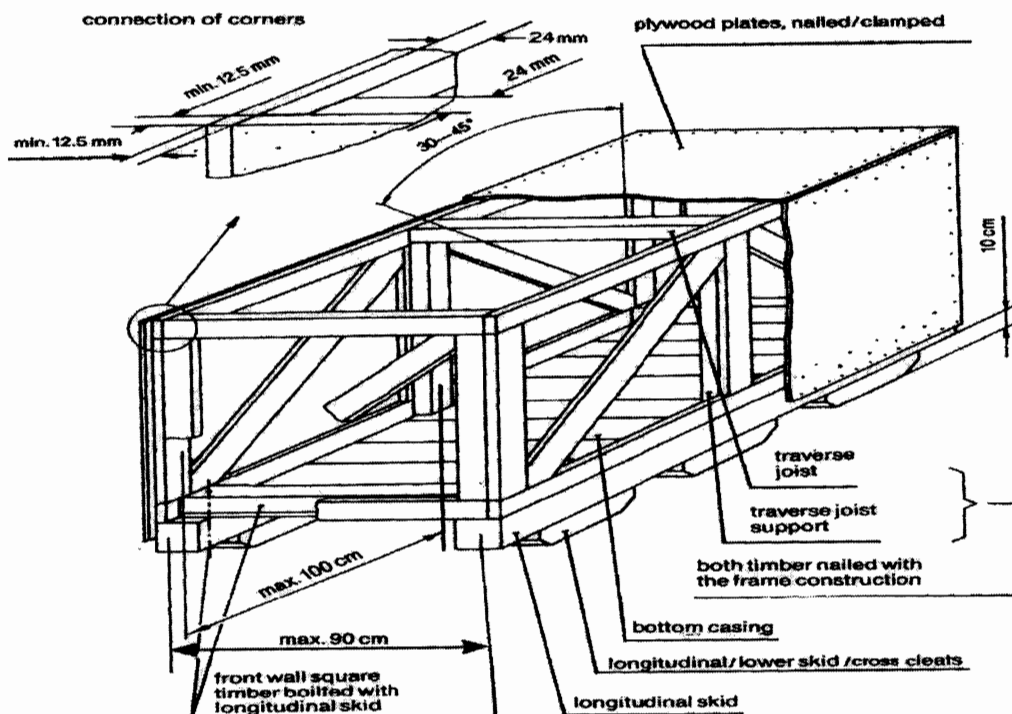


8.4.3 Cases with Alternative Surface Materials

8.4.3.1 Plywood Box – Packing Category IV A



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Case constructed of 5 layers of watertight, glued plywood with a total thickness of 12.5 mm. The frame must be constructed from minimum 24 mm timber or as per guide lines given above against clause 8.0, Fig 1 to 11 and must be suitable for the weight and nature of the parts to be packed. Planed square timber must be bolted with longitudinal skid and covered with diagonal joists. If applicable, construction of the cover and sides is to include diagonal bracing. Covers consisting of several layers of plywood are to be sealed with durable elastic putty or additional water-resistant sheets to be fixed.

8.4.4 Case with Barrier Material – Polyethylene Foil – Packing Category V

8.4.4.1 Type of Equipment

Sensitive equipment, simple electrical equipment, insulation materials, fire-resistant materials, with non-corrosion- guarantee for a period up to twelve (12) months.

8.4.4.2 Type of Construction

Preservation by welding in polyethylene-foil with addition of desiccants and if necessary, application of non-corrosive contact agents, otherwise, type of construction as indicated in article 8.4.2.2.

Additional marking:

- Case with desiccants.

8.4.5 Case with Barrier Material – Aluminium Compound Foil – Packing Category VI

8.4.5.1 Type of Equipment



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Electrical equipment such as, switchboards, electric motors, sensitive equipment, with non-corrosion guarantee, for a period up to twelve (12) months.

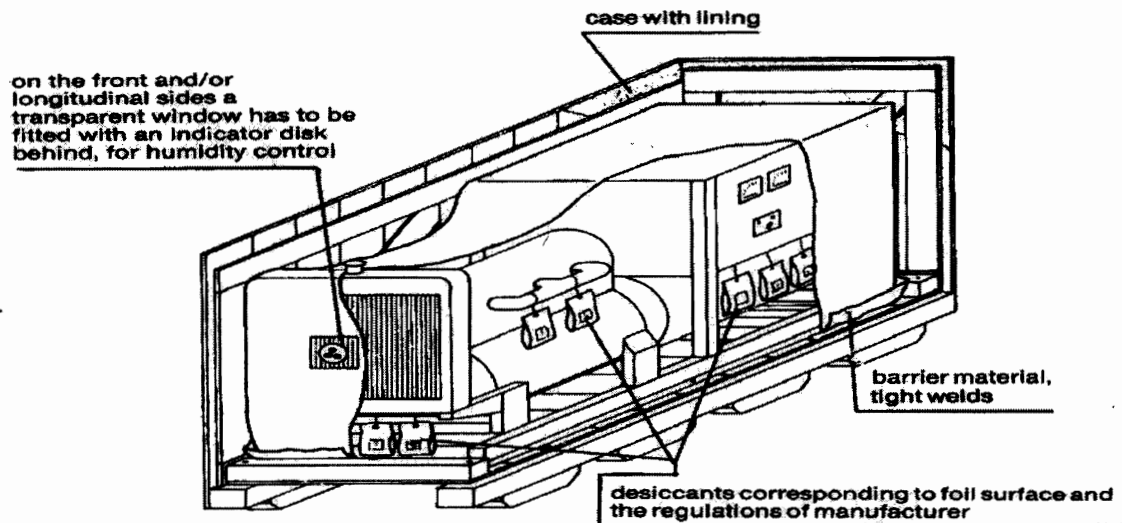
8.4.5.2 Type of Construction

Type of construction as indicated in article 8.4.2.2. Preservation by sealing an aluminium compound foil, with the addition of desiccants. Humidity indicators, if required and installed in the barrier wrapping, shall allow easy control from the outside.

Additional marking:

- Case with desiccants.

Packing Category V/VI



8.4.6 Double Case – Packing Category VII

8.4.6.1 Type of Equipment

GOODS which are of high sensitivity to shock, impact and vibration, for instance, special electrical equipment like computers, switchboards, laboratory instruments

8.4.6.2 Type of Construction

Case construction as indicated in article 8.4.2.2, with additional floating inner packing (case-in-case principle), padding corresponding to weight and sensitiveness. Preservation by sealing in aluminium compound foil with the addition of desiccants. The inner case has to be made of plywood or equivalent material with a thickness of 8-12 mm, depending on the weight of the GOODS to be packed. The inner buckles and/or frame borders have to be dimensioned so that the full stability of the inside case will be reached and no twisting is possible. The inner sides of the inside case will be lined with bituminous kraft paper on all sides (except bottom).



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8.4.7 Cable Drum – Packing Category VIII

8.4.7.1 Type of Equipment

All type of cables, wires, ropes, hoses.

8.4.7.2 Type of Construction

For all type of cables refer clause no. 11.1. For other items (wires, ropes, hoses) new or practically new drums are to be used. Planking of the e drums by use of boards, thickness minimum 20 mm, with additional double steel strapping, nailed, and carefully preserved/protected cable ends prior to packing.

8.4.8 Hazardous Materials – Packing Category IX

8.4.8.1 Type of Equipment

Hazardous materials according to the law are explosives, compressed gases, liquefied gases dissolved under pressure or deeply refrigerated, flammable liquids, flammable solids: substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases, oxidizing substances, organic peroxides, poisonous (toxic) and infectious substances; radioactive materials, corrosives, miscellaneous dangerous goods.

8.4.8.2 Type of Construction

Hazardous materials shall always be packed and documented separately from any other material. Selection of packaging materials, execution of packing and marking as well as documentation shall always be in compliance with the applicable laws and regulations. Any certificates required for transportation or for authorities to be supplied before shipment of the GOODS.

8.4.9 Wooden Floor as a Transport Support – Packing Category X

8.4.9.1 Type of Equipment

Any materials to be stuffed in containers or on flat racks and that are not stowed on standard pallets or otherwise suitably packed

8.4.9.2 Type of Construction

- Longitudinal internal square timbers bolted to the front wall runners, longitudinal skid.
- Maximum distance between longitudinal runners 90 cm (middle to middle of the runner).
- Full boarding of the floor.
- Attaching of lifting lugs and/or iron ropes for lifting/pulling the units off the transport equipment.
- If applicable, preservation of the equipment by sealing in polyethylene-foil or aluminium compound foil and the addition of desiccants.

8.5 Air Transport Packing

8.5.1 General

Certain types of material may have to be shipped by air from their country of origin. This means of transport will be exceptional, and will be used only:

- For GOODS, which are highly sensitive to shock or vibrations, such as computers, electronic instruments, or those of small dimensions and weight.
- For GOODS urgently required at the module yard(s) and/or jobsite.



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8.5.2 Type of Packing

Depending on the goods to be packed, VENDOR may use one of the following types:

- A triple-corrugated cardboard container made with waterproofed glue and a barrier layer of polyethylene on the outsides to keep out humidity.
- Wooden/cardboard packing cases: the wood being used for the framework and base of the cases, waterproofed triple-corrugated cardboard being used for the sides and top. These cases are of the "Bell" type, and used for material of small or medium dimensions.
- For larger dimensions, plywood cases are acceptable. The timber characteristics, cross-sections and thickness will be systematically determined by the nature of the loads to be packed.

8.5.3 Dimensions

In order to optimize the existing transport facilities (passenger or cargo aircraft), the dimensions of:

- Triple-corrugated containers.
 - Wooden/cardboard packing cases.
 - Plywood cases.
- Are to be adapted to pallets used for air transportation.

9.0 Detailed specification for Wooden Crates/Boxes/Cases and other packing materials

9.1 Technical specification for wood

The wood shall be Fir, Chir, Silver Oak (Gravillea Robusta), chemically treated mango and Pinewood with moisture content not exceeding 50%. The wood shall have flexural and compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, cracks, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects or fungus, etc. Surface cracks with maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

9.2 Chemical Treatment of Wood:

The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planning, joint grooving, etc.

9.3 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

9.3.1 PACKING OF EQUIPMENTS

Various mechanical, electrical and C&I equipment e.g. Pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers, etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases/crates shall be as per details given below and also given in figure 1 to 11.

9.3.1.1 Bottom Frame



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The construction of bottom frame shall be as per Fig-2. The No. of slides/runners for bottom frames shall be selected depending upon the weight and overall dimensions of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/crates. The equipment not provided with base frame/plate like cylindrical vessels, etc to be secured to the bottom frame of the wooden cases with "C" clamps fabricated from steel channels/ angle iron.

9.3.1.2 TOP FRAME

The construction of top frame shall be as per fig-3.

9.3.1.3 END PANELS

The dimension of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed. Diagonal braces shall be used for packing cases having height exceeding 500mm. Details of bracings shall be as per fig 5 to 9.

9.3.1.4 Sling Plate

To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig-11.

9.3.1.5 Angle Iron Cleats

Angle iron cleats shall be used for strengthening the joints as indicated in fig-10

9.3.1.6 Other Requirements

- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc shall be of single length i.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length up to 2400mm, proper jointing is permitted for planks for sheathing and diagonal bracings.
- Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polythene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.
- The inner surface of 4 sides of shooks shall be nailed with bituminized water proof craft paper. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- All the inner sides of the box shall be nailed with bitumen coated HESSIAN POLYTHYLENE KRAFT PAPER. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- For delicate equipment like control panels and switchgears, lighting panels and lighting transformers, suitable cushioning material like rubberised coir (min. 50 mm thick and 100 mm wide) shall be provided on their bottom support and the gap between the panel and casing



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shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose and shall be separately packed and shipped as per packing instructions in clause 10.4.
- Packing case for control panels and switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4mm.
- Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further heavier boxes shall be strapped with C clamps (ref fig-4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.
- Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be indicating type confirming to IS-304 (1979) packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into directly contact with equipment/material inside the package. The quantity of silica gel shall be adequate for storage period of one year, however it shall not be less than 4 gm. per ltr. Volume of case subject to minimum 400 gm. Per case.





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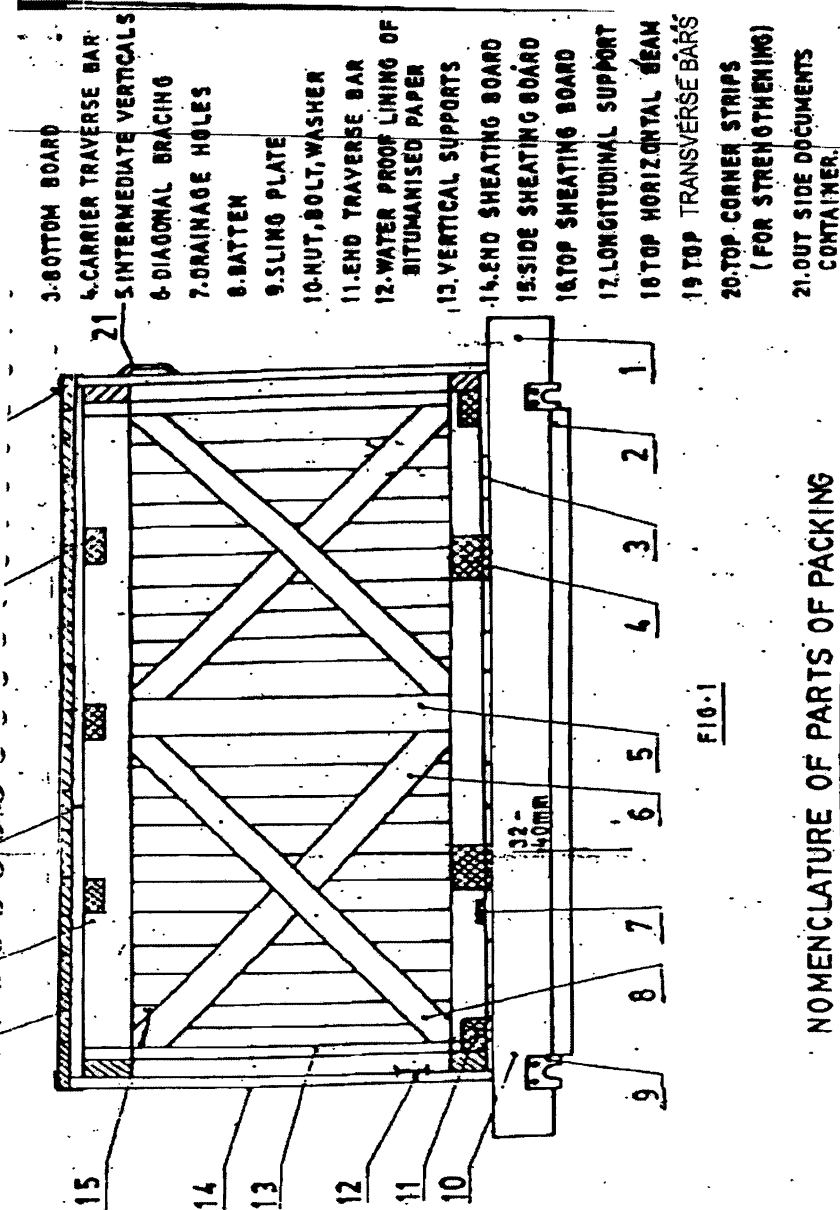


FIG-1

NOMENCLATURE OF PARTS OF PACKING

CASES

FIG-1

- 1 SLIDE
- 2 UNDER SLIDE BOARD

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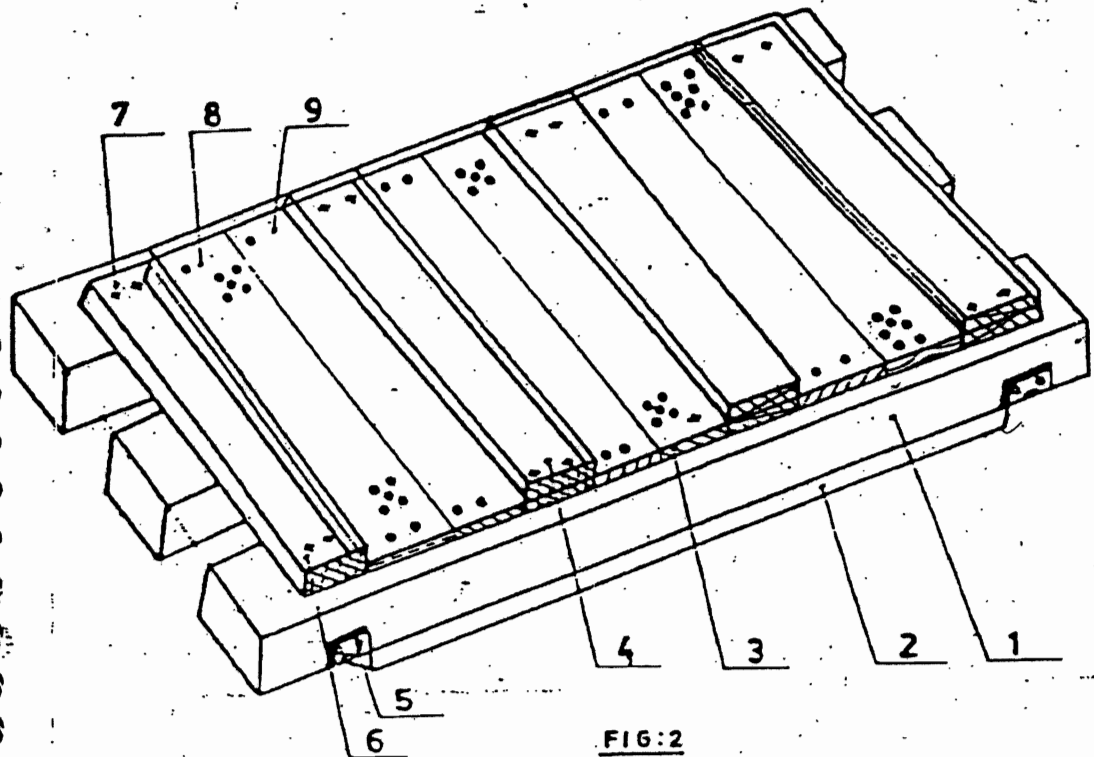
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BOTTOM FRAME ARRANGEMENTS**FIG:2**

Nos. of slides: Minimum 2 Nos.
For length more than 1800 mm or
load more than 1000kg, Nos. of
slides shall be minimum 3 Nos.
For dimensions of slides, refer Table 1
Cross section of end traverse bar; 100x100 mm.
(minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TRAVERSE BAR
5. SLING PLATE
6. TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS





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TOP FRAME ARRANGEMENT

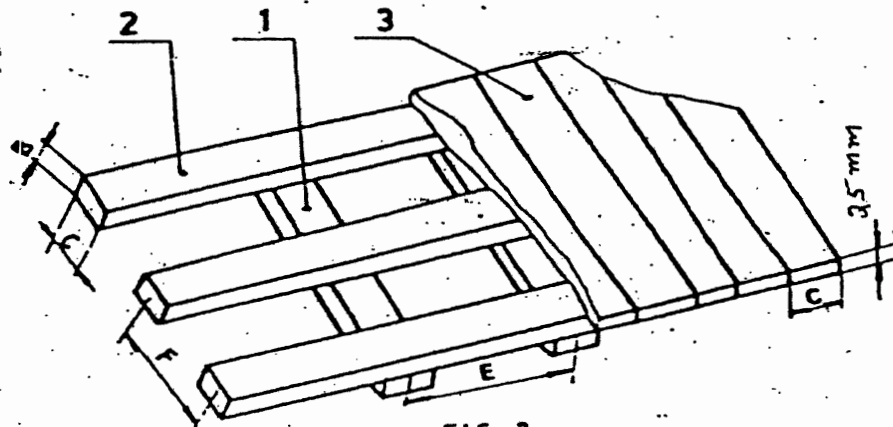
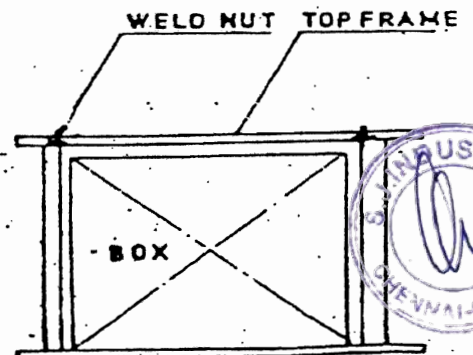
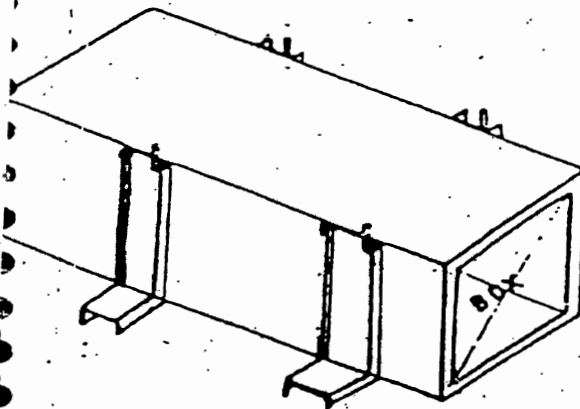


FIG-3

F : 700 to 1000 mm
E : 500 to 900 mm
30x100 mm.

- 1 - Traverse Bars
- 2 - Horizontal Soans
- 3 - Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES



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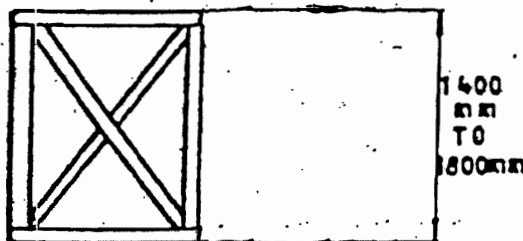
**ARRANGEMENT OF DIAGONAL BRACING AND
HORIZONTAL SUPPORT**

FIG: 6

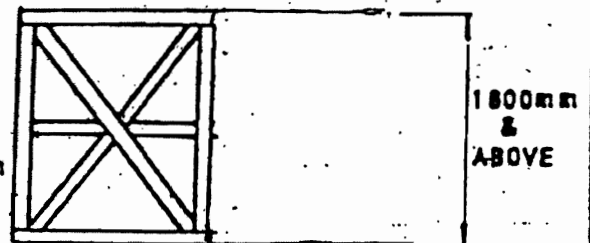


FIG: 8

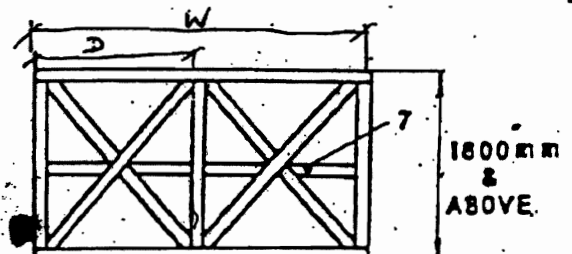


FIG: 7

7- Middle Horizontal Support

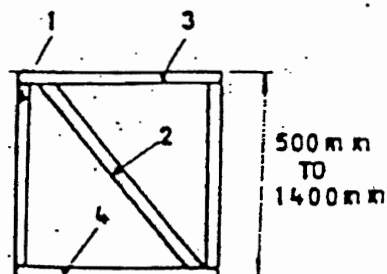


FIG: 5

1- Vertical Support

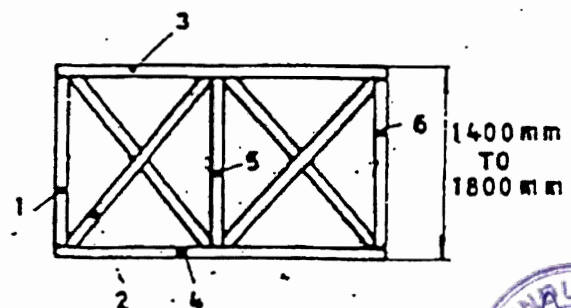


FIG: 7

1, 5, 6 - Vertical Support



**TITLE**

**TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

SPECIFICATION NO. PE-TS-888-100-A001

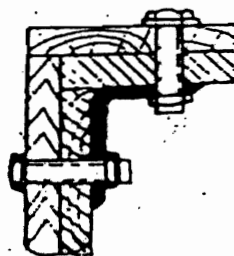
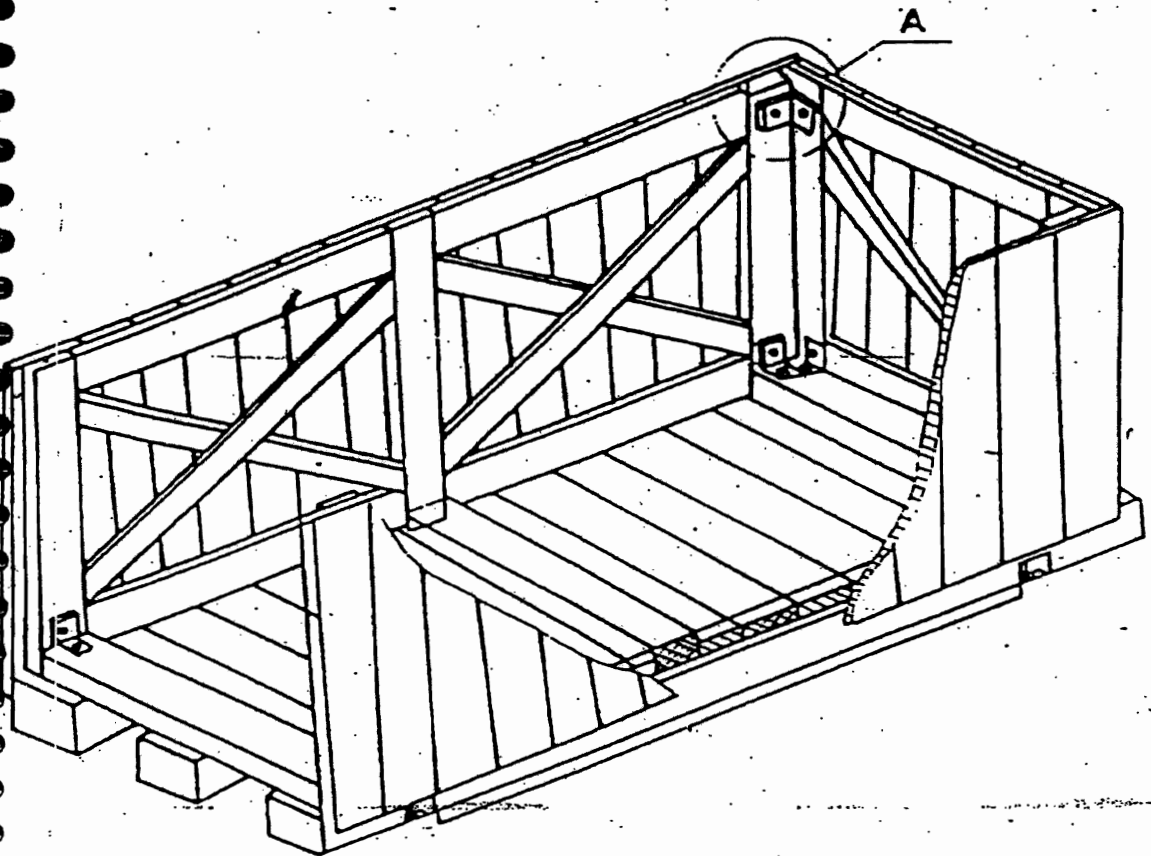
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ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER
MUST CONFORM
TO BOLT DIA

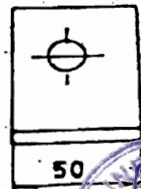
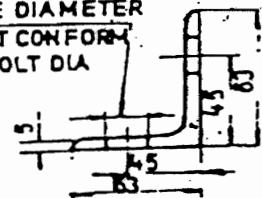
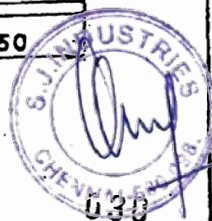


FIG:10



**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

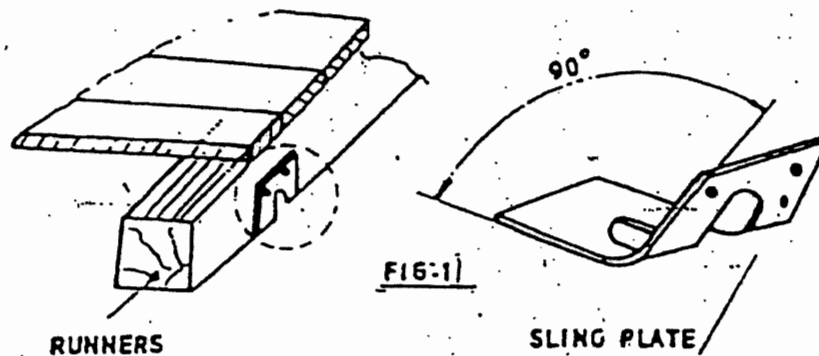
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**ARRANGEMENT OF SLING & PLATE ON
CASES**

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TABLE-1

LOADS	LENGTHS OF SLIDES						
	600	800	1000	1200	1300	1500	2000
	Cross section b x c				c b		
500	50 X 100	50 X 100	50 X 100	50 X 100	75 X 100	75 X 100	100 X 100
800	50 X 100	50 X 100	75 X 100	75 X 100	75 X 100	75 X 100	100 X 100
1000	75 X 100	75 X 100	75 X 100	100 X 100	100 X 100	100 X 110	100 X 150
1500	75 X 100	75 X 100	100 X 100	100 X 100	100 X 100	100 X 150	100 X 150
2000	75 X 100	100 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150
2500	75 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150	150 X 150
3000	100 X 100	100 X 150	150 X 150	150 X 150	150 X 150	150 X 150	150 X 150



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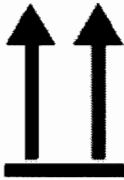
Table-2

End and side panels	Width of the panel "W"	Distance between longitudinal support (Dimension "D")						
		600	800	1000	1200	1400	1600	1800
		Cross section b x c				Item 1 to 7		
Fig- 5 to Fig-9	600 to 1200	30	30	30	30	30	30	30
		X	X	X	X	X	X	X
	1201 to 1600	100	100	100	130	130	130	130
		30	30	30	30	30	30	30
	1601 to 2000	X	X	X	X	X	X	X
		130	130	130	130	130	130	130
	2001 to 3000	30	30	30	30	30	30	40
		X	X	X	X	X	X	X
	3001 to 4000	130	130	130	130	130	130	150
		40	40	40	40	40	40	40
		X	X	X	X	X	X	X
		150	150	150	150	150	150	150



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INDICATION MARKS ON CASES/BOXES/CRATES

Designation	Symbol	Explanation
Fragile, Handle with care		The symbol should be applied to easily broken cargoes. Cargoes marked with this symbol should be handled carefully and should never be tipped over or slung.
Use no hooks		Any other kind of point load should also be avoided with cargoes marked with this symbol. The symbol does not automatically prohibit the use of the plate hooks used for handling bagged cargo.
Top		The package must always be transported, handled and stored in such a way that the arrows always point upwards. Rolling, swinging, severe tipping or tumbling or other such handling must be avoided.
Keep away from heat (solar radiation)		Compliance with the symbol is best achieved if the cargo is kept under the coolest possible conditions. In any event, it must be kept away from additional sources of heat. It may be appropriate to enquire whether prevailing or anticipated temperatures may be harmful.
Protect from heat and radioactive sources		Stowage as for the preceding symbol. The cargo must additionally be protected from radioactivity.
Sling here		The symbol indicates merely where the cargo should be slung, but not the method of lifting. If the symbols are applied equidistant from the middle or center of gravity, the package will hang level if the slings are of identical length. If this is not the case, the slinging equipment must be shortened on one side.
Keep dry		Cargo bearing this symbol must be protected from excessive humidity and must accordingly be stored under cover. If particularly large or bulky packages cannot be stored in warehouses or sheds, they must be carefully covered with tarpaulins.



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Center of gravity		This symbol is intended to provide a clear indication of the position of the center of gravity. To be meaningful, this symbol should only be used where the center of gravity is not central. The meaning is unambiguous if the symbol is applied onto two upright surfaces at right angles to each other.
No hand truck here		The absence of this symbol on packages amounts to permission to use a hand truck on them.
Stacking limitation		The maximum stacking load must be stated as "... kg max.". Since such marking is sensible only on packages with little loading capacity, cargo bearing this symbol should be stowed in the uppermost layer.
Clamp here		Stating that the package may be clamped at the indicated point is logically equivalent to a prohibition of clamping anywhere else.
Temperature limitations		According to regulations, the symbol should either be provided with the suffix "...°C" for a specific temperature or, in the case of a temperature range, with an upper ("...°C max.") and lower ("...°C min.") temperature limit. The corresponding temperatures or temperature limits should also be noted on the consignment note.
Do not use forklift truck here		This symbol should only be applied to the sides where the forklift truck cannot be used. Absence of the symbol on other sides of the package amounts to permission to use forklift trucks on these sides.
Electrostatic sensitive device		Contact with packages bearing this symbol should be avoided at low levels of relative humidity, especially if insulating footwear is being worn or the ground/floor is nonconductive. Low levels of relative humidity must in particular be expected on hot, dry summer days and very cold winter days.



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Do not destroy barrier		A barrier layer which is (virtually) impermeable to water vapor and contains desiccants for corrosion protection is located beneath the outer packaging. This protection will be ineffective if the barrier layer is damaged. Since the symbol has not yet been approved by the ISO, puncturing of the outer shell must in particular be avoided for any packages bearing the words "Packed with desiccants".
Tear off here		This symbol is intended only for the receiver.

FIG-12



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BHEL-PEM-DELHI-INDIA	
CONSIGNEE	
MATERIAL	
CUSTOMER REF.	MO. NO.
DESPATCH ADVICE NOTE NO.	CASE NO.
DIMENSIONS(MM) LXBXH	NET WT -KGS
	GROSS WT -KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE -- KEEP DRY DO NOT DROP -- DO NOT TILT

FIG-13: MARKING PLATE





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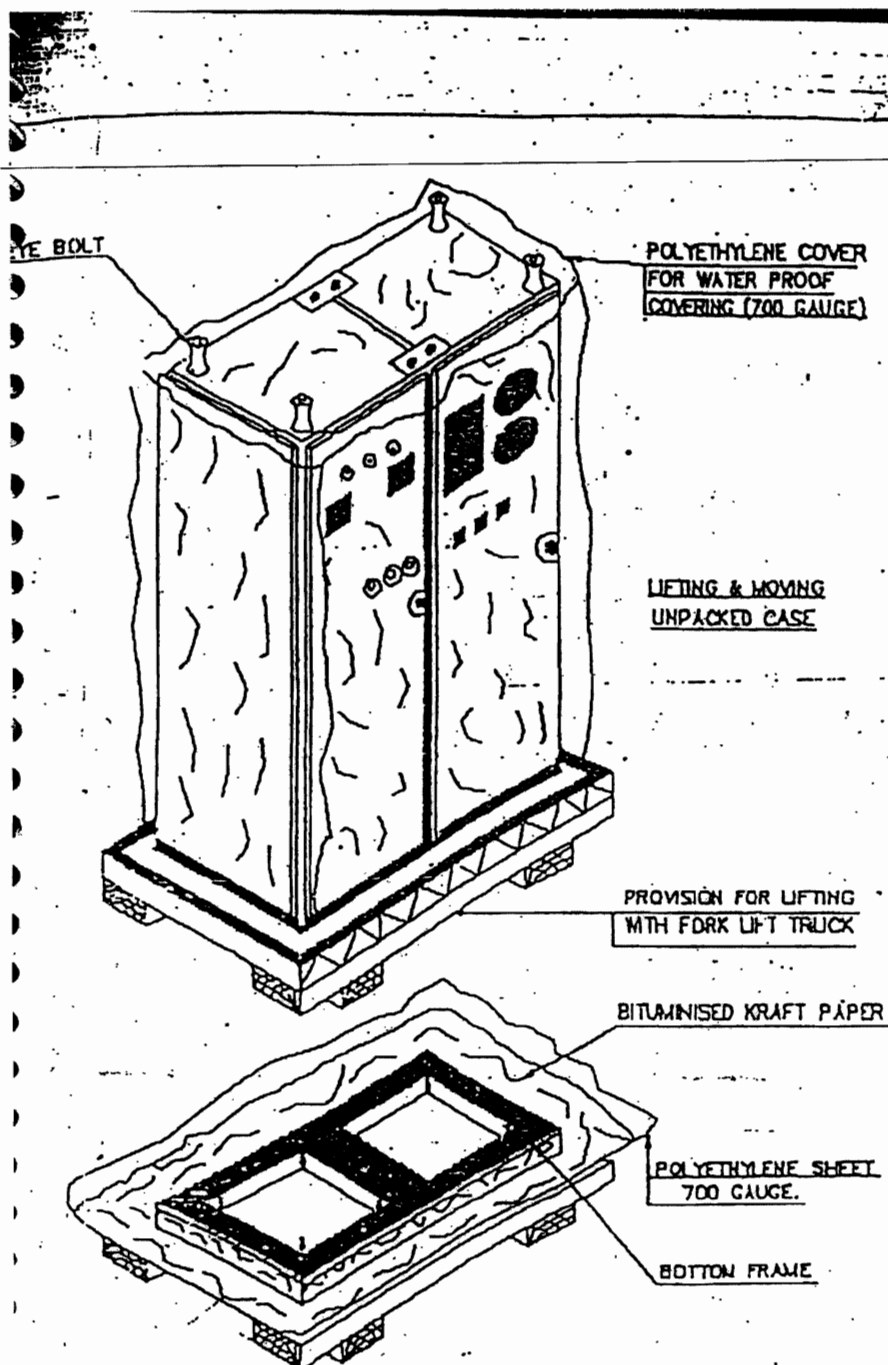


FIGURE-14





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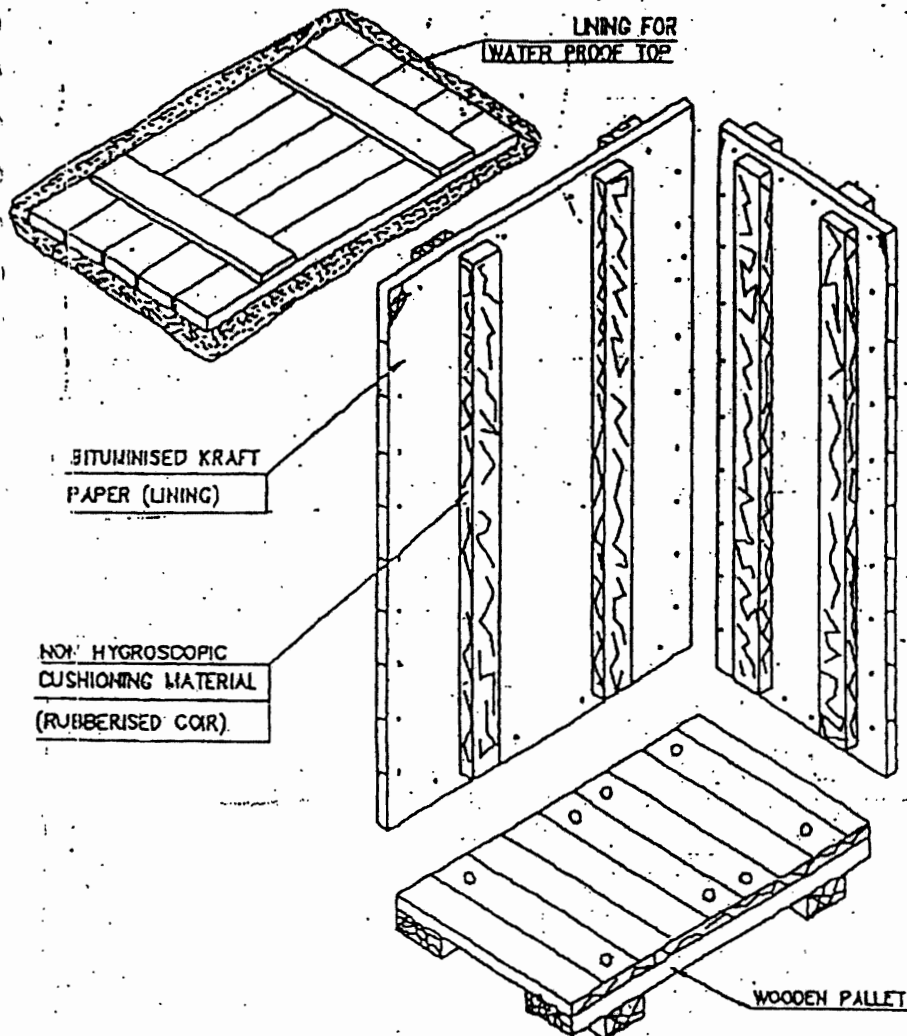
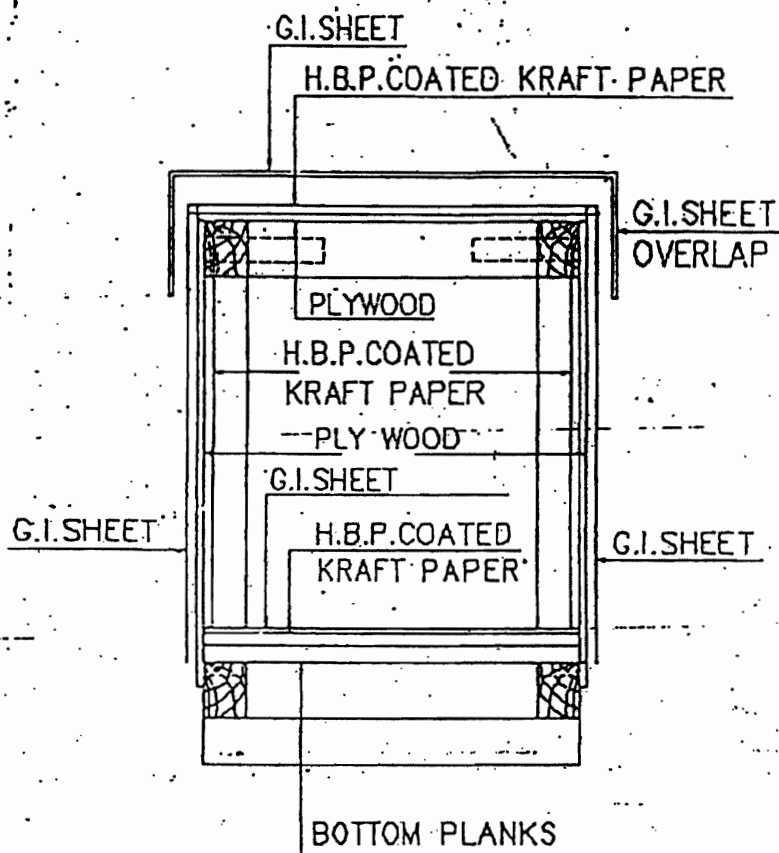


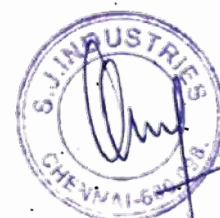
FIGURE-15



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**FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET
SHOWING LAYERS OF PACKING MATERIALS.**



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10.0 TYPICAL PACKING DETAILS/PROCEDURE FOR MECHANICAL ITEMS

10.1 INSULATION MATERIAL (MINERAL WOOL MATTRESSES)

This specification covers the requirements of seaworthy packing and marking for bonded mineral (rock) wool mattresses having metallic hexagonal wire netting as facing on one or both sides.

10.1.1 TYPE OF CONSTRUCTION

Mattress shall be packed in Polythene (of 0.2 mm thickness) all around and sealed to prevent moisture absorption during transit and storage. Further it shall be wrapped with Bitumen coated Polythene bonded/lined Hessian and stitched and then packed in 5 ply DFC carton box.

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS:304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into direct contact with the material inside the package. The quantity of silica gel shall be enough for storage period of one year. However, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

Each mattress as well as the packages shall be serial numbered. Also, printed sheets indicating the nominal thickness, density and wire netting details (i.e. material and size) shall be placed below the wire netting.

Following details shall be legibly written on the packages. The details shall also be typed on a sheet of paper & kept in a sealed Polythene cover, inside the packages

- Project Name
- Purchase Order No.
- Sl. No. of package
- Size of mattress (Thickness x Length x Width)
- Density
- Wire netting material and size
- Weight of the package

10.2 INSULATION MATERIAL (ALUMINIUM COIL)

Heavy Gauge Aluminium Coil Packaging are done by Eye-to-Sky packaging or by Eye to eye packaging as per the proven practice being followed by manufacturer of Aluminium sheets.

10.2.1 Type of construction for Eye to Sky packaging

- Strapping of coil with polyester strap around circumference at one place.
- Putting paper I. D. Edge protector.
- Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
- Wrapping the coil with HDPE film.
- Covering the coil including its build up & bore with masonite / particle board.
- Putting metallic I. D on coil.
- Putting O.D edge protector (paper) on coil.



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- h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).
- i. After placing the coil on coil tilter ply wood (10mm thick) of suitable size along with wooden pallet is to be put at the bottom side of the coil.
- j. Coil is to be tilted to eye-to-sky position.
- k. Final strapping with metallic strap to unit coil and skid at 2 places with top cover of plywood.
- l. Fixing the coil with wooden blocks at 4 corners.
- m. Labeling 2 nos.(one metallic & one adhesivetype) For specification, net wt. & gross wt.

10.2.2 Type of construction for Eye to Eye packaging

- a. Strapping of coil with polyester strap around circumference at one place.
 - b. Putting paper I. D. Edge protector.
 - c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
 - d. Wrapping the coil with HDPE film.
 - e. Covering the coil including its build up & bore with masonite / particle board.
 - f. Putting metallic I. D on coil.
 - g. Putting O.D edge protector (paper) on coil.
 - h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).
 - i. Placing of coil on wooden skid Coil is to be tilted to eye-to-sky position.
 - j. Final strapping of coil and skid at 2 places with steel strap. Fixing the coil with wooden blocks at 4 corners.
- Labeling 2 nos.(one metallic & one adhesive type) For specification net wt. & gross wt.

10.3 Packing Procedure for Online Tube Cleaning System and accessories

This procedure is applicable for the shipment of Onload Tube Cleaning System and accessories by sea.

10.3.1 Packing details:

- The Packing case shall be made of treated rubber wood. The design of the case shall be as per Annexure IIIA & IIIB.
- The Equipments shall be placed on the wooden base of the Packing case and fastened if required to arrest the movement of the same.
- Equipment shall be covered by Polythene sheet and inside wall surfaces of the wooden cases also shall be covered by polythene sheet.
- All Nozzles shall be closed with plywood dummies.
- All electrical components assembled or loose shall be covered with polythene sheets along with silica gel pack.
- Silica gel desiccants shall be kept inside each case in sufficient quantities in order to absorb the moisture.



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- Thermocol packing shall be made for glass items like Ball vessel sight glass, Vpiece
- sight glass & pressure gauge.
- Silica gel desiccants shall be kept inside of each case to absorb the moisture.
- A Packing list covered in a polythene envelope shall be fixed inside and outside of each packing case.
- Shipping marks and consignee address shall be painted on the outer surface of the case.
- All handling instruction required for the case like top, sling, rain, handle with care etc, shall be marked on the case as per the symbol attached.
- Machined surface will be applied with Anti rust oil and covered by polyurethane sheet to protect from external oxidation.
- All valves will be closed with dummies to protect the internals and placed in the wooden case which will covered by polyurethane sheet.





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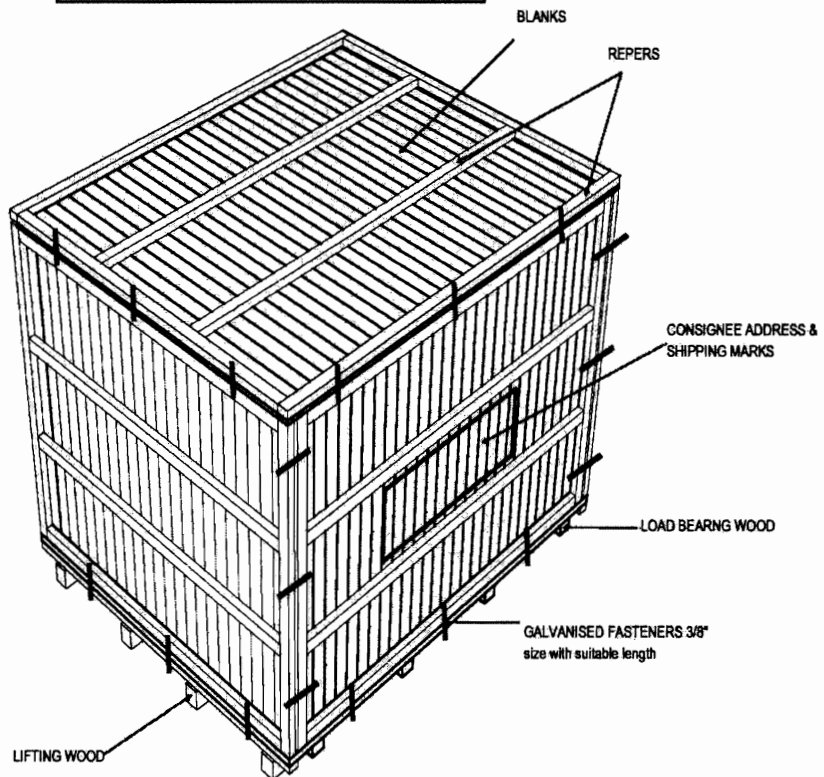
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MODEL: FASTNERS TYPE (BASE, SIDE & TOP
ATTACHED WITH BOLT, NUT & WASHER)

This Type of case to be used for
following items:

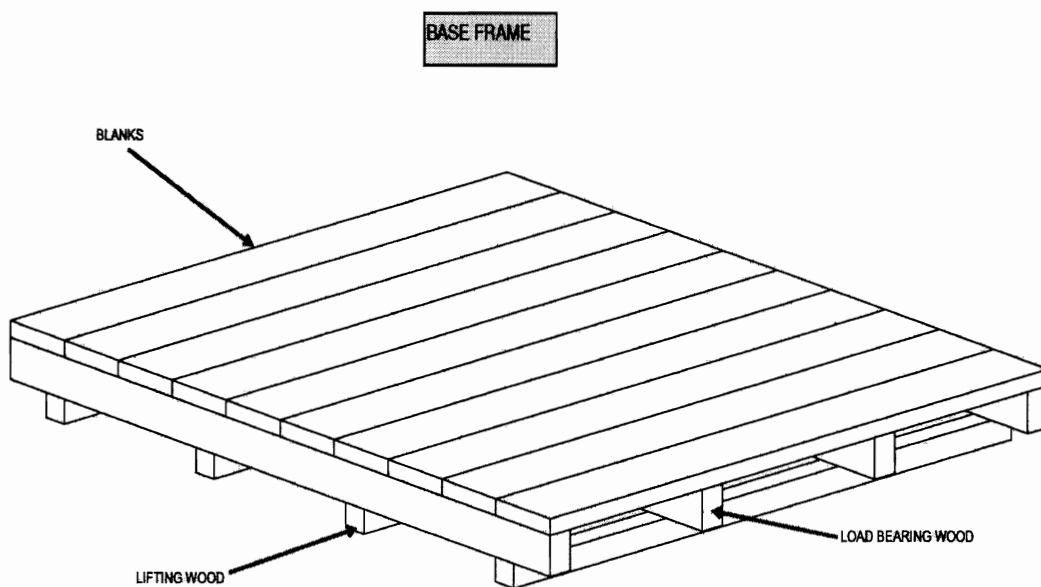
1. BALL SEPERATOR
2. BALL COLECTOR SKID



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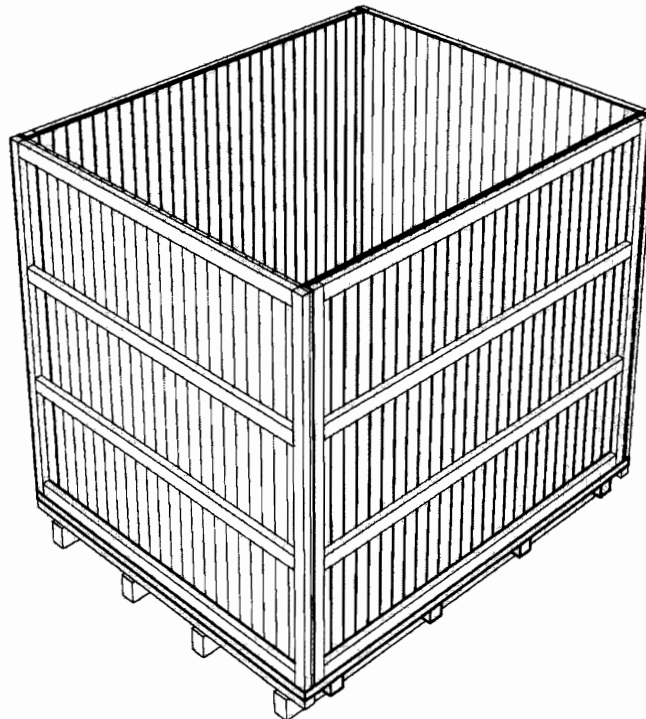
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MODEL: FASTNERS TYPE - WITHOUT TOP



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MODEL: NAILING TYPE
(FRAME & INSIDE REEFER NAILED)

THIS TYPE OF CASE TO BE USED FOR THE
FOLLOWING ITEMS:

1. PUMP SKID
2. CONTROL PANEL
3. LOOSE ITEMS, TOOLS & TACKLES
4. DPMS, BRM
5. SPARES
6. CLEANING BALLS
7. CABLES & ACCESSORIES

Shipping marks & Consignee
Address

BLANKS

LIFTING WOOD

BLANKS

REEPERS

BLANKS

REEPERS

LOAD BEARING WOOD

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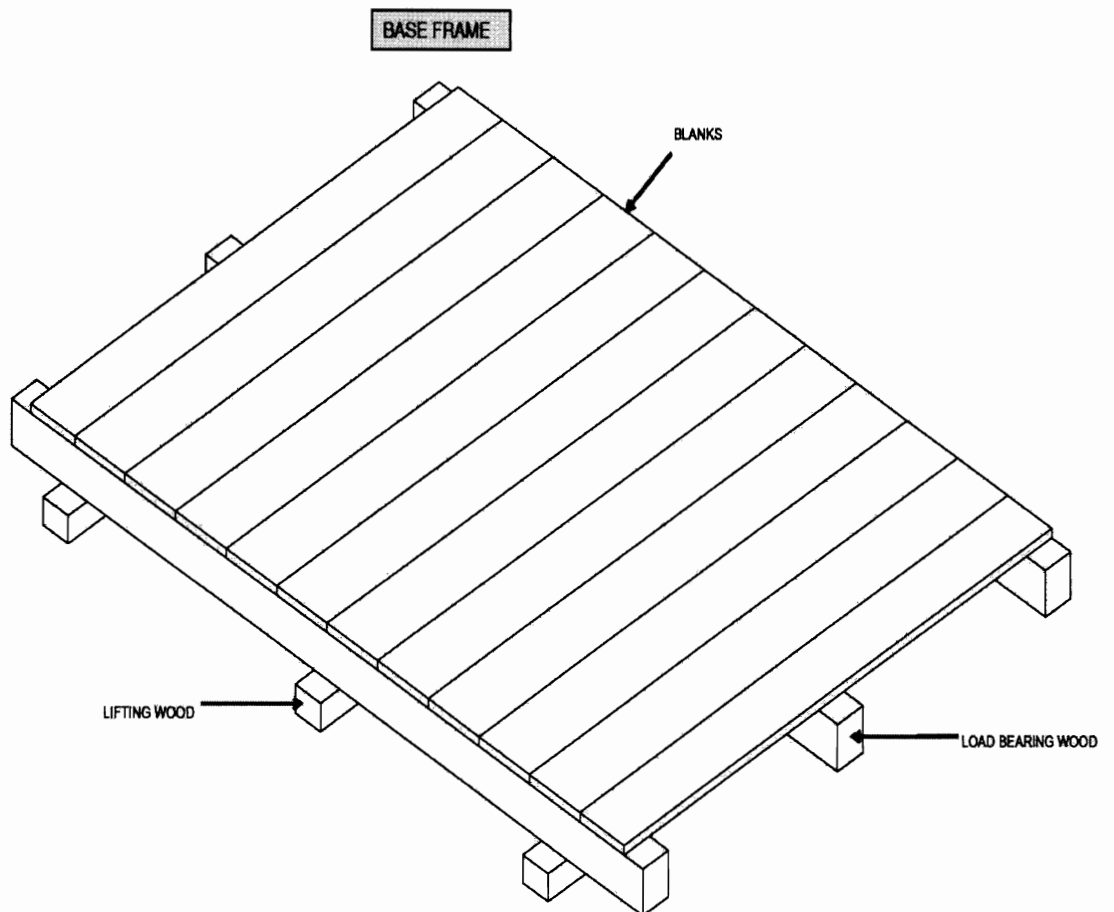
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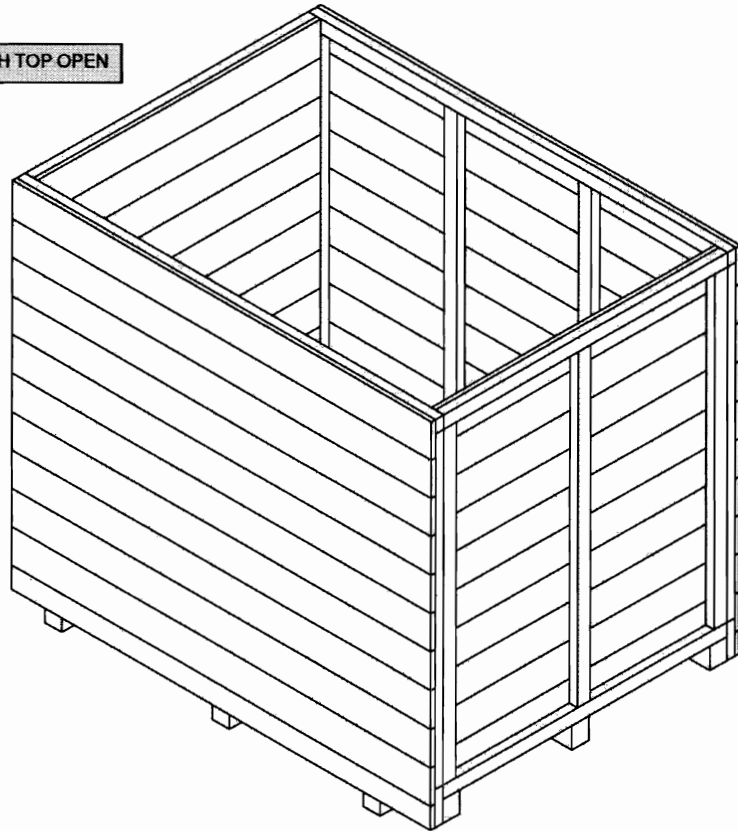
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NAILING TYPE MODEL WITH TOP OPEN



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10.4 PACKING OF LOOSE ITEMS

Loose mechanical, electrical and C&I items e.g. valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/ thermocol sheets/air bubble sheets depending upon the items and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect, Special attention shall be paid to relays, instruments etc for arresting the movements of their operating mechanism during transportation.

The construction of wooden packing cases shall be as per clause 9.3.1 retaining its all features concerning strength of the box. The construction of wooden packing case for electrical and C&I items shall be as per fig-16.

Inner surface of 6 sides of the box shall be lined with bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the boxes.

11.0 PACKING OF ELECTRICAL ITEMS

11.1 CABLES

11.1.1 Type of Equipment
All type of cables..

11.1.2 Type of Construction

New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. Cable drum can be put in wooden crates for ease in transportation and handling. (Wooden cable drum is also acceptable, however vendor to furnish constructional details for approval).





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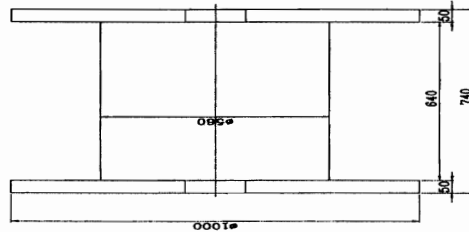
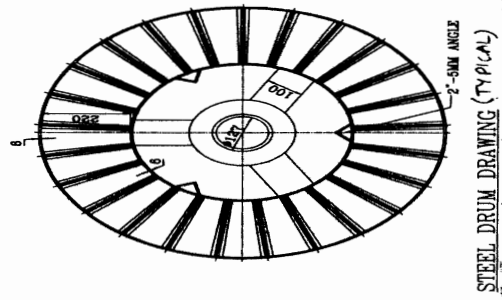
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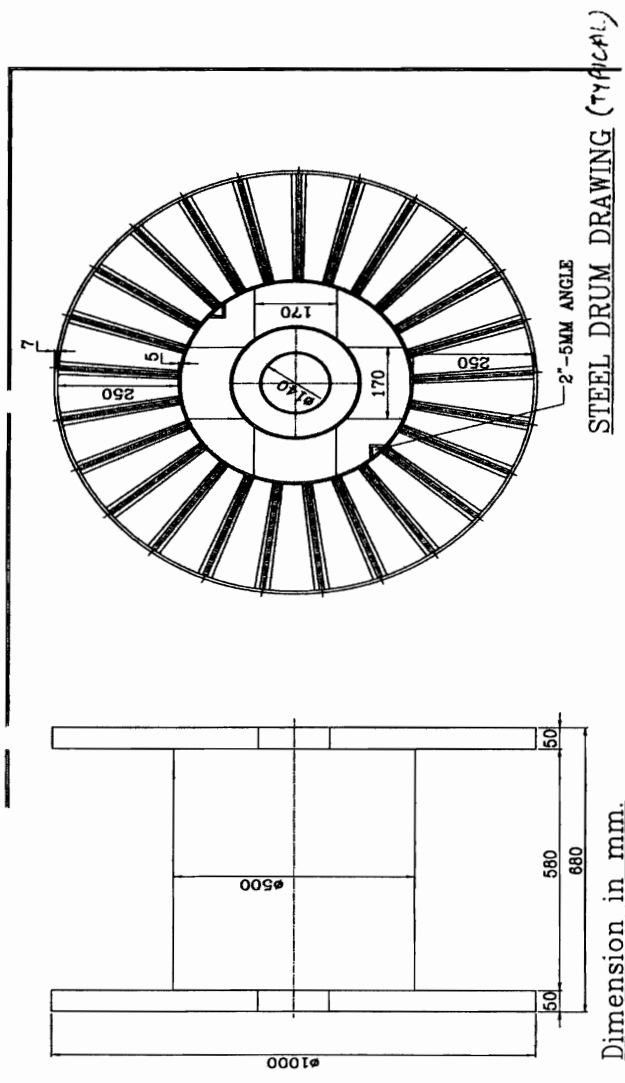
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11.2 PACKING OF CABLE TRAYS & ACCESSORIES AND CABLE TRAY SUPPORT MATERIAL

11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

- 1) All Dimensions are in "mm" unless otherwise stated.
- 2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
- 3) Finish of Packing Box Shall be Galvanized.
- 4) Angle & Channel Section forming part of the Main frame shall be welded thoroughly with each other to give a rigid structure.
- 5) Sheet Section and Flat section shall be bolted/ Riveted/ Welded suitably to the Main frame stated in '4' above.



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- 6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.
- 7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate as per details and specifications given in page 3 of 5 shall be provided on the boxes
- 8) One copy of packing slip wrapped in polythylene bag covered with suitable aluminium .packing slip holder to be nailed on the external surface of the box. One more copy 9f the packing Slip wrapped in polythylene bag to be kept inside the box at the prominent place.
- 9) **INDICATION MARKS ON THE BOXES:** Markings shall be provided on the boxes indicating position of Boxes for handling, storage and nature of consignment. For guidelines referred page 4 of 5. The ink issued for this purpose as well as for marking dispatch instruction shall be indelible/non-washable marking ink.
- 10) Each item as mentioned in BOQ shall be packed & supplied as a set comprising of required numbers of associated fasteners & hardware etc



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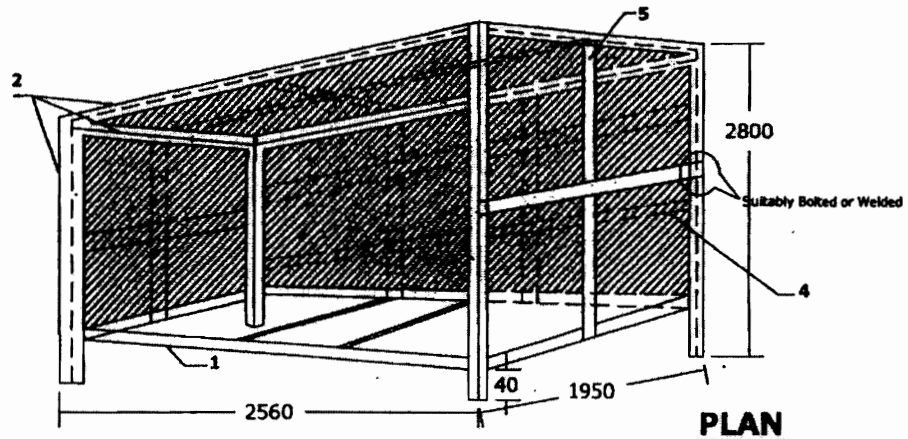
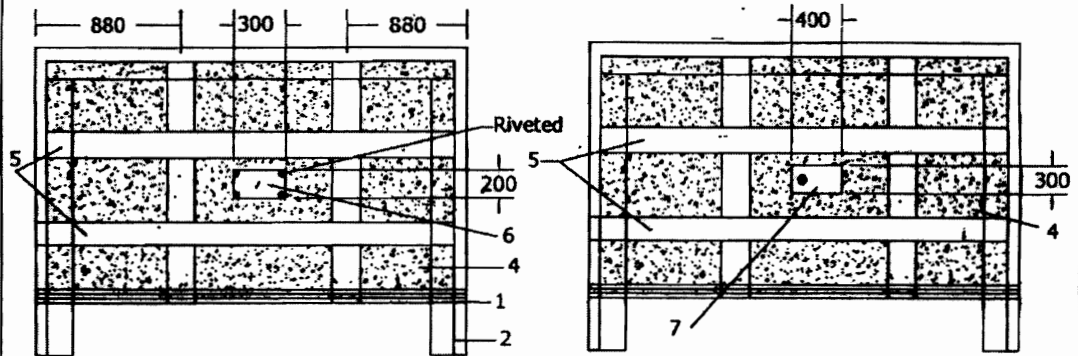
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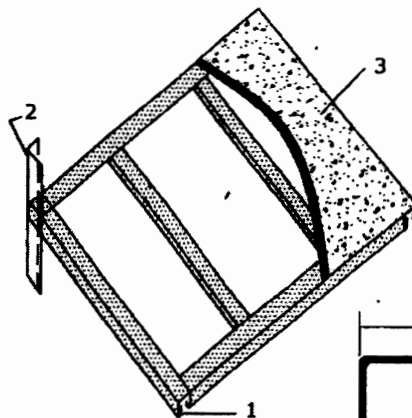
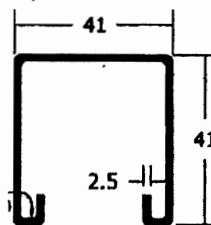
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STEEL PACKING (TYPICAL DETAILS)**PLAN****FRONT SIDE OF BOX****BACK SIDE OF BOX****Note:**

1. "C" Channel to be used on Bottom Frame.
2. 50x50x6 Angle to be used Vertically on four sides of the Box and Horizontally on four sides on the top Frame.
3. 1.6mm thick sheet (plain) on Bottom Plate.
4. 1.0mm thick sheet to cover top & four sides of BOX.
5. 50x3 Flat as additional cross members to be used Horizontally & Vertically on top & Four Sides of Box.
6. Anodised Aluminium Plate for Marking.
7. Hinged Inspection Window.

**BOTTOM FRAME ARRANGEMENT****DETAILS OF "C" CHANNEL**

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11.3 PACKING FOR STATION LIGHTING SYSTEM

Aspects of packing specific to equipments / items of station lighting system are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.3.1 For LIGHTING TRANSFORMER, DISTRIBUTION BOARDS, LIGHTING PANELS,

- Construction of packing case for LIGHTING DISTRIBUTION BOARDS, LIGHTING PANELS, TRANSFORMER . shall be EITHER as per FIGURE 1,2,3,5,6,7,8,9,10,11 OR FIGURE 14,15,16.
- Each Panel/Transformer shall be individually covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian polythene craft paper. Wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm.

For the top frame it shall be project on all sides by 100mm and shall be nailed on sides .

- The gap between the panels and packing case shall be filled with rubberized coir of thickness 50mm minimum and width 100mm. The distance between two consecutive supports of rubberized coir shall be less than 500mm.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.
- Packing case shall be finally covered with GI sheet of thickness 0.4mm minimum.

11.3.2 For LUMINARIES, RECEPTACLES. EMERGENCY LIGHT, 240/24V TRANSFORMER, CEILING FAN, SWITCH BOARDS, FLEXIBLE CONDUIT, WIRES, EARTH WIRE. JUNCTION BOXES, ERECTION COMMISSIONING SPARES, RECOMMENDED SPARES , ERECTION MATERIAL AND CONSUMABLES

- Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.
- Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian craft paper. wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm. For the top frame it shall be project on all sides by 100mm and shall be nailed on sides.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.

11.3.3 For CONDUIT PIPE

As per international practice pipes are shipped in open bundles with metal strapping. Packing as per attached figure A shall be provided which is described as following:

- Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- Then bundle will be wrapped with bitumen coated hessian craft paper.
- Bundle shall be strapped with steel straps.
- An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

11.3.4 For POLES

Poles will be wrapped with 2 layers of minimum 175 microns thick polythene sheet and then with bitumen coated hessian craft paper, packed as per Figure – C i.e. bundling.

11.3.5 For STRUCTURAL STEEL



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Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

- a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- b) Then bundle will be wrapped with bitumen coated hessian craft paper.
- c) Bundle shall be strapped with steel straps.
- d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.



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PACKING PROCEDURE FOR CONDUIT PIPE

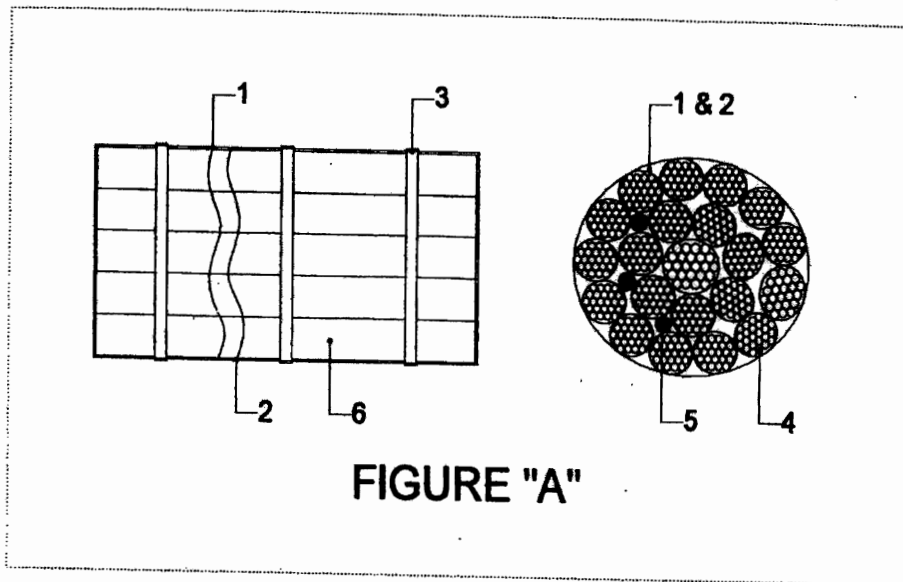


FIGURE "A"

- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) CONDUIT PIPES.
- 5) SILICA GEL POUCHES.
- 6) BUNDLES OF CONDUIT PIPES.

**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

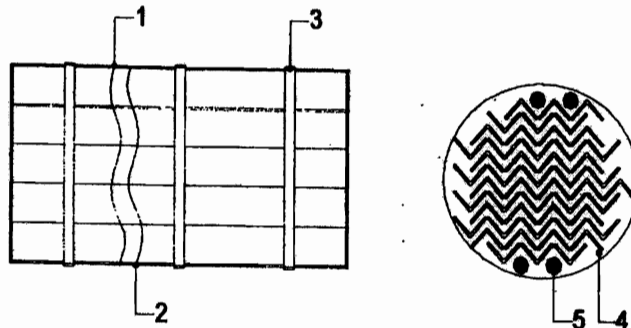
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PACKING PROCEDURE FOR STRUCTURAL STEEL**FIGURE "B"**

- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) STRUCTURAL STEEL.
- 5) SILICA GEL POUCHES.





TITLE

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FOR SEAWORTHY PACKING
FOR EXPORT JOBS

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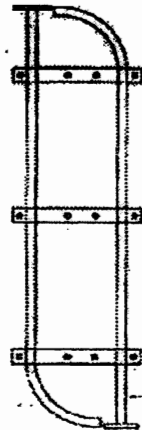
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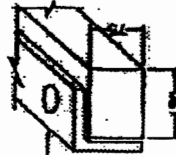
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packing procedure for poles



POLES WRAPPED WITH POLYTHENE SHEET &
EXTRUDING COATED HESSIAN CLOTH



TOP WOODEN BATTEN TO BE
FIXED WITH L50x80x6 MM ON TOP
OF IT FOR TIEING THE ROD
25 MM DIA



BOTTOM WOODEN BATTEN TO BE
FIXED ON L50x80x6 MM ANGLE

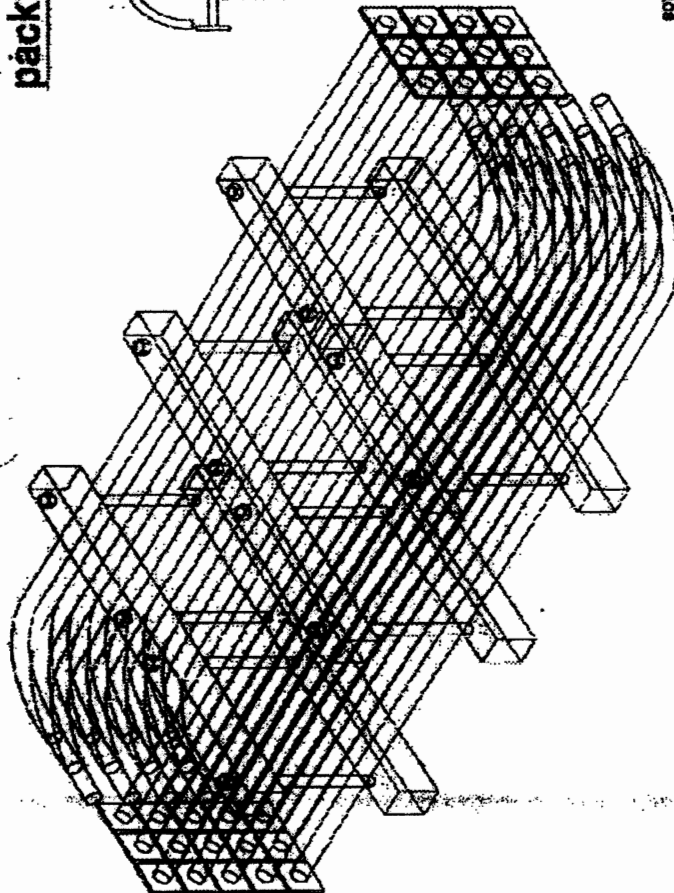


FIGURE "C"



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11.4 PACKING FOR DC BATTERY

The packing procedure for seaworthy packing of DC Battery is defined below, which is capable of withstanding impacts, compression, vibration, toppling, sea water spray, prevention against rust, temperature and extreme atmospheric conditions. Aspects of packing specific to equipments / items of DC Battery are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

The packing procedure consists of various stages namely primary packing, cushioning, securing, desiccant, outside packing box, Runners/ sliders/ transverse bars of plywood, etc., provided for each movement.

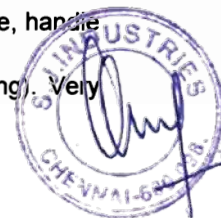
- a) The packing boxes shall be made up of plywood boxes (thickness 9mm min.) with blocks at the bottom of the box for provision for handling the boxes using the forklift. The packing boxes sizes are generally standardized to half-euro size (capable of handling equipment's weight).
- b) Rubberized coir of 25mm thickness shall be provided as cushioning material at the bottom and thermocole of 20mm shall be provided inside on all four sides. Other than this polyethylene film wrap or cover also will be provided. Left out spaces to be filled with rubberized coir/ thermocol to get cushioning effect.
- c) Silica gel in dust free air permeable cotton/paper bag shall be placed in the packing boxes for storage period of 1 year as per IS 304 (1979)
- d) While packing the cells, transit caps (polypropylene) of red and blue shall be used for big size cells for ensuring that cells does not get damaged during the transport due to vibrations etc.
- e) The battery accessories shall be packed with suitable precautions as follows:
 - i) Copper connectors shall be packed after making bunches with lead wire seals to avoid misplacement.
 - ii) Hardware items shall be packed in polyethylene bags (Thickness $\geq 0.175\text{mm}$) with item slip
 - iii) Battery rack shall be packed in dismantled condition, wrapped with polyethylene sheet
 - iv) For Ni-Cd type battery, electrolyte in solid form for dry cells shall be packed in cans with KOH, LiOH being packed separately.
 - f) Galvanized Steel straps are provided for binding the packing box sides.
 - g) The handling instructions shall be marked in indelible/ non-washable ink, indicating the upright position.

11.5 PACKING OF SERVICE TRANSFORMERS(OIL FILLED) & ACCESSORIES

This instruction is applicable for packing of transformers (oil filled), its accessories and components so as to ensure safe delivery to end user. Aspects of packing specific to equipments / items of transformers(oil filled) are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.5.01 PACKING DETAILS :

- a) Items shall be packed in case / crates as per the shipping list.
- b) All fragile items and small items shall be packed in cases and to be marked as "Fragile, handle with care Fragile items".
- c) Fragile accessories are to be first packed in their original boxes (VENDOR's packing). Very



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- d small / delicate items such as glass thermometer, door keys shall be packed in separate box.
- d In case original box is found damaged, suitable alternate box or packing method using felt or foam sheet and polythene wrap to be used.
- e These boxes are then placed in identified wooden boxes. Inside of such boxes are lined with a layer of polythene sheet, packing wool / grass and another layer of polythene sheet before placing the boxes. All boxes are then wrapped with this polythene sheet before closing the box. Fragile items shall not be placed loose, one above the other inside the case.
- f All wiring cables, connection flats of non-ferrous materials, CTs, valves bellows shall also be packed.
- g Items like CTs, Oil communicating bushings, insulators, wired equipments and housings such as RTCC Panel, M. Box, Drive Mechanism, thermometers, gauges shall be wrapped in polythene from all around.
- h Buchholz relay and OSR relay openings will be blanked using covers, before putting them in the box
- i Items shall be carefully lowered and arranged inside the crate / case and each item shall be locked from all sides in such a way to avoid its movement in any way. Wooden stoppers and separators shall be provided for this and nailed to the crate / case wood.
- j Wooden planks and batons in contact with fragile items shall be provided with kit foam at the locations of contact.
- k Oil communication bushings shall be packed in separate case on V or U shape wooden felted supports, as in case of condenser bushings.
- l While placing and arranging the items inside the crates / cases, these shall be verified for correctness and then the packing note shall be signed. The cover top of the crate / case shall then be closed.
- m The main equipment like transformer tank shall be packed suitably to prevent any damage during transit / storage. Support structures like frame, header supports etc. shall be crated. Conservator headers shall also be crated. Radiators pipe work and other instruments & components shall be packed in cases. All the cases shall be lined with polythene from inside.

11.6 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCH GEARS

For Control and switch gear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below.

Thickness of planks for all sides, binding and jointing battens shall be at least 25 mm. Width of the plank shall be at least 125mm and that of binding and jointing planks shall be at least 100mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudinal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per cl 9.3.1.3 and all other requirements shall be as per clauses 9.3.1.4 to 9.3.1.6.

12.0 Containerization

As required by BHEL, the VENDOR shall stuff the GOODS into 20 or 40 foot containers (dry open top, flat racks, etc.).

The maximum inside dimensions of containers are to be considered:



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- 40 foot containers: 11.80 m x 2.20 m x 2.05 m
- 20 foot containers: 5.80 m x 2.20 m x 2.05m
-

The present definition of containerization is valid for sea containers only. Vendor to check the size of containers before start of packing of equipment.

12.1 Protection of Cases/Crates

Since shipping containers are in general not water tight, packing in contact with the floor of the container shall be raised in order to prevent it from being damaged by the accumulation of water.

12.2 Mechanical Constraints

The mechanical constraints for "general use" closed containers are of a different nature (height of "stacking" being limited inside the containers), the packing for the GOODS may be of a lighter structure. However, it is necessary that the packing be appropriate so as to protect the GOODS on site during the storage period, as required after discharging of the GOOD'S from the containers.

Note:

It is the responsibility of the VENDOR to ensure that the cases/crates are stowed, secured and fastened inside the container. The VENDOR will take all necessary precautions to conform to the maximum weight allowed and the centre of gravity of the container. The securing and fastening of the cases/ crates can be carried out by nailing timbers on the bottom or on the vertical sides of the container.

13.0 Other Services to be provided by Vendor

In addition to the packing and shipping documents, VENDOR must also carry out the following services, which shall be included in his quotation:

Carriage of VENDOR's sub-contracted equipment and material, which must be re-grouped in VENDOR's or PACKER's workshops, whilst waiting for packaging.

BHEL reserves the right to postpone the shipping of the GOODS. In this event, any storage and insurance costs during the first ninety (90) days shall be borne by the VENDOR.

Loading, including lifting, securing, lashing, and stowing, of all cases, crates, or packages onto means of transportation such as, but not limited to, trailers, containers, etc.

14.0 Responsibilities and Guarantees

VENDOR is responsible for the choice of category for packing according to the transport facilities used, and on the basis of the present document. In case of doubt or disagreement regarding the choice, VENDOR must inform BHEL prior to packing and await BHEL's approval. All phases of packaging, marking, loading, etc. will be subject to BHEL inspection.

BHEL reserves the right to reject the packing when the packing does not conform to these instructions and/or when the packing does not ensure perfect protection of the GOODS. VENDOR is responsible for the weights and dimensions declared, and the marking of the packages.

The documents must be in strict conformity with the packing contents.

The packing specified in these "Packing, Marking and Shipping Instructions" is guaranteed for a twelve (12) months storage period after delivery on site.

VENDOR is responsible for providing storage recommendation adapted to the GOODS. According to this guarantee, VENDOR is held responsible in the event of goods becoming



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useless, damaged or broken, as a result of poor packing and/or stowing, or due to corrosion, subsequent to insufficient or inadequate protection. All direct or indirect costs resulting thereof, will be back-charged to VENDOR.



Quality requirement

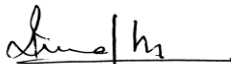
- (a) Since this items comes under Sub-QR Category, hence inspection at vendor works is applicable by BHEL/BHEL TPI and UPRVUNL/NTPC as per UPRVUNL/NTPC Approved Quality plan.
- (b) Supplier shall submit the MQP in UPRVUNL/NTPC Format (Sample QP attached herewith) for approval of UPRVUNL/NTPC. We wish to submit that attached QP is indicative only. Stage inspection and Quantum of check may vary during final approval by customer (UPRVUNL/NTPC).
- (c) With respect to Sub QR Engg may kindly comment and take care of Proveness Criteria from UPRVUNL/NTPC Engg. UPRVUNL/NTPC inform that if the item is covered under Sub-QR List, the proposed vendors for the same shall be accepted by UPRVUNL/NTPC QA subject to clearance by UPRVUNL/NTPC Engg.
- (d) Painting shall be as per approved painting schedule.
- (e) In case of order placed on foreign vendors, vendor has to finalize Inspection agency from the List enclosed in Annexure 'A' at their own cost and carry out inspection as per the approved Quality plan. Vendor has to furnish BHEL the inspection reports and other documents required as per approved Quality plan duly signed by the Inspection Agency after their witness for our review and acceptance.

(Note: NTPC is the consultant for UPRVUNL)

Annexure-A

List of Third Party Inspection Agencies

Sl no	Name of Third Party Inspection Agency
01	M/s Bureau Veritas
02	M/s TUV- Nord
03	M/s TUV- SUD
04	M/s TUV Rheinland
05	M/s Lloyds Register
06	M/s SGS
07	M/s Germanischer Lloyds
08	M/s Quest
09	M/s Certification Engineers International
10	M/s Intertek
11	M/s IR class Systems and Solutions
12	Ms/ DNV
13	M/s Fichtner
14	M/s ABS Inspection services

 MANUFACTURER'S NAME AND ADDRESS M/S BHEL: BAP: RANIPET 632 406 TAMIL NADU		STANDARD QUALITY PLAN												
		ITEM: AGITATOR SYSTEM: FGD								QP NO:		FGS: 720		
										REV. NO:		00		
										DATE:		12.02.2019		
								PAGE NO:		Page 1 of 2				
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				D *	M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D *	** 10.			11.
1.0 RAW MATERIAL INSPECTION														
1.1	All materials including casting & forgings	Chem. & Mech. Dimensions Surface Defects	MA MA MA	Review of MTC Measurement Visual	1/Heat 100% 1/Heat - 100% -		As per spec. & Appd. Dwg	TC IR IR	✓ 	P P P	V - -	V - -		
2.0 MOTOR : REVIEW OF MANUFACTURE TEST CERTIFICATE														
3.0 IN PROCESS INSPECTION														
3.1	Welding Qualifications	WPS & PQR	MA	WPS, PQR & WPQ	100%		ASME Sec IX	IR	✓	P	V	V	Recent qualified WPS, PQR and WPQ shall be submitted for review during inspection	
3.2	Marking, Cutting, Edge Preparation Tacking	Dimensions	MA	Measurement	100%	-	Appd.Dwg.	IR		P	-	-		
3.3	Welds	Dimensions & Surface Quality	MA	Measurement	100%		Appd.Dwg.& ASME Sec VIII	IR	✓	P	W	V		
3.4	Machining of Components	Dimensions Surface Defects	MA	Measurement Visual	100% 100%	- -	Appd. Dwg.	IR		P P	- -	- -		
3.5	Impeller	Static balance test	MA	Measurement	100%		As per Specs.	TR	✓	P	V	V		
3.6	Rubber Lining	Hardness test & Spark test	MA	Measurement	100%		As per Specs.	TR	✓	P	W	V		
3.7	Assembly	Dimensions Completeness	MA	Measurement Visual	100% 100%		Appd.Drg.	IR	✓	P P	V V	V V		
4.0 FINAL INSPECTION														
4.1	Final Assembly	Overall Dimensions & Completeness	MA MA	Measurement Visual	100%	10%	Appd. Dwg	IR	✓	P	W	V	*10% pf each type (Vertical / Horizontal	
LEGEND: * RECORD, IDENTIFIED WITH "TICK" (✓) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE. M: MANUFACTURER / SUB SUPPLIER, C: MAIN CONTRACTOR. N: CUSTOMER/CONSULTANT P: PERFORM W: WITNESS V: REVIEW OF RECORDS MA: MAJOR AND MI: MINOR							PREPARED BY  Rakesh Kumar Madhu,(Ser/QA)			REVIEWD & APPROVED BY  K C Gandhi Parimalam,(DGM/QA)				

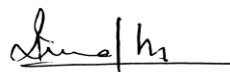
 Ranipet		MANUFACTURER'S NAME AND ADDRESS M/S BHEL: BAP: RANIPET 632 406 TAMIL NADU		STANDARD QUALITY PLAN										
				ITEM: AGITATOR SYSTEM: FGD						QP NO:		FGS: 720		
										REV. NO:		00		
										DATE:		12.02.2019		
								PAGE NO:		Page 2 of 2				
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				D *	M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D *	** 10.			11.
4.2	Free Air Run Test of complete assembly	Measurement Current, RPM, Noise & Vibration	MA	Measurement	100%	10%	Vendor Standard / Approved Drawing / Data Sheet	IR	✓	P	W	W		
4.3	Review of QA Documents	Verification of QA Documents	MA	Verification	100%	100%	As per Appd. MQP	IR		P	V	V		
5.0	PAINTING & PRESERVATION													
5.1		Painting Material	MI	Review of MTC	100%		Appd. "Painting Procedure"/Approved Painting Schedule	IR	✓	P	V	-		
5.2		Surface treatment and inspection	MI	Visual	100%	-	-do-	IR	✓	P	-	-		
5.3		DFT Check	MI	Measurement	10%		-do-	IR	✓	P	V	-		
5.4		Painting Surface Quality	MI	Visual	100%		-do-	IR	✓	P	V	-		
6.0	INSPECTION BEFORE DELIVERY													
6.1	Packing	Size, appearance & firmness	MI	Measurement & Visual	100%		As per "Packing Procedure"	IR	✓	P	V	-		
6.2	Deliver Documents	Markings, Packing List & Details Packing List, etc., Check	MI	Verification	100%		As per "Packing Procedure"	IR	✓	P	V	-		

NOTES:

1. For Agitator Motor rating is 45KW and motor make NTPC/BHEL Approved source.
2. Routine test report duly witnessed by main contractor as per applicable standard shall be reviewed during inspection (more than 30 KW Rating).

LEGEND: * RECORD, IDENTIFIED WITH "TICK" (✓) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE.
M: MANUFACTURER / SUB SUPPLIER, **C:** MAIN CONTRACTOR.
N: CUSTOMER/CONSULTANT **P:** PERFORM **W:** WITNESS **V:** REVIEW OF RECORDS
MA: MAJOR AND **MI:** MINOR

PREPARED BY



Rakesh Kumar Madhu,(Ser/QA)

REVIEWD & APPROVED BY



K C Gandhi Parimalam,(DGM/QA)