

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC																	
	The following terminology shall be followed for Annexure-I : Bidder - BHEL Bidder's subvender - Recirculation Pump manufacturer																		
4.00.00	QUALIFYING REQUIREMENTS FOR EQUIPMENTS/SYSTEMS																		
4.01.01	Provennesscriteria for critical equipment, auxiliaries, systems and bought out items: The Bidder / Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below:																		
4.01.02	Booster Fans, Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, Agitators & Vacuum Belt Filters for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured 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 reckoned as on the date of consideration for approval but not later than 30.1.2019 <u>Type and Rating for Qualification</u> <table><tr><th>Sl. No.</th><th>Name of Equipment</th><th>Type of Equipment</th><th>Application</th><th>Equipment Rating</th></tr><tr><td>(a)</td><td>Booster Fans</td><td>Axial type with variable pitch control</td><td>Coal fired power plant</td><td>80% of the flow & 100% of the head of the offered Booster Fan with Fan Speed 900 rpm (maximum)</td></tr><tr><td>(b)</td><td>Slurry Recirculation Pumps</td><td>Centrifugal type</td><td>Wet Limestone based FGD application in Coal fired power plant</td><td>80% of the flow & 100% of the head of the offered Slurry Recirculation Pump</td></tr></table>	Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating	(a)	Booster Fans	Axial type with variable pitch control	Coal fired power plant	80% of the flow & 100% of the head of the offered Booster Fan with Fan Speed 900 rpm (maximum)	(b)	Slurry Recirculation Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Recirculation Pump			
Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating															
(a)	Booster Fans	Axial type with variable pitch control	Coal fired power plant	80% of the flow & 100% of the head of the offered Booster Fan with Fan Speed 900 rpm (maximum)															
(b)	Slurry Recirculation Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Recirculation Pump															
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-4410-109-2	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 8 OF 18															

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	Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating	
	(c)	Oxidation Blowers	Centrifugal/ positive displacement type blower	Wet Limestone based FGD application in Coal fired power plant	80% of the flow & 100% of the head of the offered Oxidation Blower	
	(d)	Wet limestone Grinding mills	Horizontal Wet Ball mill	Wet Limestone based FGD application in Coal fired power plant	80% of the offered Ball mill capacity with pulverizing fineness not less than 90% thru 325 mesh	
	(e)	Slurry Pumps	Centrifugal type	Wet Limestone based FGD application or ash slurry application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Pump(s)	
	(f)	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 size unit for similar application	
	(g)	Vacuum Belt filters	Belt type	Wet Limestone based FGD application in Coal fired power plant	80% of the offered Vacuum Belt filter capacity	
4.01.03	Bidder shall offer and supply only the type of the above equipment(s) for which he himself or the manufacturer proposed by the bidder for the above equipment(s) is qualified.					
	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Booster Fans as per clause 1.2(a) above but is a manufacturer of such equipment for units of at least 500 MW rating, the Bidder or the proposed sub vendor can manufacture such equipment for 660 MW units also, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such					
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE			TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-4410-109-2		SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 9 OF 18

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4.01.04	equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.02(a) above for the Booster Fans. A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.02 above in India, can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.02 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). However, in this case, the proposed JV / Subsidiary Company before resorting to design, engineering, manufacturing of such proven equipment(s) listed at clause no. 4.01.02 above by himself should have sourced / shall source such proven equipment(s) for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s). Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later. In addition, the Bidder along with the Indian Joint Venture Company/ Subsidiary Company, qualified equipment manufacturers and its holding/ subsidiary Company, as applicable, shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed in the bidding document. The DJU shall be submitted prior to the placement of order on the approved sub-vendor for a particular equipment. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only) for each equipment.			
4.01.05	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Oxidation Blowers as per clause 4.01.02(c) above but is a manufacturer of Blowers/compressors for minimum 50 NM³/min capacity, the Bidder or the proposed sub-vendor can also manufacture Oxidation Blowers, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Oxidation Blowers in India with such manufacturer who meet the requirements stipulated at clause 4.01.02(c) above for the Oxidation Blowers. However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.			
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4.01.06	In addition, the Bidder along with the qualified equipment manufacturer shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed in the bidding document. The DJU shall be submitted prior to the placement of order on the approved sub-vendor for Oxidation Blowers. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only). In case the Bidder or the proposed sub-vendor is not manufacturer of proven Wet limestone Grinding mills as per clause 4.01.02(d) above but is a manufacturer of dry Grinding mills for power or cement industry of minimum 20 T/h capacity, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding mills, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Wet limestone Grinding mills in India with such manufacturer who meet the requirements stipulated at clause 4.01.02(d) above for the Wet limestone Grinding mills. However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments. In addition, the Bidder along with the qualified equipment manufacturer shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed in the bidding document. The DJU shall be submitted prior to the placement of order on the approved sub-vendor for Wet limestone Grinding mills. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only).			
4.01.07	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 4.01.02(f) above but is a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry, the Bidder or the proposed sub-vendor can also manufacture Agitators, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Agitators in India with such manufacturer who meet the requirements stipulated at clause 4.01.02(f) above for the Agitators. However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments. In addition, the Bidder along with the qualified equipment manufacturer shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the			
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4.01.08	successful performance of the equipment as per the format enclosed in the bidding document. The DJU shall be submitted prior to the placement of order on the approved sub-vendor for Agitators. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only). In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.01.02(e) above, the Bidder or the proposed sub-vendor can also manufacture Slurry Recirculation Pumps, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.02 (b) above for the Slurry Recirculation Pumps. However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. In addition, the Bidder along with the qualified equipment manufacturer shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed in the bidding document. The DJU shall be submitted prior to the placement of order on the approved sub-vendor for Slurry Recirculation Pumps. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only).			
4.01.09	Before taking up the manufacturing of such equipment(s) as per clause 4.01.03, 4.01.04, 4.01.05, 4.01.06, 4.01.07 & 4.01.08 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licensor's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licensor shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.			
4.01.10	Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licensor(s) proposed by the Bidder for the above equipment(s) is qualified.			
4.01.11	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract.			
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	Note to clause 4.01.02 (1) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/lignite.			
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**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE
FOR
NORTHKARANPURA STPP (3X660 MW)
BIDDING DOCUMENT NO. CS-4410-109-2**

Bidder's Name and Address:

To
Contract Services-II
NTPC Limited
Noida-201301

Summary of Critical Equipment indicated under clause 4.01.00, sub-section-I, Part-A of Section-VI.

Equipment Name	Sub-Vendor Name	Collaborator's Name, if applicable	Seeking Qualification as per clause..... Sub-Section-I, Part-A of Section-VI
Booster Fans			*4.01.01 /*4.01.02 /*4.01.03/*4.01.04
*Slurry Recirculation Pumps			*4.01.01 /*4.01.02 /*4.01.04 /*4.01.08
Oxidation Blowers			*4.01.01 /*4.01.02 /*4.01.04 /*4.01.05
Wet limestone Grinding mills			*4.01.01 /*4.01.02/4.01.04/*4.01.06/
Slurry Pumps			*4.01.01/*4.01.02/*4.01.04/*4.01.08
Agitators			*4.01.01 /*4.01.02/*4.01.04 /*4.01.07
Vacuum Belt filters			*4.01.01 /*4.01.02/*4.01.04

Note : *Strike-off whichever is not applicable.

- If qualification sought as per clause 4.01.01, sub-section-I-A, Part-A of Section-VI then the details of the sub vendor (manufacturer) shall be filled by the bidder in the format A to G.

Signature of authorized signatory.....

2. If the qualification sought as per the clause 4.01.03, sub-section-I-A, Part-A of Section-VI, then the details of proposed sub vendor (i.e manufacturer of such equipments for at least 500 MW unit rating) shall be filled individually by the bidder in the format A and the details of collaborator who meets the requirement stipulated at 4.01.02, sub-section-I-A, Part-A of Section-VI shall also be filled by the bidder in the format A separately. Further, in case of qualification vide clause 4.01.02, sub-section-I-A, Part-A of Section-VI a copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.02, sub-section-I-A, Part-A of Section-VI shall also be furnished.
3. If the qualification sought as per the clause 4.01.04, sub-section-I-A, Part-A of Section-VI then the details of JV/Subsidiary Company formed for manufacturing of such equipments in India shall be furnished individually for each equipment by the bidder such as,
- i) Copy of document of incorporation of JV/Subsidiary company in India
 - ii) Copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.02, sub-section-I-A, Part-A of Section-VI.
 - iii) Copy of document of at least 26% equity participation of qualified equipment manufacturer in the Indian JV company/subsidiary company directly or indirectly through its holding company /Subsidiary company, which shall be maintained for a lock -in period of seven (7) years from the date of incorporation of such JV/subsidiary or up to the end of defect liability period of the contract which ever is later.

Further, the details of collaborator or technology provider of the qualified equipment manufacturer who meets the requirement stipulated at 4.01.02, sub-section-I-A, Part-A of Section-VI shall be filled by the Bidder in the format A to G (format given at 1.00.00). In addition to that, the sub vendor along with the Indian JV company/subsidiary company, qualified equipment manufacturer and its holding company/subsidiary company as applicable shall furnish the DJU.

*** strike out whichever is not applicable.**

- 1.00.00 (Applicable for Bidder/his sub vendors seeking qualification as per clause no. 4.01.02, Sub section-I, Part-A of Section-VI. Bidder shall furnish the required data only for those equipments / auxiliaries which are proposed to be sourced under this route.)

We, hereby furnish the data on proveness criteria for critical equipment, auxiliaries, systems and Bought Out Items such as ~~Booster Fans, Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, Agitators & Vacuum belt filters~~ which have been designed (either by self manufacturer or under valid ongoing collaboration and technology transfer agreement), *manufactured/ *got manufactured and supplied by us /Manufacturer (or manufactured/ got manufactured & supplied by our proposed sub-vendors) and these are in successful operation in at least one (1) plant for a period not less than one year reckoned

Signature of authorized signatory.....

as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder. The details of type and minimum equipment rating of such equipment are given below :

Signature of authorized signatory.....

- B. Slurry Recirculation Pumps:** We declare that, we/our Sub-Vendor, have designed (either by itself or under collaboration / licensing agreement), *manufactured/*got manufactured and supplied at least one (1) number of Slurry Recirculation Pumps of minimum 80% of the flow & 100% of the head of the offered Slurry Recirculation Pump, Centrifugal type working in a Wet Limestone based FGD application in Coal fired power plant and which has been in successful operation for minimum one (1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder, as per the details furnished below:

Sl. No.	Description	Reference Work
1.	Name of the reference plant & location:	
2.	Client name and his address:	
3.	No. of units and capacity in MW of unit:	
4.	Whether operating in a Wet Limestone based FGD application in Coal fired power plant	- *Yes/*No
5.	Name of equipment manufacturer & address:	
6.	Date of commission of the equipments:	
7.	Model no. of the equipment:	
8.	Brief Technical particulars of the equipments:	
9.	Flow-	m ³ /h

Signature of authorized signatory.....

Sl. No.	Description	Reference Work
10.	Head-	 meters of liquid column
11.	Whether the equipment(s) are in successful operation in atleast one (01) plant for a period not less than one(01) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder	- *Yes/*No
12.	Flue gas Desulphurization system details:	*Technical extract/ *paper letter/ *email/ *Drawing from user or *contract document or *scheme or *any document in public domain enclosed at annexure....to Attachment-3K
13.	Scope of Work:	*Letter of Award or *Contract or *P.O. enclosed at Annexure.....to Attachment-3K
14.	Performance details:	*Certificate/*Letter/*E-mail from End user enclosed at Annexure.....to Attachment-3K

*** Strike off whichever is not applicable.**

Signature of authorized signatory.....

**FORM OF DEED OF JOINT UNDERTAKING TO BE PROVIDED
FOR *BOOSTER FANS/*SLURRY RECIRCULATION PUMPS/*OXIDATION BLOWERS/*WET LIMESTONE GRINDING MILLS/*SLURRY
PUMPS/*AGITATORS/*VACUUM BELT FILTERS (TO BE FILLED SEPARATELY FOR EACH APPLICABLE EQUIPMENT)
AS PER CLAUSE 4.01.04 OF SUB-SECTION-I, PART A, SECTION VI**

(ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)

DEED OF JOINT UNDERTAKING TO BE EXECUTED BY THE BIDDER/CONTRACTOR, INDIAN JV/SUBSIDIARY COMPANY MEETING THE REQUIREMENTS SPECIFIED AT CLAUSE NO. 4.01.04 OF SUB-SECTION-I, PART A, SECTION VI AND THE QUALIFIED EQUIPMENT MANUFACTURER & ITS *HOLDING/*SUBSIDIARY COMPANY(IES), AS APPLICABLE, MEETING THE REQUIREMENTS AS PER CLAUSE 4.01.02 OF SUB-SECTION-I, PART A, SECTION VI FOR ~~*BOOSTER FANS/*SLURRY RECIRCULATION PUMP/*OXIDATION BLOWERS/*WET LIMESTONE GRINDING MILLS/*SLURRY PUMPS/*AGITATORS/*VACUUM BELT FILTERS~~ IN WHICH EXECUTANT OF THE DJUs ARE JOINTLY AND SEVERALLY LIABLE FOR THE SUCCESSFUL PERFORMANCE OF THE *BOOSTER FANS/*SLURRY RECIRCULATION PUMP/*OXIDATION BLOWERS/*WET LIMESTONE GRINDING MILLS/*SLURRY PUMPS/*AGITATORS/*VACUUM BELT FILTERS

The DEED OF UNDERTAKING executed thisday ofTwo thousandby M/sa Company incorporated underhaving its Registered Office at (hereinafter called the "Bidder/Contractor", which expression shall include its successors, administrators, executors and permitted assigns) AND

****M/s**, a JV / SUBSIDIARY COMPANY as per the requirement of clause 4.01.04 of sub-section-I, Part-A, Section-VI, incorporated under having its Registered Office at (hereinafter called the " Indian JV/ SUBSIDIARY Manufacturing Company"), which expression shall include its successors, administrators, executors and permitted assigns) AND

M/shaving its Registered Office at (hereinafter called the "Qualified Equipment Manufacturer", which expression shall include its successors, administrators, executors and permitted assigns) AND

*M/sA Company registered underhaving its Registered Office at , hereinafter called holding/ subsidiary company of the qualified equipment manufacturer in favour of NTPC Limited, A Government of India Enterprise, incorporated under the Companies Act, 1956, having its Registered Office at NTPC Bhawan, Scope Complex, 7, Institutional Area, Lodhi Road, New Delhi-110003 INDIA (hereinafter called "NTPC" or "Employer" which expression shall include its successors, administrators, executors and assigns).

Signature of authorized signatory.....

WHEREAS, the Employer invited Bids for design, engineering, manufacture, supply, transportation to site, construction, installation, testing, commissioning and conductance of guarantee tests for the **Flue Gas Desulphurisation (FGD) System Package** for **North Karanpura STPP (3X660MW)** (hereinafter referred to as "Plant") vide its Bidding Document No. **CS-4410-109-2**.

AND WHEREAS vide clause 4.01.04 of Sub-Section-I, Part A, Section VI of bidding documents, it has been specified that a Qualified Indian Manufacturing Company can also manufacture equipment listed at clause no. 4.01.02 (...) of Sub-Section-I, Part A, Section VI for which it is qualified, provided that it has a valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing of ~~*BOOSTER FANS/*SLURRY RECIRCULATION PUMP/*OXIDATION BLOWERS/*WET LIMESTONE GRINDING MILLS/*SLURRY PUMPS/*AGITATORS/*VACUUM BELT FILTERS~~ in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.02(...) of Sub-Section-I, Part-A, Section-VI of bidding documents. Before taking up the manufacturing of ~~*BOOSTER FANS/*SLURRY RECIRCULATION PUMP/*OXIDATION BLOWERS/*WET LIMESTONE GRINDING MILLS/*SLURRY PUMPS/*AGITATORS/*VACUUM BELT FILTERS~~, the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/ licensor's design, manufacturing and quality control system for Wet limestone Grinding mill. In addition, the Bidder/Contractor along with the Qualified Indian JV/SUBSIDIARY Manufacturing Company, qualified equipment manufacturers and its holding/subsidiary company shall furnish DJU for each equipment in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment.

WHEREAS M/s (Bidder/Contractor) has submitted its proposal in response to the aforesaid Invitation for Bid by the Employer bearing No. dated for **Flue Gas Desulphurisation (FGD) System Package** for **North Karanpura STPP (3X660MW)** (hereinafter referred to as "Plant") vide its Bidding Document No. **CS-4410-109-2**.

AND WHEREAS M/s (Indian JV/SUBSIDIARY Company) meets the requirement of clause 4.01.04 of sub-section-I, Part-A, Section-VI and has a valid ongoing collaboration*/licensing* agreement for design, engineering, manufacturing of(Name Of Equipment) in India with M/swho meets the requirements stipulated at clause 4.01.02(a)*/(b)*/(c)*/(d)*/(e)*/(f)*/(g)* of Sub-Section-I, Part A, Section-VI of bidding documents.

AND WHEREAS M/s (Qualified Equipment Manufacturer) meets the requirements of clause 4.01.02 of sub-section-I, Part-A, Section-VI for(Name Of Equipment)

AND WHEREAS M/s..... directly*/indirectly through its holding/subsidiary company M/s* have atleast 26% equity participation in the Indian JV/SUBSIDIARY Company which shall be maintained for a lock in period of seven (7) years from the date of incorporation of the Indian JV/ SUBSIDIARY Company or upto the end of defect liability of the contract whichever is later.

Signature of authorized signatory.....

AND WHEREAS the Bidder/Contractor along with the *Qualified Indian Manufacturing Company , Qualified Equipment Manufacturers alongwith its holding/subsidiary company are required to jointly execute and furnish prior to the placement of order for..... (Name of equipment), an irrevocable Deed of Joint Undertaking and be jointly and severally responsible and bound unto the Employer for successful performance of the (Name of Equipment) for **North Karanpura STPP (3X660MW) Project** fully meeting the stipulated technical requirements, guaranteed parameters and characteristics as per the Bidding Documents, in the event the bid is accepted by the Employer resulting into a Contract.

NOW THEREFORE, THIS DEED WITNESSETH AS UNDER:

1. We the Qualified Equipment Manufacturer and the Indian JV/SUBSIDIARY Company and the Bidder/Contractor, do hereby declare and undertake that we shall be jointly and severally responsible to the Employer for the successful performance of the (Name of Equipment).
2. In case of any breach of the Contract committed by the Indian JV/SUBSIDIARY, we the Bidder/Contractor and Qualified Equipment Manufacturer do hereby undertake, declare and confirm that we shall be fully responsible for the successful performance of the (Name of Equipment) and undertake to carryout all the obligations and responsibilities under this Deed of Joint Undertaking in order to discharge the Indian JV/SUBSIDIARY Company obligations stipulated under the Contract. Further, if the Employer sustains any loss or damage on account of any breach of the Contract for the (Name of Equipment), we the Bidder/Contractor and Qualified Equipment Manufacturer jointly and severally undertake to promptly indemnify and pay such loss/damages caused to the Employer on its written demand without any demur, reservation, Contest or protest in any manner whatsoever. This is without prejudice to any rights of the Employer against the Contractor/ his Sub-Vendor under the Contract and/or guarantees. It shall not be necessary or obligatory for the Employer to first proceed against the Indian JV/SUBSIDIARY Company / Bidder/Contractor before proceeding against the Qualified Equipment Manufacturer nor any extension of time or any relaxation given by the Employer to the Qualified Indian Manufacturing Company / **Bidder/Contractor shall prejudice any rights of the Employer under this Deed of Joint Undertaking to proceed against the Qualified Equipment Manufacturer.
3. The liability of the Contractor, his sub-vendor and Associate/Collaborator shall be limited to an amount equal to 100% of the value of the contract** between the contractor and the sub supplier for the equipment.
4. Without prejudice to the generality of the Undertaking in paragraph 1 above, the manner of achieving the objective set forth in paragraph 1 above shall be as follows:
 - (a) We the Qualified Equipment Manufacturer shall ensure that complete design, manufacturing, quality assurance and installation of the (Name of Equipment) is carried out inline with our manufacturing & quality drawings and

Signature of authorized signatory.....

procedures and shall be fully responsible for its compliance so as to ensure satisfactory, reliable, safe and trouble free performance of (Name of Equipment).

Further, we, the Qualified Equipment Manufacturer shall extend our quality surveillance/ supervision/ quality control to the Contractor during manufacture, erection, commissioning and performance testing, both at Qualified Indian Manufacturing Company's works and/ or at Employer's project site.

Further, the Qualified Equipment Manufacturer shall depute their technical experts from time to time to the Indian JV/SUBSIDIARY Manufacturing Company's works/ Employer's project site as required by the Employer and agreed to by Indian JV/SUBSIDIARY Manufacturing Company to facilitate the successful performance of the (Name of Equipment) as stipulated in the aforesaid Contract.

Further, the Qualified Equipment Manufacturer shall ensure proper design, manufacture, installation, testing and successful performance of the (Name of Equipment) under the said Contract in accordance with stipulations of Bidding Documents and if necessary, the Qualified Equipment Manufacturer shall advise the Indian JV/SUBSIDIARY Manufacturing Company suitable modifications of design and implement necessary corrective measures to discharge the obligations under the contract.

- (b) In the event Indian JV/SUBSIDIARY Manufacturing Company /Contractor fail to demonstrate that the (Name of Equipment) meets the guaranteed parameters and demonstration parameters as specified in the contract, the Qualified Equipment Manufacturer shall promptly carry out all the corrective measures related to engineering services at their own expense and shall promptly provide corrected design to the Employer.
- (c) Implementation of the corrected design and all other necessary repairs, replacements, rectification or modifications to the (Name of Equipment) and payment of financial liabilities and penalties and fulfillment of all other contractual obligations as provided under the contract shall be the joint and severally responsibility of the Contractor and Indian JV/SUBSIDIARY Manufacturing Company and Qualified Equipment Manufacturer.

- 5. We, the Bidder/Contractor and Qualified Equipment Manufacturer and the Indian JV/SUBSIDIARY Manufacturing Company do hereby undertake and confirm that this Undertaking shall be irrevocable and shall not be revoked till ninety (90) days after the end of the defect liability period of the equipment covered under the Contract and further stipulate that the Undertaking herein contained shall terminate after ninety (90) days of satisfactory completion of such defect liability period. In case of delay in completion of defect liability period, the validity of this Deed of Joint Undertaking shall be extended by such period of delay. We further agree that this Undertaking shall be

Signature of authorized signatory.....

without any prejudice to the various liabilities of the Contractor including Contract Performance Security as well as other obligations of the Contractor in terms of the Contract.

6. The Bidder/Contractor and Qualified Equipment Manufacturer will be fully responsible for the quality of all the equipment/main assemblies/components manufactured at their works or at their Vendors' works or constructed at site, and their repair or replacement, if necessary, for incorporation in the Plant and timely delivery thereof to meet the completion schedule under the Contract.
7. In case of Award, in addition to the Contract Performance Security for the Contract, the Qualified Equipment Manufacturer, Its holding/subsidiary company (as applicable) and Indian JV/SUBSIDIARY manufacturing company shall furnish 'as security' an on demand Performance Bank Guarantee in favour of the Employer as per provisions of the bidding documents. The value of such Bank Guarantee shall be equal to **INR 1.5 Million (Indian Rupees One and half Million) for each** and it shall be guarantee towards the faithful performance /compliance of this Deed of Joint Undertaking in accordance with the terms and conditions specified herein. The bank guarantee shall be unconditional, irrevocable and valid till ninety (90) days beyond the end of defect liability period of the last equipment covered under the Contract. In case of delay in completion of the defect liability period, the validity of this Bank Guarantee shall be extended by the period of such delay. The guarantee amount shall be promptly paid to the Employer on demand without any demur, reservation, protest or contest.
8. Any dispute that may arise in connection with this Deed of Joint Undertaking shall be settled as per arbitration procedure/rules mentioned in the Contract Documents. This Deed of Joint Undertaking shall be construed and interpreted in accordance with the Laws of India and the Courts of Delhi shall have exclusive jurisdiction.
9. We, the Bidder/Contractor and Qualified Equipment Manufacturer and the Indian JV/SUBSIDIARY Manufacturing Company shall form an integral part of the Contracts from the date of signing of this Deed of Joint Undertaking. We further agree that this Deed of Joint Undertaking shall continue to be enforceable till its validity.
10. That this Deed of Joint Undertaking shall be operative from the effective date of signing of this Deed of Joint Undertaking.

IN WITNESS WHEREOF, the Bidder/Contractor and Qualified Equipment Manufacturer and its holding/subsidiary company (as applicable) and the Indian JV/SUBSIDIARY Manufacturing Company through their authorised representatives, have executed these presents and affixed common seal of their respective companies, on the day, month and year first mentioned above.

1. WITNESS
For M/s
(Bidder/Contractor)

Signature of authorized signatory.....

.....
(Signature Name)

(Signature of the Authorised
Representative)

.....
(Official Address)

Name

Designation

Common Seal of the
Company

1. WITNESS

For M/s
(Indian JV/SUSIDIARY Company)

.....
(Signature Name)
Representative)

(Signature of the Authorised

.....
(Official Address)

Name.....

Designation

Company

Common Seal of the

1. WITNESS

For M/s
(Qualified Equipment Manufacturer)

.....
(Signature Name)

(Signature of the Authorised
Representative)

Signature of authorized signatory.....

FORM OF DEED OF JOINT UNDERTAKING TO BE PROVIDED
FOR SLURRY RECIRCULATION PUMP
AS PER CLAUSE 4.01.08 OF SUB-SECTION-I, PART A, SECTION VI

(ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)

DEED OF JOINT UNDERTAKING TO BE EXECUTED BY THE BIDDER/CONTRACTOR, QUALIFIED INDIAN MANUFACTURING COMPANY MEETING THE REQUIREMENTS SPECIFIED AT CLAUSE NO. 4.01.08 OF SUB-SECTION-I, PART A, SECTION VI AND QUALIFIED EQUIPMENT MANUFACTURER OF SLURRY PUMPS MEETING THE REQUIREMENTS AT CLAUSE 4.01.02 (e) OF SUB-SECTION-I, PART A, SECTION VI FOR SLURRY RECIRCULATION PUMP FOR SUCCESSFUL PERFORMANCE OF SLURRY RECIRCULATION PUMP IN WHICH EXECUTANT OF THE DJU ARE JOINTLY AND SEVERALLY LIABLE FOR THE SUCCESSFUL PERFORMANCE OF THE SLURRY RECIRCULATION PUMP

The DEED OF UNDERTAKING executed thisday ofTwo thousandby M/sa Company incorporated underhaving its Registered Office at (hereinafter called the "Bidder/Contractor", which expression shall include its successors, administrators, executors and permitted assigns) AND

M/s, a **SLURRY PUMPS manufacturer as per the requirement of clause 4.01.08 of sub-section-I, Part-A, Section-VI, incorporated under having its Registered Office at (hereinafter called the "Qualified Indian Manufacturing Company"), which expression shall include its successors, administrators, executors and permitted assigns) AND

M/sa **SLURRY PUMPS** manufacturer meeting the requirements of clause **4.01.02(b)** of sub-section-I, Part-A, Section-VI for slurry recirculation pump incorporated underhaving its Registered Office at (hereinafter called the "Qualified Equipment Manufacturer", which expression shall include its successors, administrators, executors and permitted assigns) AND

in favour of NTPC Limited, A Government of India Enterprise, incorporated under the Companies Act, 1956, having its Registered Office at NTPC Bhawan, Scope Complex, 7, Institutional Area, Lodhi Road, New Delhi-110003 INDIA (hereinafter called "NTPC" or "Employer" which expression shall include its successors, administrators, executors and assigns).

WHEREAS, the Employer invited Bids for design, engineering, manufacture, supply, transportation to site, construction, installation, testing, commissioning and conductance of guarantee tests for the **Flue Gas Desulphurisation (FGD) System Package for North Karanpura STPP (3X660MW)** (hereinafter referred to as "Plant") vide its Bidding Document No. **CS-4410-109-2**.

Signature of authorized signatory.....

AND WHEREAS vide clause 4.01.08 of Sub-Section-I, Part A, Section VI of bidding documents, it has been specified that a Qualified Indian Manufacturing Company can also manufacture equipment listed at clause no. **4.01.02(b)** of Sub-Section-I, Part A, Section VI for which it is qualified, provided that it has a valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing of **SLURRY PUMPS/SLURRY RECIRCULATION PUMP** in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.02(e) of Sub-Section-I, Part-A, Section-VI for SLURRY RECIRCULATION PUMP of bidding documents. Before taking up the manufacturing of **SLURRY RECIRCULATION PUMPS**, the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/ licensor's design, manufacturing and quality control system for **SLURRY RECIRCULATION PUMPS**. In addition, the Bidder/Contractor along with the Qualified Indian Manufacturing Company, qualified equipment manufacturers shall furnish DJU for each equipment in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment.

WHEREAS M/s (Bidder/Contractor) has submitted its proposal in response to the aforesaid Invitation for Bid by the Employer bearing No. dated for **Flue Gas Desulphurisation (FGD) System Package for North Karanpura STPP (3X660MW)** (hereinafter referred to as "Plant") vide its Bidding Document No. **CS-4410-109-2**.

AND WHEREAS M/s (Qualified Indian Manufacturing Company) meets the requirement of clause 4.01.08 of sub-section-I, Part-A, Section-VI and has a valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of(Name Of Equipment) in India with M/swho meets the requirements stipulated at clause 4.01.02(e) of Sub-Section-I, Part A, Section-VI of bidding documents.

AND WHEREAS M/s (Qualified Equipment Manufacturer) meets the requirements of clause 4.01.02(e) of sub-section-I, Part-A, Section-VI for(Name Of Equipment).

The Bidder/Contractor along with the *Qualified Indian Manufacturing Company , Qualified Equipment Manufacturers, are required to jointly execute and furnish prior to the placement of order for..... (Name of equipment), an irrevocable Deed of Joint Undertaking and be jointly and severally responsible and bound unto the Employer for successful performance of the (Name of Equipment) for **North Karanpura STPP (3X660MW) Project** fully meeting the stipulated technical requirements, guaranteed parameters and characteristics as per the Bidding Documents, in the event the bid is accepted by the Employer resulting into a Contract.

NOW THEREFORE, THIS DEED WITNESSETH AS UNDER:

1. We the Qualified Equipment Manufacturer and the Qualified Indian Manufacturing Company and the Bidder/Contractor, do hereby declare and undertake that we shall be jointly and severally responsible to the Employer for the successful performance of the (Name of Equipment).

Signature of authorized signatory.....

2. In case of any breach of the Contract committed by the Qualified Indian Manufacturing Company, we the Bidder/Contractor and Qualified Equipment Manufacturer do hereby undertake, declare and confirm that we shall be fully responsible for the successful performance of the (Name of Equipment) and undertake to carryout all the obligations and responsibilities under this Deed of Joint Undertaking in order to discharge the Qualified Indian Manufacturing Company obligations stipulated under the Contract. Further, if the Employer sustains any loss or damage on account of any breach of the Contract for the (Name of Equipment), we the Bidder/Contractor and Qualified Equipment Manufacturer jointly and severally undertake to promptly indemnify and pay such loss/damages caused to the Employer on its written demand without any demur, reservation, Contest or protest in any manner whatsoever. This is without prejudice to any rights of the Employer against the Contractor/ his Sub-Vendor under the Contract and/or guarantees. It shall not be necessary or obligatory for the Employer to first proceed against the Indian Qualified Indian Manufacturing Company / Bidder/Contractor before proceeding against the Qualified Equipment Manufacturer nor any extension of time or any relaxation given by the Employer to the Qualified Indian Manufacturing Company / **Bidder/Contractor shall prejudice any rights of the Employer under this Deed of Joint Undertaking to proceed against the Qualified Equipment Manufacturer.
3. The liability of the Contractor, his sub-vendor and Associate/Collaborator shall be limited to an amount equal to 100% of the value of the contract** between the contractor and the sub supplier for the equipment.
4. Without prejudice to the generality of the Undertaking in paragraph 1 above, the manner of achieving the objective set forth in paragraph 1 above shall be as follows:
 - (a) We the Qualified Equipment Manufacturer shall ensure that complete design, manufacturing, quality assurance and installation of the (Name of Equipment) is carried out inline with our manufacturing & quality drawings and procedures and shall be fully responsible for its compliance so as to ensure satisfactory, reliable, safe and trouble free performance of (Name of Equipment).

Further, we, the Qualified Equipment Manufacturer shall extend our quality surveillance/ supervision/ quality control to the Contractor during manufacture, erection, commissioning and performance testing, both at Qualified Indian Manufacturing Company's works and/ or at Employer's project site.

Further, the Qualified Equipment Manufacturer shall depute their technical experts from time to time to the Qualified Indian Manufacturing Company's works/ Employer's project site as required by the Employer and agreed to by Qualified Indian Manufacturing Company to facilitate the successful performance of the (Name of Equipment) as stipulated in the aforesaid Contract.

Signature of authorized signatory.....

Further, the Qualified Equipment Manufacturer shall ensure proper design, manufacture, installation, testing and successful performance of the (Name of Equipment) under the said Contract in accordance with stipulations of Bidding Documents and if necessary, the Qualified Equipment Manufacturer shall advise the Qualified Indian Manufacturing Company suitable modifications of design and implement necessary corrective measures to discharge the obligations under the contract.

- (b) In the event Indian Qualified Indian Manufacturing Company /Contractor fail to demonstrate that the (Name of Equipment) meets the guaranteed parameters and demonstration parameters as specified in the contract, the Qualified Equipment Manufacturer shall promptly carry out all the corrective measures related to engineering services at their own expense and shall promptly provide corrected design to the Employer.
- (c) Implementation of the corrected design and all other necessary repairs, replacements, rectification or modifications to the (Name of Equipment) and payment of financial liabilities and penalties and fulfillment of all other contractual obligations as provided under the contract shall be the joint and severally responsibility of the Contractor and Qualified Indian Manufacturing Company and Qualified Equipment Manufacturer.

- 5. We, the Bidder/Contractor and Qualified Equipment Manufacturer and the Qualified Indian Manufacturing Company do hereby undertake and confirm that this Undertaking shall be irrevocable and shall not be revoked till ninety (90) days after the end of the defect liability period of the equipment covered under the Contract and further stipulate that the Undertaking herein contained shall terminate after ninety (90) days of satisfactory completion of such defect liability period. In case of delay in completion of defect liability period, the validity of this Deed of Joint Undertaking shall be extended by such period of delay. We further agree that this Undertaking shall be without any prejudice to the various liabilities of the Contractor including Contract Performance Security as well as other obligations of the Contractor in terms of the Contract.
- 6. The Bidder/Contractor and Qualified Equipment Manufacturer will be fully responsible for the quality of all the equipment/main assemblies/components manufactured at their works or at their Vendors' works or constructed at site, and their repair or replacement, if necessary, for incorporation in the Plant and timely delivery thereof to meet the completion schedule under the Contract.
- 7. In case of Award, in addition to the Contract Performance Security for the Contract, the Qualified Equipment Manufacturer and Qualified Indian manufacturing company shall furnish 'as security' an on demand Performance Bank Guarantee in favour of the Employer as per provisions of the bidding documents. The value of such Bank Guarantee shall be equal to **INR 1.5 Million for each (Indian Rupees One and half Million)** and it shall be guarantee towards the faithful performance /compliance of this Deed of Joint Undertaking in accordance with the terms and conditions specified herein. The bank guarantee shall be unconditional, irrevocable and valid till ninety (90) days beyond the end of defect liability period of the last equipment covered under the Contract. In case of delay in completion of the defect

Signature of authorized signatory.....

liability period, the validity of this Bank Guarantee shall be extended by the period of such delay. The guarantee amount shall be promptly paid to the Employer on demand without any demur, reservation, protest or contest.

8. Any dispute that may arise in connection with this Deed of Joint Undertaking shall be settled as per arbitration procedure/rules mentioned in the Contract Documents. This Deed of Joint Undertaking shall be construed and interpreted in accordance with the Laws of India and the Courts of Delhi shall have exclusive jurisdiction.
9. We, the Bidder/Contractor and Qualified Equipment Manufacturer and the Qualified Indian Manufacturing Company shall form an integral part of the Contracts from the date of signing of this Deed of Joint Undertaking. We further agree that this Deed of Joint Undertaking shall continue to be enforceable till its validity.
10. That this Deed of Joint Undertaking shall be operative from the effective date of signing of this Deed of Joint Undertaking.

IN WITNESS WHEREOF, the Bidder/Contractor and Qualified Equipment Manufacturer and the Qualified Indian Manufacturing Company through their authorised representatives, have executed these presents and affixed common seal of their respective companies, on the day, month and year first mentioned above.

- | | | |
|----|-----------------------------|--|
| 1. | WITNESS | For M/s
(Bidder/Contractor) |
| |
(Signature Name) | (Signature of the Authorised
Representative) |
| |
(Official Address) | Name

Designation

Common Seal of the
Company |
| 1. | WITNESS | For M/s |

Signature of authorized signatory.....

(Qualified Indian Manufacturing Company)

.....
(Signature Name)
Representative)

(Signature of the Authorised

.....
(Official Address)

Name.....

Designation

Company

Common Seal of the

1. WITNESS

For M/s
(Qualified Equipment Manufacturer)

.....
(Signature Name)

(Signature of the Authorised
Representative)

.....
(Official Address)

Name.....

Designation

Common Seal of the
Company

Note : Power of Attorney of the persons signing the said Deed of Joint Undertaking is to be furnished.

* Contractor/Sub-Vendor shall strike out, whichever is not applicable

** copy of priced purchase order for the equipment/system shall be furnished by the Bidder.

Signature of authorized signatory.....

Sl.No	3890106E : Annexure-I : Provenness Criteria and/or Qualification Requirement	Bidder response
1	SLURRY RECIRCULATION PUMP for Wet Limestone based Flue Gas Desulphurization (FGD) application in coal fired power plant offered by the bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under colloboration/Licensing agreement) manufactured/got manufactured the respective equipmet(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 reckoned as on the date of consideration for approval but not later than 30.01.2019.	
2	Name of Equipment : SLURRY RECIRCULATION PUMP	
3	Type of Equipment : CENTRIFUGAL TYPE	
4	Application: Wet Limestone based FGD application in Coal fired power plant	
5	Equipment rating : 80% OF THE FLOW AND 100% OF THE HEAD OF THE OFFERED SLURRY RECIRCULATION PUMP	
6	Bidder shall offer and supply only the type of above equipment (s) for which he/himself is qualified.	
7	Performance certificate from End User has to be provided for meeting the qualification requirement.	
8	Specific conformation to clause 4.00.00 of Annexure-I Qualification Requirement/Provenness Crieteria	
9	Specific conformation to clause 4.01.01 of Annexure-I Qualification Requirement/Provenness Crieteria	
10	Specific conformation to clause 4.01.02 of Annexure-I Qualification Requirement/Provenness Crieteria	
11	Specific conformation to clause 4.01.04 of Annexure-I Qualification Requirement/Provenness Crieteria	
12	Specific conformation to clause 4.01.08 of Annexure-I Qualification Requirement/Provenness Crieteria	
13	Specific conformation to clause 4.01.09 of Annexure-I Qualification Requirement/Provenness Crieteria	
14	Specific conformation to clause 4.01.10 of Annexure-I Qualification Requirement/Provenness Crieteria	
15	Specific conformation to clause 4.01.11 of Annexure-I Qualification Requirement/Provenness Crieteria	
16	Conformation to all the points of ATTACHMENT 3K documents, Filled in, Signed, Official Seal Affixed in all pages and shall be submitted the document ATTACHMENT 3K IN PART - I BID . This is mandatory to evluate your offer for further processing.	

TECHNICAL SPECIFICATION

FOR

RECIRCULATION PUMPS

CONFIDENTIAL

CUSTOMER : NATIONAL THERMAL POWER CORPORATION(NTPC)
PROJECT : NORTH KARANPURA 3x660MW
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM



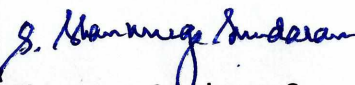
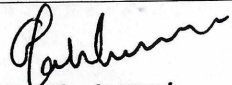
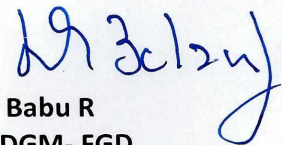
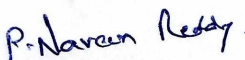
BHARAT HEAVY ELECTRICALS LIMITED
(A GOVT OF INDIA UNDERTAKING)
Flue Gas Desulphurization Group
Ranipet



TECHNICAL SPECIFICATION OF RECIRCULATION PUMP
NTPC-NORTH KARANPURA (3X660 MW)

NORTH KARANPURA:FGD:ARP:R00

TECHNICAL SPECIFICATION FOR RECIRCULATION PUMP

Prepared	Checked	Approved
 Shanmuga Sundaram S, Dy.Mgr-FGD	 Kabilash KM/ S.Engr-FGD	 Babu R DGM- FGD  EDC BHEL / KARANPURA Sulphurisation 632 406.
	 Naveen Reddy, Mgr-FGD	
	 EC&I	
	 Quality	
Revision – 00 Dated 28-12-18	COMMENTS : -----	

This document is meant for the exclusive purpose of bidding against this specification and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued.



**TECHNICAL SPECIFICATION OF RECIRCULATION PUMP
NTPC-NORTH KARANPURA (3X660 MW)**

NORTH KARANPURA:FGD:ARP:R00

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TECHNICAL SPECIFICATION OF RECIRCULATION PUMP NTPC-NORTH KARANPURA (3X660 MW)

NORTH KARANPURA:FGD:ARP:R00

1.0 PROJECT INFORMATION:

North Karanpura Super Thermal Power Project (3x660 MW) is located in Hazaribagh and Chatra districts of Jharkhand State. Basic inputs i.e. coal, water and land have already been tied up. The project is proposed for the States & Union Territories of Northern, Western and Eastern Regions and the State of Jharkhand.

The capacity of the project is 1980 MW comprising of three (3) units of 660 MW each

a.	Owner	NTPC
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	Jharkhand
b.	District	Chatra

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 pump shall follow the latest applicable Indian/International (ASME/EN/Japanese)



TECHNICAL SPECIFICATION OF RECIRCULATION PUMP NTPC-NORTH KARANPURA (3X660 MW)

NORTH KARANPURA:FGD:ARP:R00

Standards. GB standards are not acceptable. In general, pumps shall confirm to latest edition of the following standards

- IS: 1520: Horizontal centrifugal pumps for clear cold fresh water
- IS: 5120: Technical requirements of rotor dynamic special purpose pumps
- API:610: Centrifugal pumps for general refinery service
- IS:5639: Pumps handling chemicals & corrosion liquids
- IS:5659: Pumps for process water
- HIS: Hydraulic Institute Standards USA
- ASTM-1-165-65: Standard methods for Liquid Penetration Inspection

3.0 INTENT OF SPECIFICATION

This specification covers the minimum requirements for the complete design, material, manufacturing, shop inspection, performance testing at the manufacturer's works, delivery supervision of erection & performance testing at bidder's works of Recirculation pump along with accessories which is furnished in the Flue Gas Desulphurization plant of NORTH KARANPURA 3x660 MW FGD system. The following points may be noted.

- Total 15 nos of Recirculation pumps are required .i.e. 5 Nos of RC pumps per unit.
- Bidder shall assume full 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.
- The Bidder shall offer only proven design which meets the Provenness criteria indicated in the **Annexure-I**. Necessary document evidences as per **Attachment-3K 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.
- 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-IV**)".
- Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable.
- No deviation or exception shall be permitted without the written approval of the purchaser.
- 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.
- 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.
- 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.



**TECHNICAL SPECIFICATION OF RECIRCULATION PUMP
NTPC-NORTH KARANPURA (3X660 MW)**

NORTH KARANPURA:FGD:ARP:R00

4.0 PROVENNESS CRITERIA:

The Bidders are required to meet the Qualification Requirement (QR) for Recirculation Pumps as per **Annexure-I & submit the Annexure to qualification requirement (Attachment-3K)** . Offer will be rejected if bidder is not meeting the Qualification Criteria.

5.0 TECHNICAL INFORMATION

S.No	Description	Requirement
1.	Quantity	
	Quantity of Recirculation Pumps for Unit-1	5 no's (4 working + 1 standby)
	Quantity of Recirculation Pumps for Unit-2	5 no's (4 working + 1 standby)
	Quantity of Recirculation Pumps for Unit-3	5 no's (4 working + 1 standby)
	Total	15 no's
2.	Parameters	
	Pump Design capacity	14000 m ³ /hr.
	Pump discharge Head	20.4 m H
	Medium to be handled	Gypsum slurry
	Slurry Analysis	Refer Clause 5.1
	Type of Recirculation pump	Impeller Centrifugal (non- Clogging) type
	Nozzle Orientation	End Suction- Top Discharge
	Seal Type	Single Mechanical seal
	Duty	Continuous
	Location	Outdoor
3.	POWER SUPPLY	
	The following voltage levels shall apply:	
	3.3 kV $\pm 6\%$, 50 Hz	Voltage for motors equal to / bigger than 200KW and for power distribution within the plant.
	415 V $\pm 10\%$, 50Hz	Standard voltage for power supplies to small electric power consumers and motors below 200KW lighting and domestic power outlets
	Bidder shall design and supply the equipment suitable for satisfactory operation under above mentioned power supply condition.	



TECHNICAL SPECIFICATION OF RECIRCULATION PUMP NTPC-NORTH KARANPURA (3X660 MW)

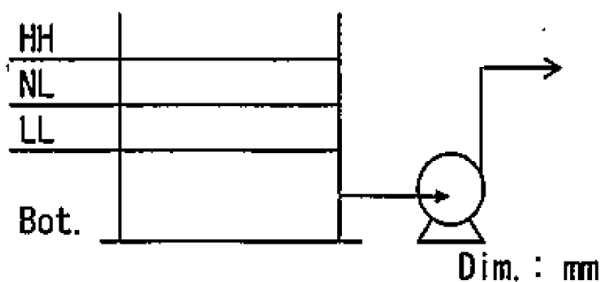
NORTH KARANPURA:FGD:ARP:R00

5.1 SLURRY ANALYSIS

S.No	Constituents	Parameters
1.	Slurry to be handled	Gypsum Slurry
2.	Chloride Content	<22500 ppm
3.	Specific Gravity at pump section	1.217 @ design and 1.215 @ guarantee point
4.	Vapor Pressure at Pump	23.2 KPa
5.	Viscosity at Pump	0.01 Pa.S
6.	Concentration of Solid	30% wt.
7.	SiO ₂ Content	4 to 6 g/l
8.	pH	4-8
9.	Slurry Temperature	63 deg c(normal) 70 deg c(max)

5.2 ABSORBER TANK LEVEL

HH	Bottom +	6,500	
NL	Bottom +	5000	@ NPSH Base
LL	Bottom +	4,200	



S.No	NPSH Calculation Results	SI Unit	Value
1	Discharge Pressure	kg/cm ² G	3.066
2	Suction Pressure	kg/cm ² G	0.583
3	Differential Pressure	kg/cm ² G	2.484
4	Max. Suction Pressure	kg/cm ² G	0.766
5	NPSH av.	m	10.74

5.3 WATER ANALYSIS

The following water to be used for flushing of the Recirculation pump.

S.No	Constituents	Unit	Water quality
1.	Total Dissolved Solids	ppm	~330
2.	Calcium	ppm	26
3.	Magnesium as Mg	ppm	10
4.	Sodium as Na	ppm	45



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S.No	Constituents	Unit	Water quality
5.	Potassium as K	ppm	3.9
6.	Iron as Fe	ppm	1.2
7.	Chlorides as Cl	ppm	19.2 mg/lit
8.	Sulphate as SO ₄	ppm	32.6
9.	Silica	ppm	9
10.	pH		7.6 to 8.2
11.	Turbidity	NTU	<200

5.4 OPERATION & PUMP PERFORMANCE

a) Operating Description:

Operating Description of the pumps is as follows. Pumps shall cover this entire operation mode

1. No of Boilers-3 No's
2. Five (05) pumps (4 working + 1 standby) are connected to the common header of the recirculation line per boiler
3. Operating modes of this pumps are:
 - (1) Sequential startup of the pumps one by one
 - (2) i) Four (04) Pumps in continuous operation per boiler
ii) Three (03) Pumps in continuous operation per boiler
 - (3) Sequential shut down of the pumps one by one
 - (4) Emergency shutdown of maximum four (04) pumps per boiler at the same time in case of power failure. In this case the discharge valve of the pumps will be fully closed within 15 sec. Pump shall endure reverse flow.

4. Table-1 Pump Operating condition

S.No	Condition	Required total flow rate m ³ /hr	Required Pump Head m	Each Pump Capacity (m ³ /hr)	Pump Head (m)	Pump Efficiency (%)	Shaft Power consumption (KW)
1	4 Pumps in Continuous operation	56,000	20.4			> 87%	

b) Pump Performance (Important): The following are the requirement on the pump performance

- (1) The capacity of the pump (design Condition) shall be 14000 m³/hr. at the pump head of 20.4 meter Height.
- (2) The shaft power at the design conditions specified in (1) shall be kept as minimum as possible (overall pump efficiency **shall not be less than 87%**) and this shaft power shall be guaranteed by the vendor.



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6.0 SCOPE OF SUPPLY

Scope for the bidders shall include Design, 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 NTPC.

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, handing over to customer

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

Sl. No	Scope
1.	Recirculation pump complete with
	i. Casing
	ii. Rotor and Shaft assembly
	iii. Gear box Coupling arrangement
	iv. Common base frame and shock pads
	v. Single Mechanical seal with automatic flushing with a connection for additional manual flushing.
	vi. Flushing and drain system
	vii. Coupling guards
	viii. Expansion joints at Inlet and Discharge with limiting bolt & nuts.
	ix. Companion flanges with gaskets and fasteners
	x. Casing drain terminated at battery limit with flange as applicate
	xi. Bearing cooling as applicate
	xii. Lubrication system as applicate
	xiii. Foundation bolts for supplied items
	xiv. Mechanical Running and Performance test at shop
	xv. Instrument like bearing temp sensor,tc. as per requirements
	xvi. Painting and Rust Prevention during shipment and construction
	xvii. Supervision of Erection & commissioning at site
	xviii. Special tools & tackles as applicable
	xix. Erection and start-up spares like temporary strainers at pump suction pre-commissioning
	xx. Installation, operation and maintenance manuals
	xxi. Mandatory spares
	xxii. Any other items required for completeness of the equipment except the items covered in the exclusions.



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6.1	TECHNICAL REQUIREMENTS
1.	All recirculation pumps shall be identical and interchangeable.
2.	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type capable of delivering the rated flow at rated head as specified in the respective clauses. The slurry concentration in the pump shall not exceed 30% by weight.
3.	The Absorber Recirculation Pumps shall circulate the scrubbing liquid from the absorber sump to the spray nozzles in the absorber. The pumps shall be designed as impeller centrifugal (non-clog centrifugal) pump.
4.	The Pumps shall be wear resistant be equipped with flushing devices to prevent sedimentation and shall be designed and installed in a manner to allow easy replacements, repair and maintenance.
5.	The recirculation pumps shall be equipped with oil level indication, coupling guard and collecting equipment for leakage, made of resistant material.
6.	Single mechanical seals with automatic flushing with a connection for additional manual flushing shall be applied.
7.	Pump shall be driven by the motor with gearbox. A service factor of 1.5 or better should be constituent of Gear Box.
8.	All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer a Hi-chrome alloy lined pump if the bidder has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations. A Silicon Carbide Impeller and SiC lining for casing can also be accepted if the manufacturer has supplied a similar pump for a previous installation of a similar service.
9.	The design of the shaft shall ensure that the operating speed is at least 20% above the critical speed of the shaft.
10.	The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy duty ball/roller bearings.
11.	All pumps shall be designed to withstand a test pressure of 1.5 times the maximum possible pump shut off pressure under maximum suction pressure conditions
12.	Product water flushing lines and drains are to be supplied for each pump handling the prevailing water to avoid corrosion if the pump is out of operation for extended periods.
13.	Pumps must be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate. The NPSH Values are to be referred to the least favorable operating conditions- lowest atmospheric pressure, lowest level of water on the suction side of the pump and highest temperature of the pumped fluid. An adequate safety margin of normally greater than 1m to the max NPSH required shall be provided.
14.	The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within $\pm 10\%$ of the rated design flow as indicated in data sheets. The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of about 15% more than the design head.



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15.	Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:		
	Speed	Antifriction Bearing	Sleeve Bearing
	1500 rpm and below	75.0 micron	75.0 micron
	3000 rpm	50.0 micron	65.0 micron
	The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface		
16.	The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump		
17.	Venting valve shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting due to the arrangement of the suction and discharge nozzles. Drainage facilities shall be provided on the pump casing or adjacent pipe work to facilitate the dismantling of pumps.		
18.	Design pumps not to be damaged during reverse rotation at up to 150% of design RPM, at full discharge head in the event that a pump trips while the other operating pump remain on line.		
19.	Pumps shall have stable head-capacity characteristics curve from run-off to shut-off. Shut-off head should be minimum 125% of Best Efficiency Point (BEP).		
20.	Selection of Duty point should preferably be at BEP (Best Efficiency Point) or slightly at the left of BEP. Selection point beyond 115% of BEP will not be acceptable. It should be noted that head variation is due to level variation in tank. Pump has to run in the system without compromising it's NPSH requirement at lowest water level in tank. Hence, when tanks are filled-up and is at normal water level, pump will operate at the right of BEP, pump's operating zone should be considered accordingly.		
21.	The Pump should achieve a minimum efficiency of 87 % at duty point (13,880 m³/hr. @ 20.3 mH).		
22.	A factor of 1.2 for "Froth" should be taken into account for sizing the pump. If Bidder, from their own experience, specifies that froth factor should not be taken into account or a different factor to be taken into account for FGD pump, the same should be clearly specified. Suction size of the pump should be adequate to take this extra capacity and the same should be reflected in master curve suction specific speed of pump should not exceed $N_s=160$ (metric), taking into account the "Froth factor".		
23.	External flushing is required to remove the accumulated particles and all related information should be mentioned in data sheet.		
24.	Pump should have adjustment provision of axial clearance between casing and impeller for maintenance of performance at best efficiency when there is wear in between impeller and casing.		



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25.	In case rubber or nonmetallic linings are used, these will be two piece molded under pressure and adjusted to the screwed metallic clamping which have been welded to the casting.
26.	Each pump will have a coupling of adequate size, designed for full load and capable of supporting start –Up an overload moment. Each half of the coupling will be factory mounted and locked to its shaft. The coupling must be able to accept the adjustment of the impeller.
27.	The Antifriction bearing of the pumps shall be designed for minimum useful life (L-10) of 20,000 hours of continuous operation (Under the design condition). The thrust bearing will have dimensions for a minimum of 175 % of the required load.
28.	The pumps shall have mechanical seals of cartridge type with self-lubrication sliding ring cartridges. The static part will be mounted on the seal plate with circumferential ring (O-ring) or another flexible sealing ring. Built in seal design will not be accepted.
29.	The sealing areas shall be designed in such a way so that solids do not precipitate in them affect the cooling or affect the adjustment and mechanical functioning of the seals. Seals which do not need jet cleaning are preferred.
30.	Pump induced vibration due to flow pulsations shall be avoided through suitable design.
31.	Each rotating equipment shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
6.2	CONSTRUCTIONAL FEATURES
A)	CASING
a.	The pump casing shall preferably be radially split for ease of maintenance and be designed such that the impeller and shaft are capable of being withdrawn from the casing without disturbing any of the main pipework and valves carrying the pumped fluid. In general all horizontal pumps with draw-out-rotors are to be fitted with a coupling to facilitate disassembly without removing the motor.
b.	The casing and flanges shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.
c.	Pressure casing shall be designed with a corrosion allowance to meet the requirement “Technical requirements” and taking into account the “Operating Parameters”.
d.	Connection for suction and discharge pressure gauge shall be provided as standard feature.
e.	Lifting provision of pump as a whole and individual casing half should be provided.
f.	For all pumps, the casing material shall be Carbon steel / C.I with rubber lining or Silicon carbide or, hi chrome alloy line. The material used by the contractor shall be proven in previous installations.



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g.	For replaceable rubber liner, hardness of rubber should be of Shore hardness- SA 65 (+/-) 5. Rubber should be of Type and Class as defined by ASTM D-2000 which is suitable for uninterrupted operation of 5 years (minimum).
h.	Pump casing shall be provided with a vent connection and piping with valves and fittings. Casing drain as required shall be provided complete with drain valves.
i.	All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 14000 hrs.
j.	Renewable wear rings shall be provided at points of running clearance and shall be made from appropriate materials.
B)	IMPELLER
a.	Impeller material shall be either Hi Chrome or a Silicon Carbide impeller, guided by operating parameters taking into account the corrosion and erosion effect as per slurry parameters.
b.	Miller number for the material should be justified for that pumping medium as per ASTM G75-95 as well as the corrosion effect of pumping medium.
c.	Base material for rubber-lined impeller should be capable of handling speed as specified in the respective clause without affecting adhesion of lining. Impeller as rotating assembly along with all elements should be dynamically balanced according to ISO 1940
d.	Impeller tip speed shall be within vendor's experience. And Impeller shall have air bleed holes to eliminate any air accumulation around the shaft seal
e.	Maximum size impellers for the pump body shall not be quoted for. By installation of a new impeller a head increase of 5% minimum shall be possible.
C)	SEALS:
a.	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. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.
b.	Design the mechanical seals chamber to have sufficient room to lubricate and get seal face cool with its own slurry.
c.	Provide requirements for periodical flushing to rinse the seal face for leaked slurry.
d.	Pump shall be supplied with mechanical seal. All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not be used.
e.	Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.
f.	Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, pump should have a provision of collecting of any drip leakage and flushing the same to nearby pit is to be providing without corroding the base plate of pump.
g.	Mechanical seals shall be fitted and installed in the pump before shipment and shall be clean.



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	Mechanical seals shall be plugged with screw for shipping
h.	Intention of the specification is not to specify Type of Seal, Seal design, Spring configuration, Seal configuration, Balanced or Unbalance type etc. The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply
i.	Seal life has to be guaranteed, taking into consideration all its components for 20000 hrs. If the seals fail before the completion of guaranteed period, the same should be replaced free of cost by the bidder.
D)	SHAFT AND SHAFT SLEEVE
a.	All Pump shafts shall be of ample size to transmit the maximum possible output from the prime mover.
b.	The pump shaft and coupling are to be so dimensioned that the maximum permissible torque of the shaft is higher than the maximum transmissible torque of the coupling and gear. Pumps with Gearbox are preferred.
c.	Pumps shall operate smoothly throughout the speed range up to their operating speeds. The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed. The determination of the shaft diameter and the distance between two consecutive bearings must include a sufficiently large safety margin to satisfy this condition.
d.	Shafts shall be conservatively designed to transmit maximum power required and to assure rigidity. The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.
e.	Shaft shall run in high precision heavy duty roller bearings. Lubrication system provided shall be such that visual checking of lubricant level is possible
f.	The shaft shall be finished to close tolerance at the rotor, coupling and bearing diameters. The size of shaft shall be calculated on the basis of maximum combined shear stress. This shear stress shall not exceed 30 percent of the elastic limit in tension or 18 percent of ultimate tensile strength.
g.	No parts of the shaft should come in contact with the liquid medium.
h.	Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland. Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation. Shaft sleeve should be CD4M Cu ASTM A-743 or equivalent. Sleeve should have this as a guaranteed value/parameter to prevent wear and corrosion of mating surface. Manufacture to indicate the



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	diameter in data sheet.
i.	Shaft should have a keyed joint or thread connection between impeller and shaft.
E)	COUPLING
a.	The HT drive motor is excluded from the scope of supply. However, the bidder shall supply coupling and gearbox for secondary transmission.
b.	Coupling halves shall be machine matched to ensure accurate alignment. Couplings and gears must have a rated capacity of at least 120% of the maximum potential power transmission requirement.
c.	Coupling shall be of flexible type made of cast steel. The Bidder shall furnish both halves of the coupling. Both the Coupling halves shall be bored and keyed to fit shafts of the gearbox and the motor by bidder.
d.	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type. If weight of the coupling is heavy (>40 kgs), provision of tapped hole should be incorporated in right place of hub to handle the same effortlessly
F)	BASE PLATE
a.	A common base plate shall be provided for pump assembly & Motor and the same shall be rigidly constructed, adequately braced and provided with finish pads for mounting pump.
b.	Suitable holes shall be provided for grouting and these shall be so located that the base plate can be grouted in place without disturbing the pump and motor.
c.	Common base plate for pump and Motor shall be in the scope of the bidder and the details of the Motor will be furnished to the bidder to provide Motor mounting bolts.
d.	Base plate must have provision of aligning driver and driven shaft in both directions of base plate so that shafts can be aligned. Similarly, provision must be provided for alignment of shaft in vertical plane.
e.	Pump manufacturer is to supply base plate along with Foundation bolt & Nut, "Taper wedge" and the necessary fastener for Pump and Motor with Base plate. Even if Motor is excluded from their scope, necessary fastener for motor foot with base plate will remain in pump scope of supply in order to avoid any problem.
f.	Base plate must be provided with a trough, material of which must be compatible of pumping liquid. Leaked liquid, collected in trough, can be systematically routed at designated point
g.	Base plate must be stress-relieved for any residual welding stress and certificate to that effect is to be submitted as per inspection requirement.
G)	BEARINGS



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a.	The bearings may be ball, roller or sleeve bearing. If sleeve bearings are used these shall be machined for close running fit. The bearings shall be designed to take the necessary radial load as well as the net axial thrust. Bearings shall be lubricated properly and sized for an operating life of 20,000 hours on the basis of maximum load. Oil level indication shall be provided.
b.	The bearings shall be of automatic oil lubricated type. Bearing temperature element with temperature transmitter shall be provided.
c.	Bearing housings on horizontal shaft pumps shall be designed to enable the bearings to be replaced without removing the pump or motor from its mounting. Bearing housings on horizontal shaft pumps shall be effectively protected against the ingress of water, pumped fluid and dust by suitable nonferrous deflectors.
d.	If Cooling water for gearbox cooling is required, volume and pressure of cooling water is to be indicated in Technical Data Sheet. The following details has to be provided 1. Inlet temp: 38°C 2. Max allow temp increase: 5°C 3. Pressure Drop : < 1 Bar
e.	Bearing temperature sensor shall be provided for local monitoring of the bearing metal temperature of pump. Bearing temperature sensor shall provide signals to FGD DCS for continuous monitoring.
f.	Lubricating oil will be the responsibility of pump 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.
H)	ACCESSORIES:
1.	Expansion Joints:
i.	Expansion Bellows with limiting bolt & nut shall be provided at suction and discharge of each pump .
2.	Pump control:
i.	Each pump shall be furnished with required instrumentation and electrical accessory devices mounted and connected in a control cabinet.
ii.	Provisions shall be made for the interface between the local cabinet and the DCS such that the operation of the pumps can be controlled from the control console in the FGD Control room
iii.	Provision for vibration sensor, key phase sensor shall be provided. These shall be provided for X axis & Y axis vibration measurement in bearing housing. Provision shall be in line AP1670, 15th edition & provision shall be covered suitably.
iv.	Alarm Signal: Bearing temperature sensor for alarm during when “Bearing Temperature high” shall be



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supplied by Bidder.		
The following instruments have to be provided for each pump:		
S.No.	Description	Min Qty / pump
1	Pump Bearing TE RTD PT100 DUPLEX	6

7.0 GENERAL REQUIREMENTS:

S.No	Description
1.	Metric unit shall be used in the drawings and in the any displays on the equipments. 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. Predicted sound pressure levels for the pump drive assemblies shall be submitted as part of the proposal data.
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.	Limit of connection: The buyer (BHEL) has an intention to minimize interface for utilities as much as possible. The bidder shall consider this requirement in the planning stage of layout for the equipment. The bidder shall provide the header piping for utilities and branch piping to each nozzle. Terminal points for all utilities shall be located at skid edge. The bidder shall specify all terminal points with tie-in number in the P&ID and submit it in the proposal to confirm the scope of supply.
10.	Service life: Entire equipment except wearing parts shall be designed and fabricated for a minimum service life of 30 years of operation or 200,000 full load operating hours whichever is longer.
11.	Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable Indian / International standard.



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S.No	Description
12.	Unless otherwise specified , flanges shall be in accordance with ANSI B16.5 Class 150,ASME B 16.47
13.	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.
14.	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
15.	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.
16.	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
17.	Two pieces of stainless steel earth lugs shall be provided with equipment diagonally. The position of earth lugs shall be shown on each GA and/or outline drawing.
18.	Provide double nuts for anchor bolts
19.	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.
20.	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.
21.	Bidder shall provide the mating flanges with the necessary gaskets.
22.	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.
23.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.
24.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted
25.	Quality Plan to be submitted along with the offer.
26.	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA,



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S.No	Description
	boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.
27.	Material of construction for all equipment/components shall be subject to NTPC/ BHEL approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component as per best engineering practice, global standard and global references.
28.	Bidder to provide sub vendor list and Bidder shall strictly adhere to NTPC 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 NTPC/ BHEL before placing order and bidder shall submit relevant documents to take up with NTPC for approval.
29.	It shall be the complete responsibility of the successful bidders to obtain "Sub Vendor Approval" from BHEL / NTPC for all equipments & 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 NTPC/ BHEL, the same may be replaced with another NTPC/BHEL approved sub-vendor only, without any price implications to BHEL.
30.	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 NTPC/ 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: a. Relevant Standards b. Specifications c. Approved drawings d. Data Sheets e. Calibration certificate for all the measuring instruments f. Bidder should also coordinate in getting the MDCC's (Material Dispatch clearance certificate) and all types of IC's (Inspection Certificates) from the NTPC along with BHEL.
31.	Minor Chipping i.e. up to 50 mm thk, micro leveling and providing shim plates for erection of equipment / item at site shall be in the scope of bidder.
32.	During detail engineering, bidder to strictly adhere to BHEL/NTPC drawing formats, document numbering, quality plan & FQP formats



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S.No	Description
33.	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.
34.	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/NTPC during detail engineering
35.	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word /Excel format.
36.	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/NTPC should be addressed timely by the bidder.
37.	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.
38.	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: Pump & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the pump 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 - VI. 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.



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S.No	Description
4.	Crates and packing material used for shipping will become the property of owner.(NTPC)
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 NORTH KARANPURA SUPER THERMAL POWER PROJECT 3x660 MW, NATIONAL THERMAL POWER CORPORATION JHARKHAND. 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.
	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.
9.	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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S.No	Description
10.	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.
11.	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)
12.	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 safe handling)
13.	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.
14.	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 pump & accessories, BHEL item Code, Gross Weight and Net weight of Supplied items.
15.	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.
16.	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.
17.	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. Also, complete billing break-up with above mentioned details shall be submitted within 10days of LOI.
18.	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).



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S.No	Description
19.	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 Recirculation Pumps will be done by owner as per Erection Manual and check List. However, the bidder shall make one visit per boiler 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.	There will be one visit per boiler and totally there will be 3 visits for 3 boilers. The bidder will be informed well in advance for the visit. Bidder shall include 15 working days per visit in the offer with minimum 3 visits.
3.	TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in supervision portion.
10.0	EXCLUSION
	The following work associated with the recirculation pump are excluded from bidder's scope: a. Supply of main drive HT motor b. Civil foundations c. Walkways, platforms and ladders d. Equipment/item handling hoists
11.0	INSPECTION AND TESTING
A)	Minimum Testing requirements to be considered are as below:
1.	Hydrostatic test is to be conducted at 150 % of design pressure for duration of 30 minutes, taking into consideration of the fact that actual operating temperature is 60 deg Celsius (maximum).
2.	Impeller and rotor shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
3.	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.
4.	List of Non-Destructive test over and above the material test are as follows: a. Casing: Material test, Magnetic particle (MPI), DP and Hydro test as applicable.



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S.No	Description
	b. Impeller- DPT and MPI as applicable. c. Shaft- Ultrasonic (UT), DPT and MPI. d. Sleeve- DP and Hardness test / Manufacturer's recommendation. e. Mechanical Seal- Manufacturer's recommendation. f. Base Plate- Stress relieving of weld. g. Replaceable Rubber liner- Shore Hardness, Class and Type certificate
5.	Once mounting is finished and operation less will be conducted on each pump to determine the characteristic curves. For dynamic pressure and volume output, and to determine the parameters at the design point, mechanical running & performance testing shall be performed & witnessed.
6.	NPSH Test, Vibration test and Noise level test shall be witnessed at shop.
7.	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.
8.	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.
9.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
10.	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.
11.	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.
B)	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 for review by BHEL / NTPC prior to manufacture. Inspection of above mentioned tests by BHEL/ NTPC representative at bidder's works is envisaged.
2.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/NTPC.
3.	Out of 8 Recirculation Pumps, One Number of Recirculation Pump will be inspected at the Bidder's works before dispatch or where the test facilities are available. However, if NTPC insists for performance testing of all the pumps the same shall be carried out at no additional cost.
4.	The Bidder shall conduct performance test for the remaining pumps and submit the reports.



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S.No	Description
5.	A dynamic balancing certificates stating that the rotating assembly has been balanced dynamically shall be sent to NTPC/ BHEL within one (1) week of the successful completion of balancing.
6.	Acceptance tolerance of actual versus guaranteed performance for capacity, head, efficiency and power absorbed shall be as per applicable standard.
7.	Vibration levels shall be measured during shop running/performance tests.
8.	Contract shaft seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition.
9.	Recirculation pumps shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
10.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.
11.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
12.	Bidder to arrange all calibrated gauges, Instruments during inspection.
13.	Mechanical running and the performance test shall be carried out. Bidder to arrange Motor of same / higher rating for the shop test and inspection.
14.	The performance test may be carried out using water at shop and shall be converted to the design condition.
15.	Inspection and testing will be done as per NTPC approved Quality Plan. In case of order placed on foreign Vendor(i.e supplies from outside India), Vendor shall engage and appoint at their cost of any reputed Third Party Inspection Agencies having international presence for carrying out inspection of equipment's and material at vendor's & sub vendors works.
12.0	PAINTING
1.	Surface Preparation : Power Tool Cleaning to St3 (SSPC- SP3)
2.	PRIMER COAT: Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) - 60 μ
3.	Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50μ



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S.No	Description
4.	FINISH COAT: Two coats of Synthetic Enamel to IS 2932, DFT- 50μ/ coat Shade will be informed later Total DFT= 210 μ
5.	COLOUR CODE (based on DIN 2403:2007-05 & DIN 5381) a. Base: To be informed laterx b. Lettering: To be informed later.
6.	Rust preventive paint after inspection at shop floor before dispatch shall be in bidder's scope
7.	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 / NTPC.
13.0	SPARES,TOOLS & TACKLES
13.1	START UP & COMMISSIONING SPARES
	Start-up & Commissioning Spares shall be part of the main supply of the Recirculation pumps. Start-up & commissioning spares are those spares which may be required during the start- up and commissioning of the equipment/system. All spares required for successful operation till commissioning of pump 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 equipments are energized. Supply of temporary strainers for pre-commissioning is mandatory.
13.2	FINAL SPARE PARTS LIST (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.
13.2	INITIAL SPARE PARTS (MANDATORY SPARES):
	Bidder to quote for below mentioned mandatory spares with break up price: 1. Impeller Assembly 2 nos. of each type 2. Casing Liners 3 nos. of each type 3. Seals 3 sets of each type 4. Bearings 3 nos. of each type 5. Motor-Pump Coupling 3 nos. of each type



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S.No	Description
	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 equipments. 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 indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools.
13.3	SPECIAL 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.
14.0	PERFORMANCE GUARANTEE
	All performance tests for Recirculation pumps shall be carried out in accordance with any latest international codes/standards. 1) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Recirculation pump and its accessories 2) Capacity and head of the pump to be guaranteed. 3) The Contractor shall guarantee 98 % availability of equipment for a continuous period of 120 days. 4) All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 14000 hrs. 5) Noise level-≤85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. 6) Vibration levels measured on the non-rotating parts shall not exceed the zone limit



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S.No	Description
	“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. 7) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ NTPC approval. 8) 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 guaranteed Shaft power per Pump operating at the duty point in their offer.(i.e. the guaranteed power consumption-GPC)
2.	BID EVALUATION CRITERIA FOR POWER CONSUMPTION: Power consumption quoted by bidder shall be limited to the ceiling value specified below. Ceiling value for Shaft power for the designated Recirculation pump= Lowest of the GPC offered by the bidders In case, Guaranteed Shaft power offered by the bidder exceeds the ceiling value specified above, his bid price will be loaded for excess power consumption as per the formula given below. Adjustment factor for excess power consumption in USD = $(GPC-CV) \times PL \times 12$ No's of Working pumps GPC- Guaranteed Shaft Power Consumption quoted by bidder in KW CV- Ceiling Value for Shaft Power Consumption PL- Power Loading @ USD 2230/KW (Exchange rate on the date of bid opening will be considered for evaluation)
16.0	LIQUIDATED DAMAGES FOR POWER CONSUMPTION
	If actual shaft 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 = $(APC-GPC) \times P \times$ No of Working Pumps Where • GPC- Guaranteed Shaft Power Consumption quoted by bidder in KW • APC- Actual Shaft Power Consumption in KW • P- Penalty @ USD 3275/KW



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S.No	Description
17.0	WARRANTY/DEFECT LIABILITY
1.	The Bidder warrants that the equipments/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 Defect Liability Period shall be 24 months from the date of supply or 18 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, NTPC/BHEL reserves the right to reject the equipment. However, NTPC/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement .
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 NTPC/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 chemicals, 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 NTPC/BHEL Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the Recirculation pumps - 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 NTPC in writing of any conflicts between the specifications and Bidder's design, including



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S.No	Description
	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.
22.0	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 a minimum requirement, the information required as per Annexure-V shall be furnished to fully describe the scope of work and services offered. The above documents are required for proper evaluation purpose and vendors are requested to comply with above in all respect.
B	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT
	The Successful bidder shall submit necessary data, documents and drawings for review, approval with requirements specified under Annexure-V. Drawings that are reviewed by the NTPC/ 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. NTPC/ 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 NTPC 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 like P&IDS 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 five (05) 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 NTPC requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team. However all the engineering related information shall be furnished in soft form to BHEL.



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23.0 ANNEXURES

ANNEXURE-I (PROVENNESS CRITERIA)



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ANNEXURE – II- TECHNICAL DATA SHEET

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: NORTH KARANPURA 3x660
	c. Ultimate Customer	: NTPC
	d. Location	: Hazaribagh & Chata district Jharkand, India
	e. Service	: Continuous
	f. Installation	: Inside steel structure shed with roof side sheeting



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	g. No of pumps for each unit	:	4 Working + 1 Standby
	h. Total number of pumps	:	15 No's
2.0	MANUFACTURER DETAILS		
	a. Model	:	Bidder to provide
	b. Type	:	Centrifugal
	c. Type of Driver	:	With Gearbox
3.0	OPERATING CONDITION		
	Medium to be handled	:	Gypsum slurry
	Maximum solid particle size	:	150 mesh (140 microns)
	Normal solid particle size, d 50	:	325 mesh (43 micron) and fine particles
	Concentration of chloride	:	22,500 ppm (Max)
	Viscosity of slurry	:	10 cp
	Concentration of slurry	:	30(% by weight)
	Specific gravity of slurry	:	1.217 @ design and 1.215@ guarantee point
	pH of slurry	:	4-8
4.0	PERFORMANCE DATA		
	a. Capacity	m ³ /hr	:
	b. Head	M	:
	c. Pump efficiency	%	:
	d. BkW Normal / Maximum	KW	:
	e. Motor rating	KW	:
	f. Motor Speed	Rpm	:
	g. Differential pressure (inclusive of losses)	Kg/cm ²	:
	h. Speed Maximum/ Normal/Minimum	rpm	:
	i. Noise level	dB(A)	:
	j. Performance curve		:
4.0	CONSTRUCTION DATA		
	a. Manufacturer	:	
	b. Model No.	:	Bidder to Provide
	c. Suction Rating / Size	:	Bidder to Provide
	d. Discharge Rating / Size	:	Bidder to Provide
	e. Type of rotor	:	Bidder to Provide
	f. Size of rotor Dia	mm	:
	g. Journal bearing: Type / Size:	:	Bidder to Provide
	h. Thrust bearing: Type / Size:	:	Bidder to Provide
	i. Bearing cooling required	:	Yes / No - Bidder to confirm
	j. Cooling water required	:	Bidder to confirm the quantity
	k. Type of drive	:	With Gearbox
	l. Shaft seal	:	Mechanical
	m. Size / Code	:	Bidder to Provide
	n. Type of coupling	:	Bidder to Provide
	o. Service factor	:	Bidder to Provide



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	p. GD ² at drive shaft end	:	Bidder to Provide
	q. Rotation viewed from coupling end	:	Clock wise / Counter clock wise
	r. Coupling type	:	Yes / No - Bidder to confirm
	s. Coupling make	:	Bidder to Provide
	t. Base plate common to pump, bearing housing, coupling	:	Yes / No - Bidder to confirm
	u. Total weight kg	:	Bidder to Provide
	v. Maximum Erection weight kg	:	Bidder to Provide
5.0	MATERIALS		
	a. Casing	:	Bidder to Provide
	b. Impeller	:	Bidder to Provide
	c. Shaft	:	Bidder to Provide
	d. Shaft Seal	:	Bidder to Provide
	e. Base frame	:	Bidder to Provide

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----



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NORTH KARANPURA:FGD:ARP:R00

ANNEXURE III- SCHEDULE OF GUARANTEES

Sl. No	Description	Data
1.	Rated capacity of pump m ³ /hr.	:
2.	Total head at design capacity M	:
3.	Guaranteed shaft power consumption at rated capacity & head kW	:
4.	Noise level at a distance of 1.0 meter from the equipment at site and 1.5 m above operating floor dB(A)	:
5.	Maximum vibration (peak to peak amplitude at site) microns	:
6.	Equipment Availability (%)	:
7.	Pump Efficiency (%)	:
8.	Life of Pump wear parts including, Casing liners, bearing etc Hours	: ≥14000 hours operation

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----



**TECHNICAL SPECIFICATION OF RECIRCULATION PUMP
NTPC-NORTH KARANPURA (3X660 MW)**

NORTH KARANPURA:FGD:ARP:R00

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

SI No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----



**TECHNICAL SPECIFICATION OF RECIRCULATION PUMP
NTPC-NORTH KARANPURA (3X660 MW)**

NORTH KARANPURA:FGD:ARP:R00

ANNEXURE -V

A) DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER:

Sl. No.	Description	No of copies With proposal
1.	Clause wise Compliance to Specification	1
2.	Un-Price Sheet	1
3.	Annexure I –Qualification documents along with Attachment 3K	1
4.	Annexure II - Data Sheet	1
5.	Annexure III- Schedule of Guarantee	
6.	Annexure IV- Deviation List	
7.	Annexure VI, Annexure VII	
8.	Performance curve(flow vs total pressure, flow vs efficiency, flow vs power consumption, Torque vs speed for motor selection)	1
9.	Approximate weight of each skid	1
10.	Anchor Plan & Civil foundation Loading details	
11.	Required Electric power & other Utility List	1
12.	General Assembly Drawing	1
13.	Pump and Motor Sizing Calculation	1
14.	Cross-sectional Drawing	1
15.	Sub-Vendor List	1
16.	Spare List (Mandatory, Recommended)	1
17.	Start-up & Commissioning Spares	1
18.	List of Special Tools	1
19.	Delivery Schedule	1
20.	Test Arrangement & Test procedure	1
21.	T-S curve	1
22.	Hoist/Crane requirement	1
23.	P & I Diagram	1
24.	Catalogue	1



**TECHNICAL SPECIFICATION OF RECIRCULATION PUMP
NTPC-NORTH KARANPURA (3X660 MW)**

NORTH KARANPURA:FGD:ARP:R00

B) DOCUMENTS TO BE SUBMITTED AFTER CONTRACT:

Sl. No.	Description	No of copies After award of contract	Delivery Time
1.	Utility Consumption	1	2 weeks after contract
2.	HT Motor sizing calculation	1	2 weeks after contract
3.	Foundation Data including Anchor plan	1	2 weeks after contract
4.	Performance curve(flow vs total pressure, flow vs efficiency, flow vs power consumption, Torque vs speed for motor selection)	2	2 weeks after contract
5.	Assembly drawings of each equipment	1	1 month after contract
6.	Exploded view, Cross section detail drawing	1	1 month after contract
7.	Data Sheet	1	2 weeks after contract
8.	Lubricating oil list	1	2 months after contract
9.	Special tools list	1	2 months after contract
10.	Installation and assembly procedure	1	4 months after contract
11.	Inspection and Test Procedure	1	1 month after contract
12.	Inspection & Test record	1	In 2 weeks after test
13.	Inspection Certificate	1	In 2 weeks after test
14.	Sub vendors List	1	2 weeks after contract
15.	Manufacturing Schedule	1	2 weeks after contract
16.	Progress report	1	Every month
17.	Proforma Packing List	1	2 months prior to shipping
18.	Approximate weight of each skid	1	2 months after contract
19.	Required Electric power	2	2 weeks after contract
20.	Pump and Motor Sizing Calculation	1	2 weeks after contract
21.	Material Test Certificates	2	In 2 weeks after test
22.	Pre Commissioning Check List	2	4 months after contract
23.	Quality Plan	4	1 month after contract



**TECHNICAL SPECIFICATION OF RECIRCULATION PUMP
NTPC-NORTH KARANPURA (3X660 MW)**

NORTH KARANPURA:FGD:ARP:R00

Sl. No.	Description	No of copies After award of contract	Delivery Time
24.	Operation and Maintenance Manual	• 10 hardcopies and 5 electronic copies in English	4 months after contract
25.	Spare List (Mandatory, Recommended)	1	1 month after contract
26.	Start-up & Commissioning Spares	2	1 month after contract
27.	List of Special Tools	1	1 month after contract
28.	Delivery Schedule	1	2 weeks after contract
29.	Test Arrangement & Test procedure	2	1 month after contract
30.	T-S curve	2	2 weeks after contract
31.	P & I Diagram	2	2 weeks after contract
32.	Catalogue	2	2 weeks after contract

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----



**TECHNICAL SPECIFICATION OF RECIRCULATION PUMP
NTPC-NORTH KARANPURA (3X660 MW)**

NORTH KARANPURA:FGD:ARP:R00

ANNEXURE-VI

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING (applicable for supplies from outside India)

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

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----



**TECHNICAL SPECIFICATION OF RECIRCULATION PUMP
NTPC-NORTH KARANPURA (3X660 MW)**

NORTH KARANPURA:FGD:ARP:R00

ANNEXURE-VII

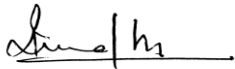
INSPECTION & TESTING

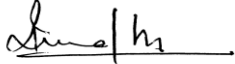
Refer to all clauses for Inspection & testing requirements. Sample QP enclosed

SIGNATURE OF BIDDER -----

NAME -----

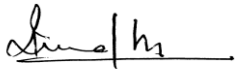
DESIGNATION -----

 Ranipet		MANUFACTURER'S NAME AND ADDRESS M/S BHEL: BAP: RANIPET 632 406 TAMIL NADU		STANDARD QUALITY PLAN										
				ITEM: RECIRCULATION PUMP SYSTEM: FGD						QP NO		FGS:723		
										REV. NO:		00		
										DATE:		12.02.2019		
								PAGE NO:		Page 1 of 3				
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.			11.
1.0 RAW MATERIALS														
1.1	Volute Casing, Casing Cover	Chemical & Mechanical Properties	Major	Composition analysis & Mechanical Properties test	1 Sample / Heat		Approved GA Drawing / Data Sheet/ Specification		MTC	✓	P	V	V	
1.2	Impeller, Wear Plate SS	Chemical & Mechanical Properties	Major	Composition analysis & Mechanical properties test	1 Sample / Heat		Drawing & Specification		MTC	✓	P	V	V	
1.3	Volute Casing	Surface Defects	Major	DPT on machined surface	100%		ISO4987	ASME Sec V	DPT Report	✓	P	V	V	
1.4	Shaft	Chemical Composition	Major	Chemical composition	1 Sample/Heat	Drawing/Specification		Test Report	✓	P	V	V		
		Mechanical Properties		Mechanical Tests		Drawing/Specification		Test Report	✓	P	V	V		
		Hardness Test		Mechanical Hardness	100%		Drawing/Specification	Test Report	✓	P	V	V		
		Internal Soundness		UT	100%		ASTM A 388/ ASME Sec V	UT Report	✓	P	V	V		
		Surface & Sub Surface Defects		MT-on m/c Surface	100%		ASTM E709 ASME Sec V	MT Report	✓	P	V	V	MT-Magnetic Particle Test	
1.5	Impeller	Surface & Sub Surface Defects	Major	DPT	Accessible Areas		ISO4987	ASME Sec V	PT Report	✓	P	V	V	
2.0 IN PROCESS INSPECTION														
2.1	Impeller/Volute Casing/ Wear Plate	Surface Condition/ Defects/	Major	Visual and Measurement	100%		Drawing		IR (Protocol)		P	-	-	Spot Check by BHEL
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: RECIRCULATION PUMP SYSTEM: FGD						QP NO		FGS:723		
										REV. NO:		00		
										DATE:		12.02.2019		
						PAGE NO:		Page 2 of 3						
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.			11.
	SS/ Casing Cover/ Shaft After Machining	Measurement												
2.2	Couplings/Other Parts/Semi finished Products	Verification	Major	Compliance With Order	100%		Drawing		COC		P	-	-	Spot Check by BHEL
2.3	Rotating Parts	Balancing	Major	Static & Dynamic Balancing	100%		ISO 1940	ISO 1940, grade 2.5	Balancing Report	√	P	V	V	
2.4	Volute Casing	Water Pressure (Static) Testing	Major	Static Pressure Testing of Casing	100%		See Remarks Column	No Leakage	Test Report	√	P	W	W	Test Pressure at 2x rated head or 1.5x shut of head whichever is higher for 30min
3.0 FINAL INSPECTION														
3.1	Complete Pump Assembly	Completeness	Major	Visual & Dimensional	100%		Manufacturer Drawing		IR	√	P	W	W	
		Measurement- Flow vs Head(Complete operating range), Power, Efficiency	Major	Performance testing of pump	100%		*	Approved Drawing /Data Sheet	Performance Test Report	√	P	W	W	
		Vibration Velocity RMS [MM/S] Bearing Temperature Noise		Measurement	100%		*	Approved Drawing. Approved Data Sheet	Performance Test Report	√	P	W	W	
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: RECIRCULATION PUMP SYSTEM: FGD						QP NO		FGS:723		
										REV. NO:		00		
										DATE:		12.02.2019		
						PAGE NO:		Page 3 of 3						
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.
		Level RMS[MM/S]												
		NPSH Test	Major	Measurement	1 Pump / each type / design		Design Standard of Pump	NPSH Test Report	✓	P	W	W		
3.2		Leakage Test	Major	Leakage Testing	100 %	*	Approved Ga Drawing & Data Sheet	IR	✓	P	W	W		
3.3		Strip Down Test Not Required If Performance Test is Fine	Major	Visual	100%		Mfg. Drawing, Approved Data Sheet		✓	P	W	W	Only Required in case of Abnormal Sound	
3.4	Painting	Dry Film Thickness/Color	Major	Visual & Measurement	Spot Check		Approved Painting Scheme	IR(Protocol)	✓	P	V	V		
4	DOCUMENTATION													
4.1	Check of Quality Assurance Documentation	Compliance to MQP	Major	Check of Complements	100%		Manufacturing Quality Plan	Protocol	✓	V	V	V		

NOTE: Electrical Motor for Recirculation Slurry Pump is in BHEL Bhopal Scope. Separate MQP to be submitted for Motor.

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	REVIEWD & APPROVED BY
		
	Rakesh Kumar Madhu,(SEr/QA)	K C Gandhi Parimalam,(DGM/QA)

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
		SHEET 1	OF 52

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	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 2	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
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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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
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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

	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
		SHEET 5	OF 52

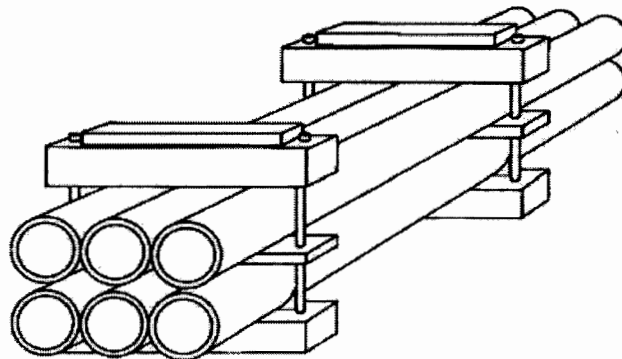
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long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

8.2 Bundling – Packing Category I

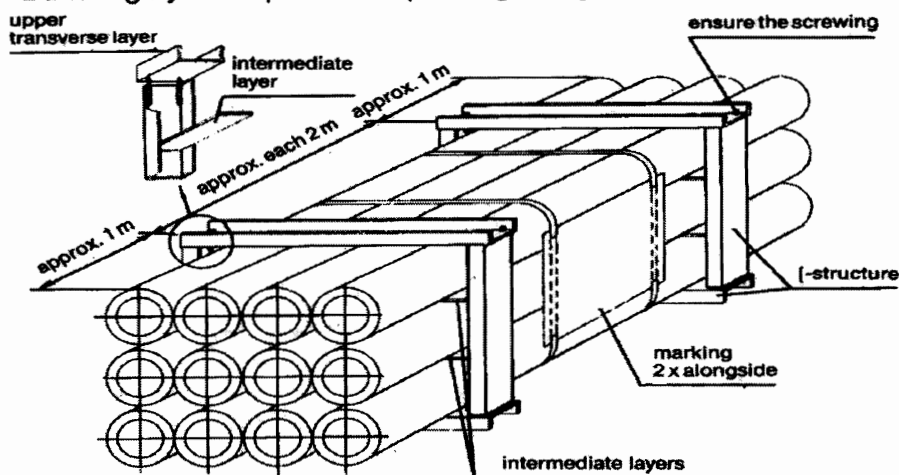
8.2.1 Type of Equipment

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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
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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)

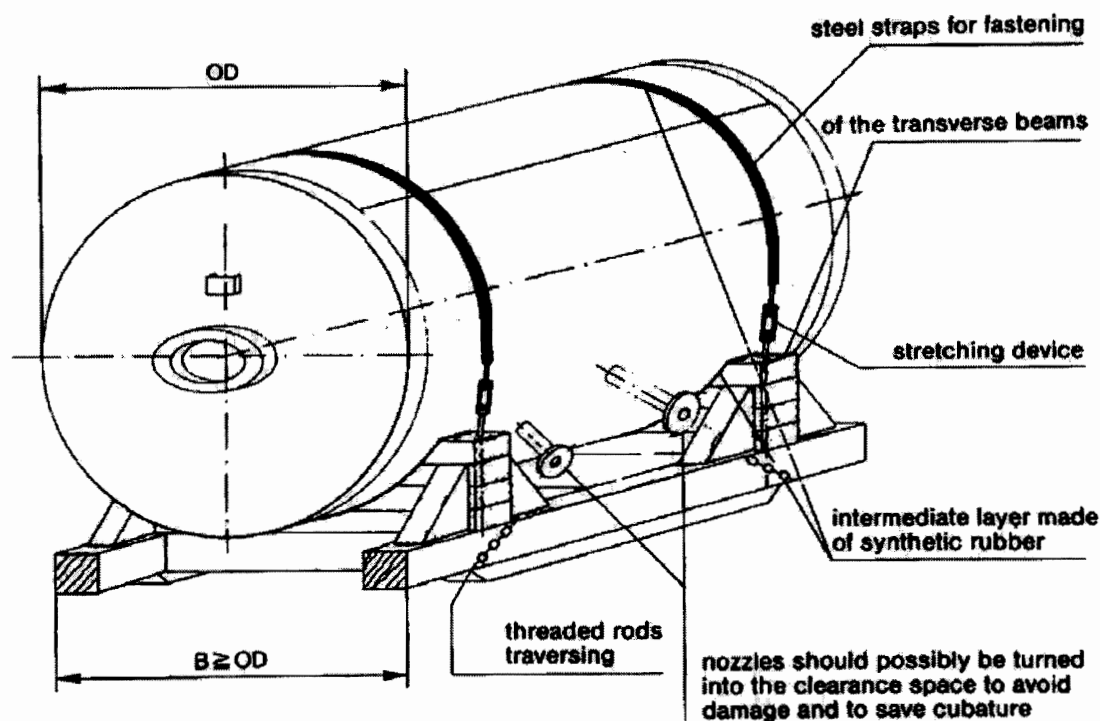
8.3.1 Type of Equipment

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

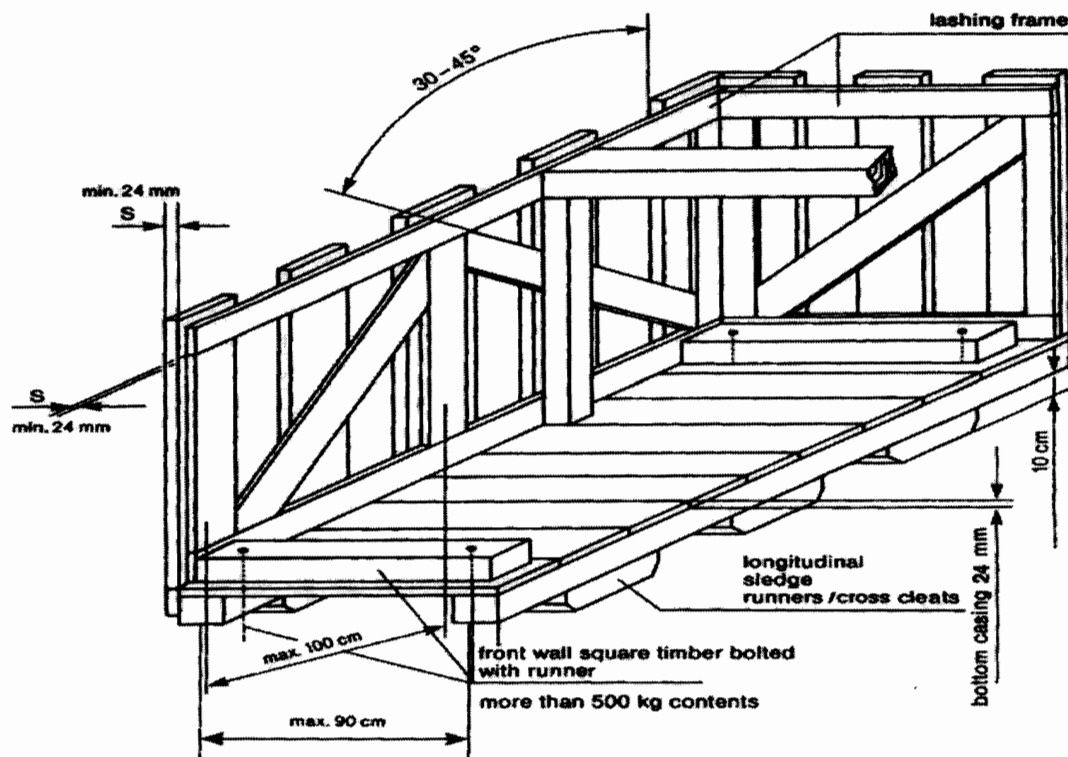
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

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

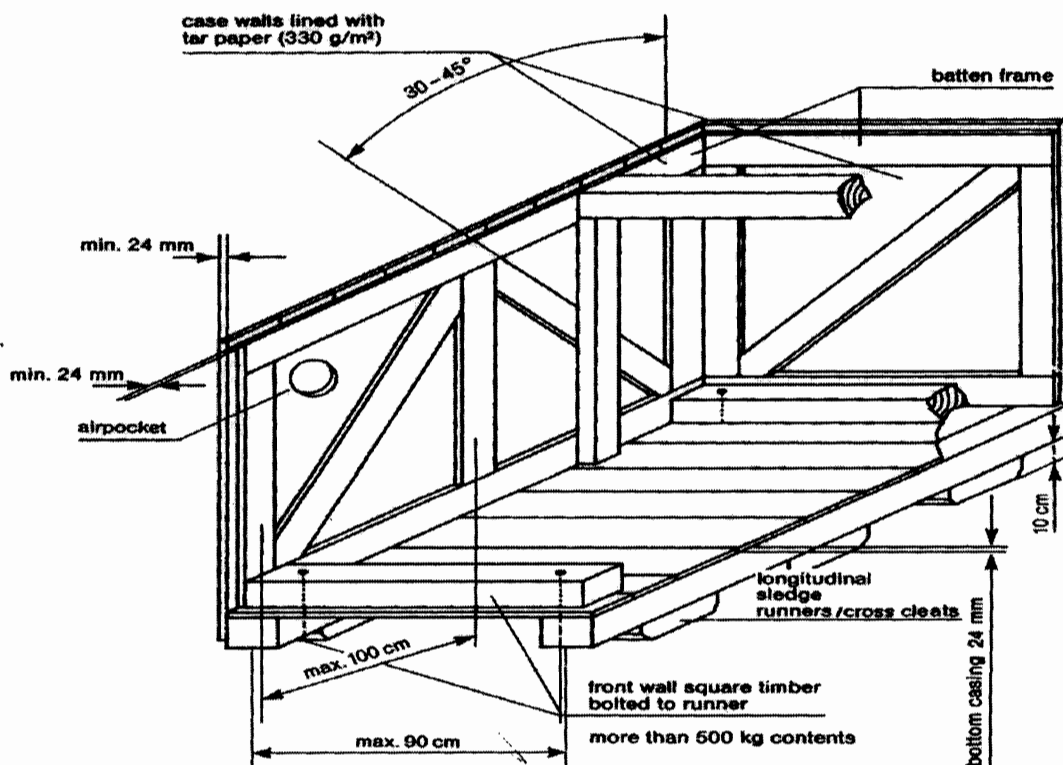
8.4.2.1 Type of Equipment

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.

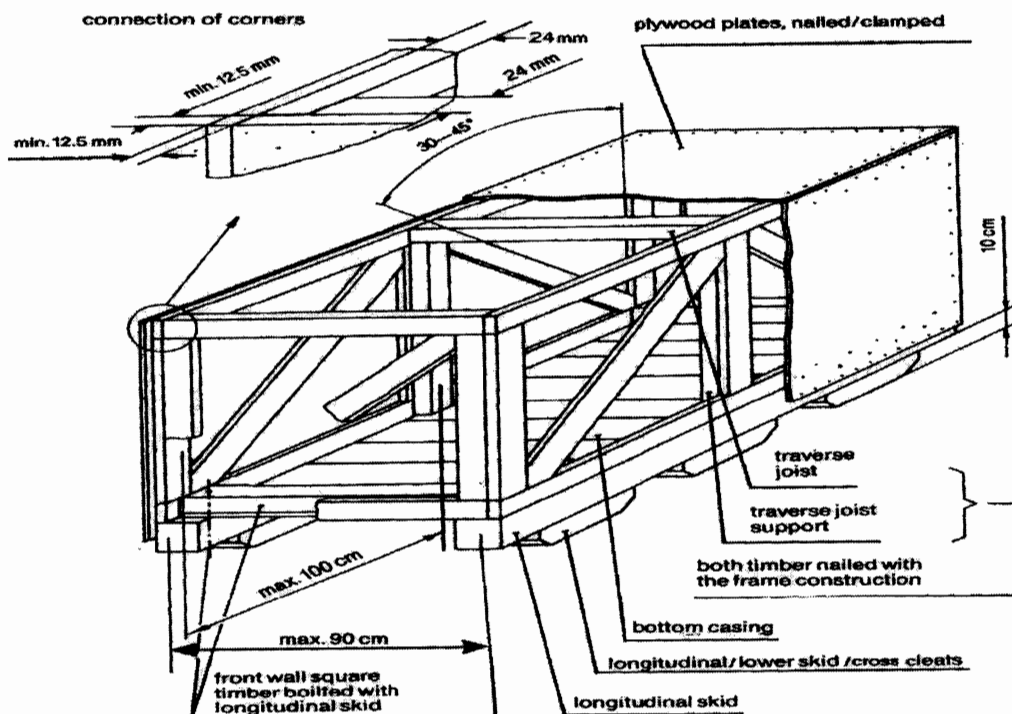
Packing Category IV



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.

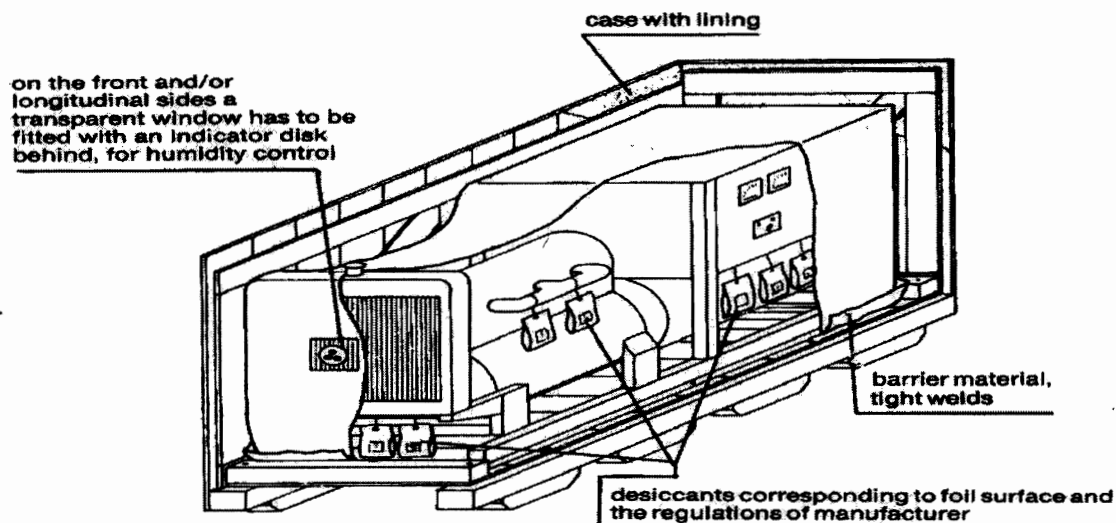
8.4.5.2 Type of Construction

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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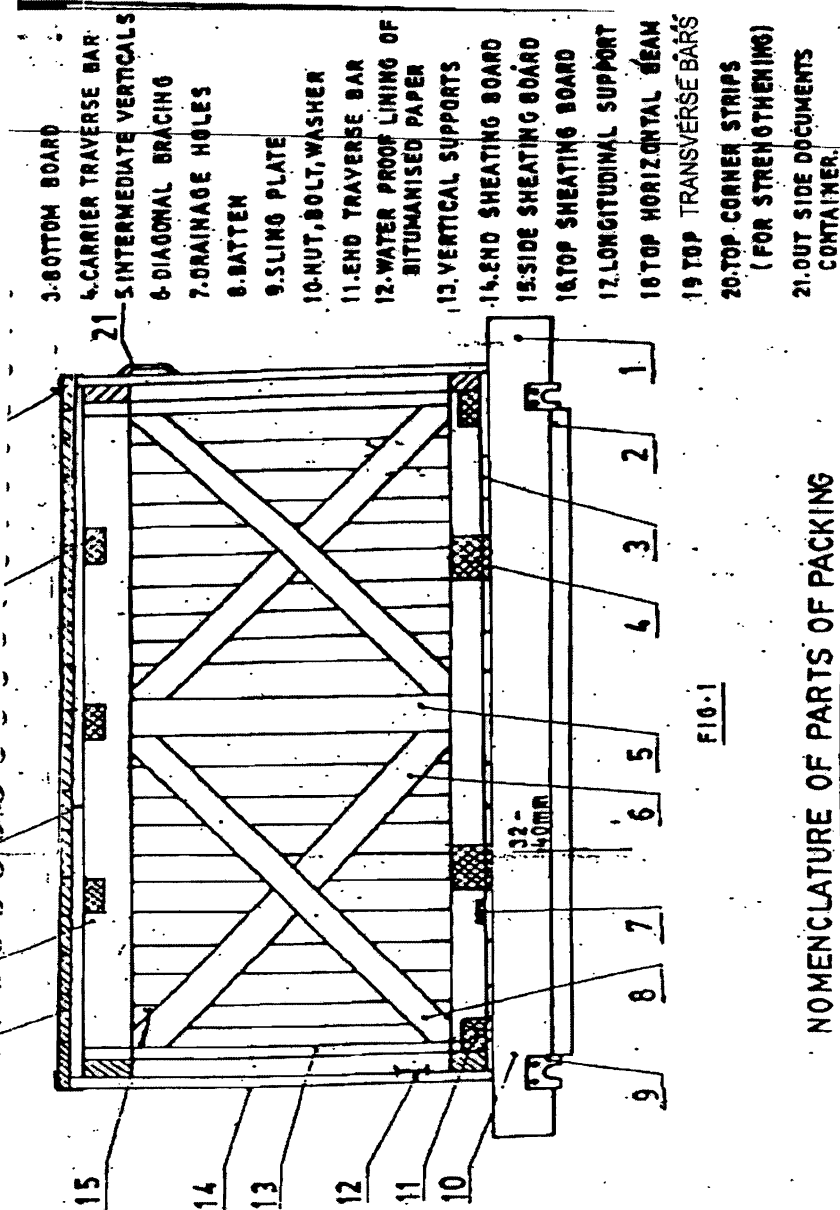


FIG-1

NOMENCLATURE OF PARTS OF PACKING

CASES

FIG-1

1 SLIDE
2 UNDER SLIDE BOARD

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BOTTOM FRAME ARRANGEMENTS

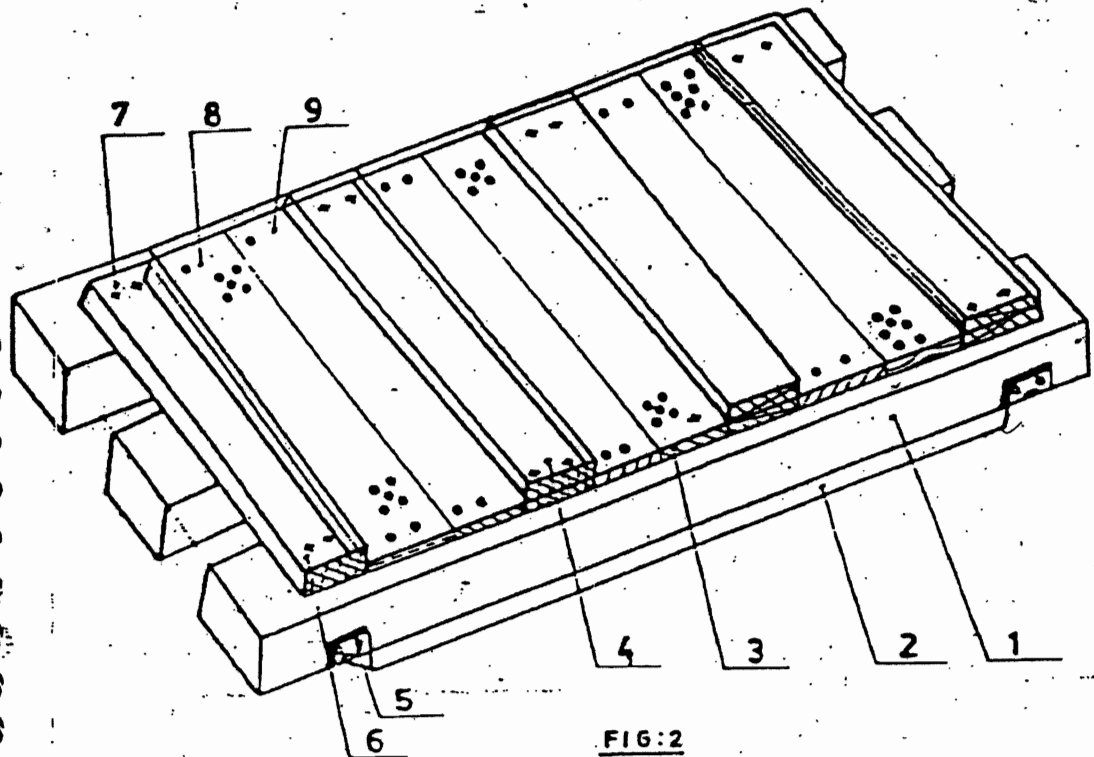


FIG:2

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; 100 x 100 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

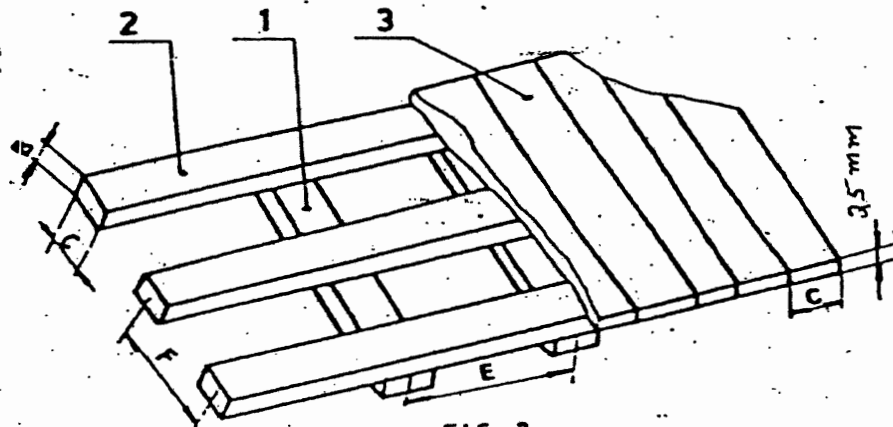
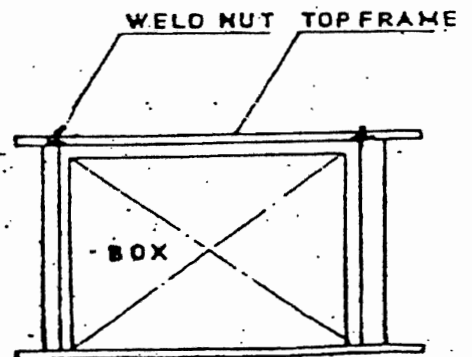
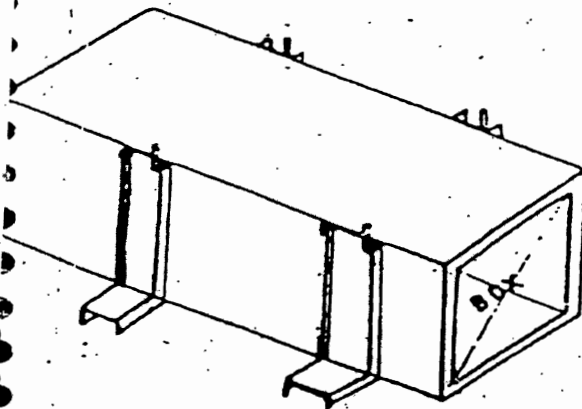


FIG-3

F : 700 to 1000 mm
E : 500 to 900 mm
30 x 100 mm.

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

ARRANGEMENT OF C-CLAMPS AROUND CASES



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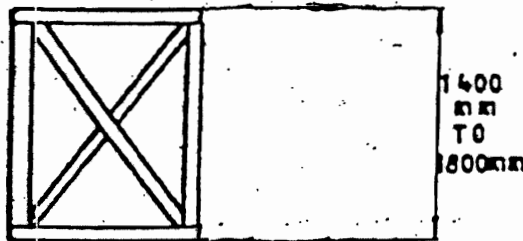
**ARRANGEMENT OF DIAGONAL BRACING AND
HORIZONTAL SUPPORT**

FIG: 6

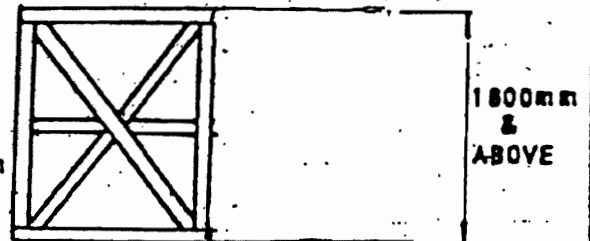


FIG: 8

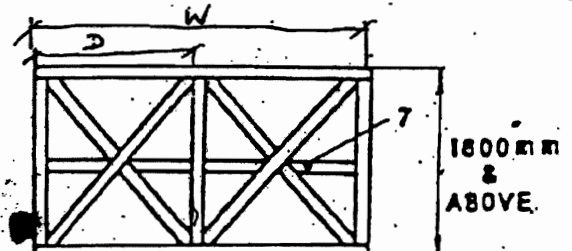


FIG: 7

7- Middle Horizontal Support

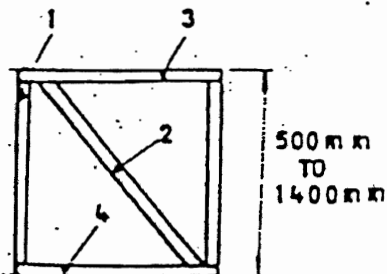


FIG: 5

1- Vertical Support

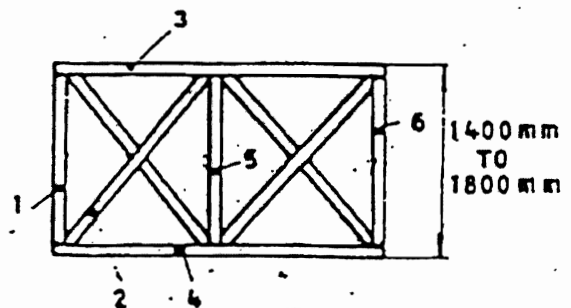


FIG: 7

1, 5, 6 - Vertical Support

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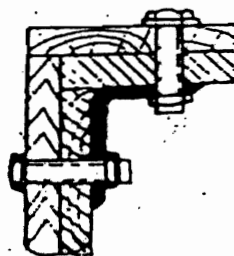
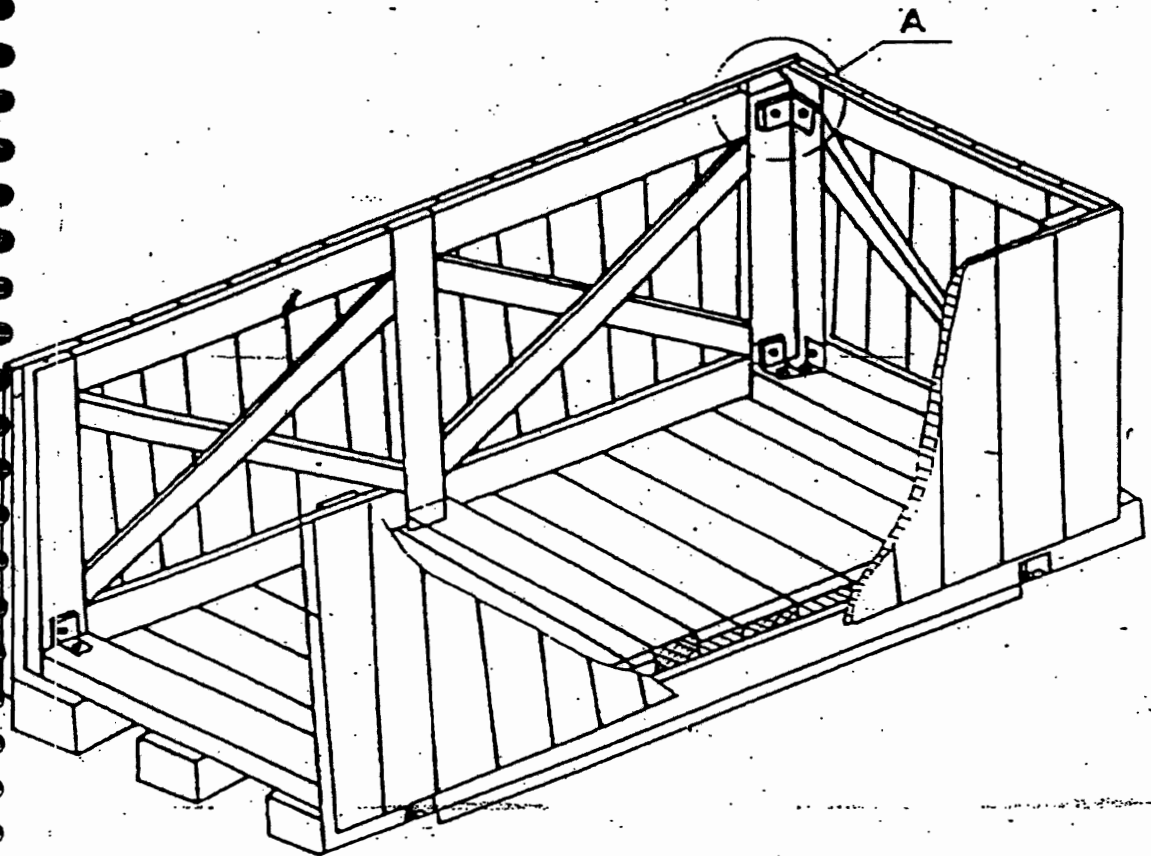
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ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER
MUST CONFORM
TO BOLT DIA

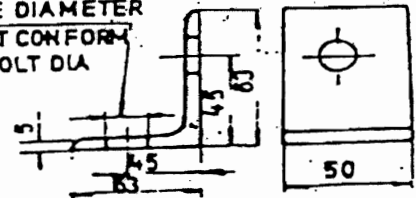


FIG:10

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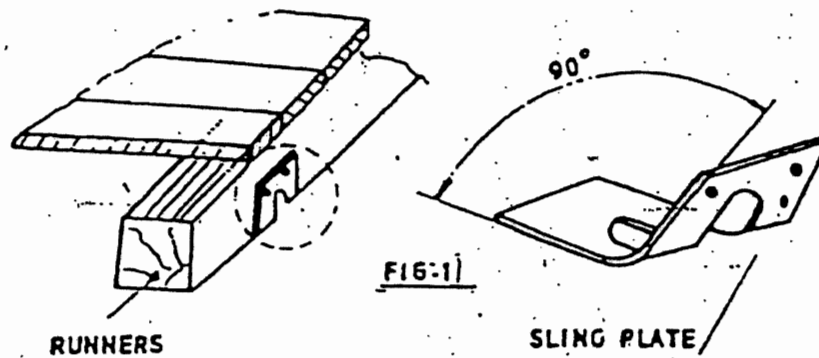
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**ARRANGEMENT OF SLING & PLATE ON
CASES**

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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

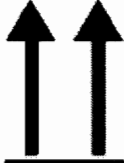
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Table-2

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
		X	X	X	X	X	X	X
	1601 to 2000	130	130	130	130	130	130	130
		X	X	X	X	X	X	X
	2001 to 3000	130	130	130	130	130	130	130
		X	X	X	X	X	X	X
	3001 to 4000	130	130	130	130	130	130	150
		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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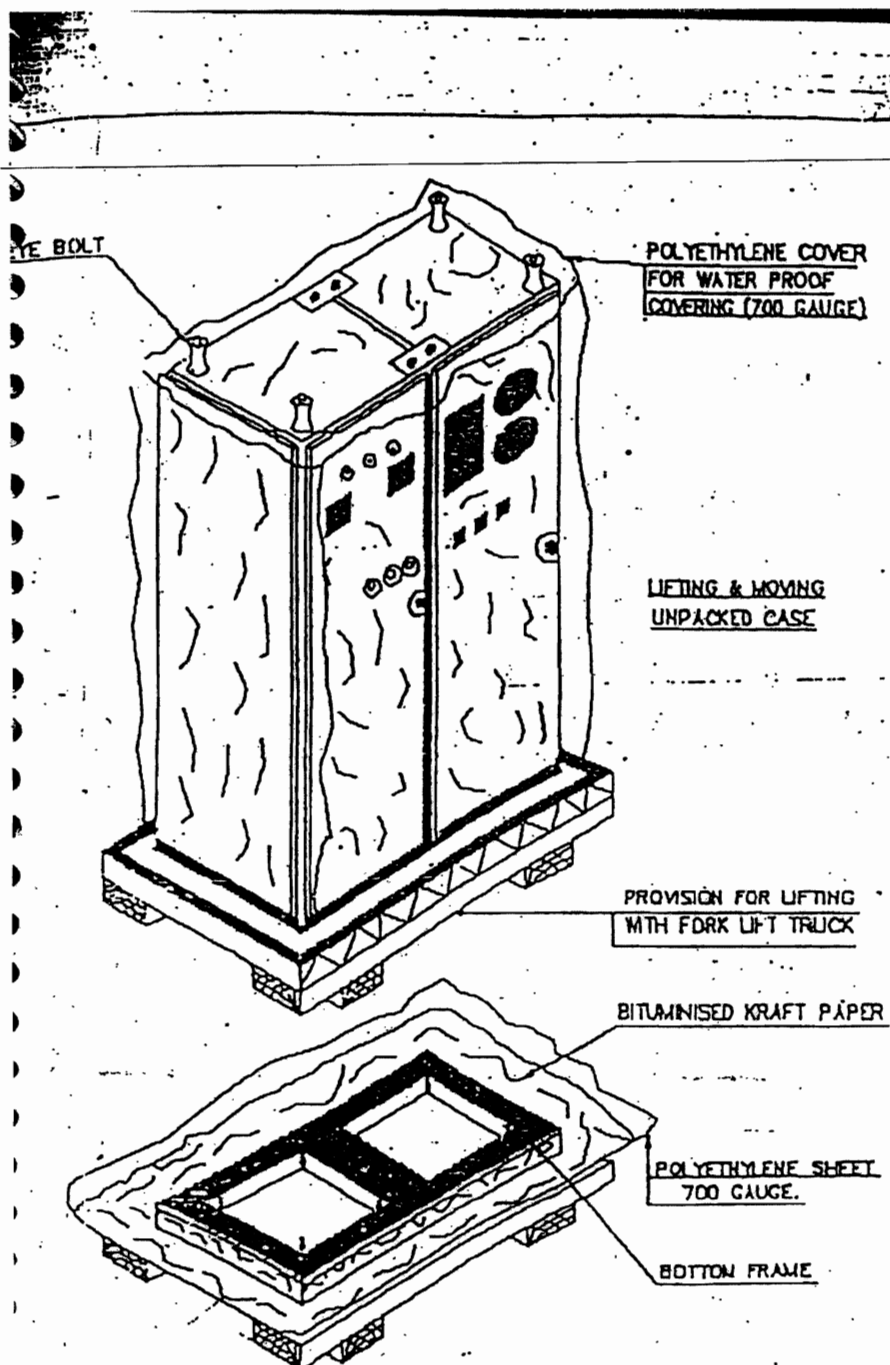


FIGURE-14



TITLE

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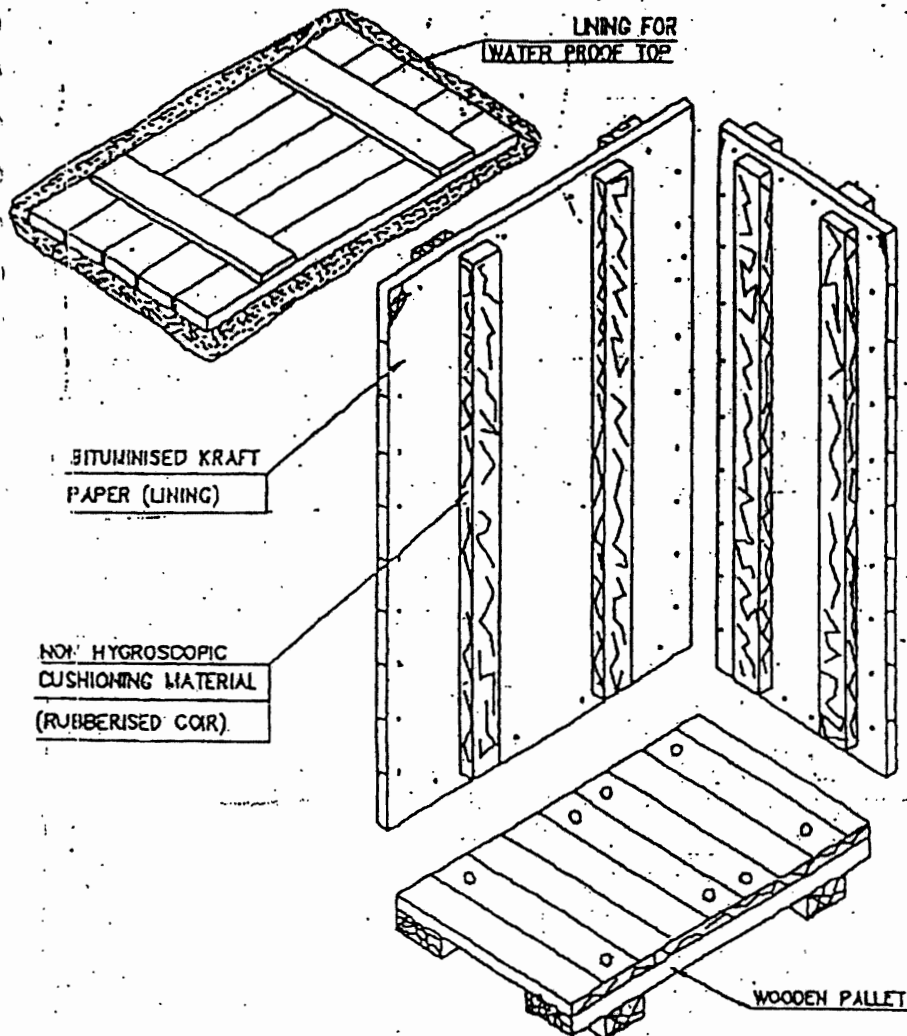
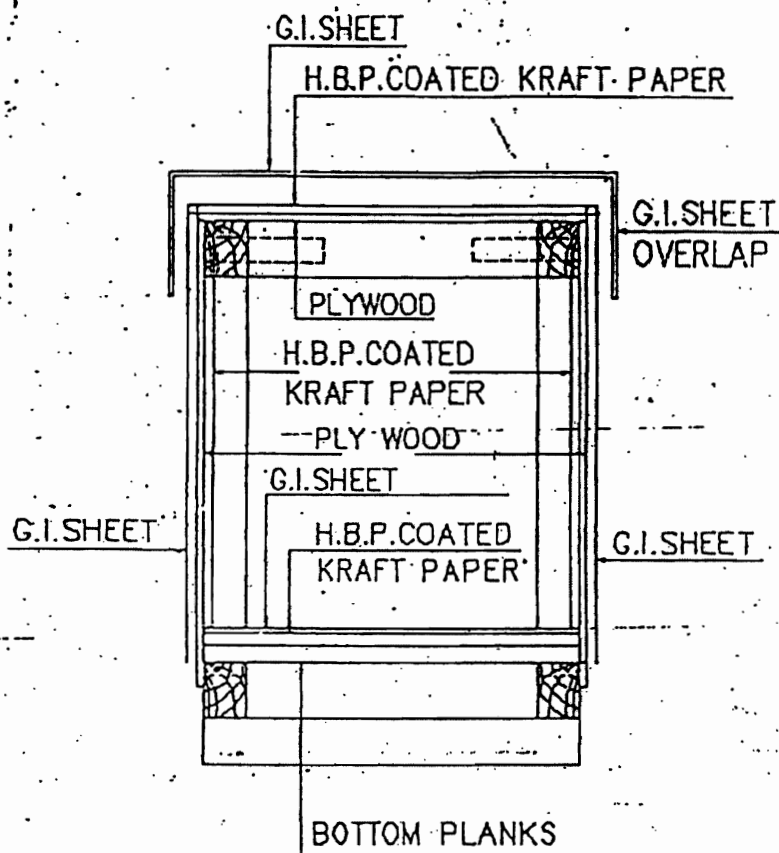


FIGURE-15

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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

- a) Project Name
- b) Purchase Order No.
- c) Sl. No. of package
- d) Size of mattress (Thickness x Length x Width)
- e) Density
- f) Wire netting material and size
- g) 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

- 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.

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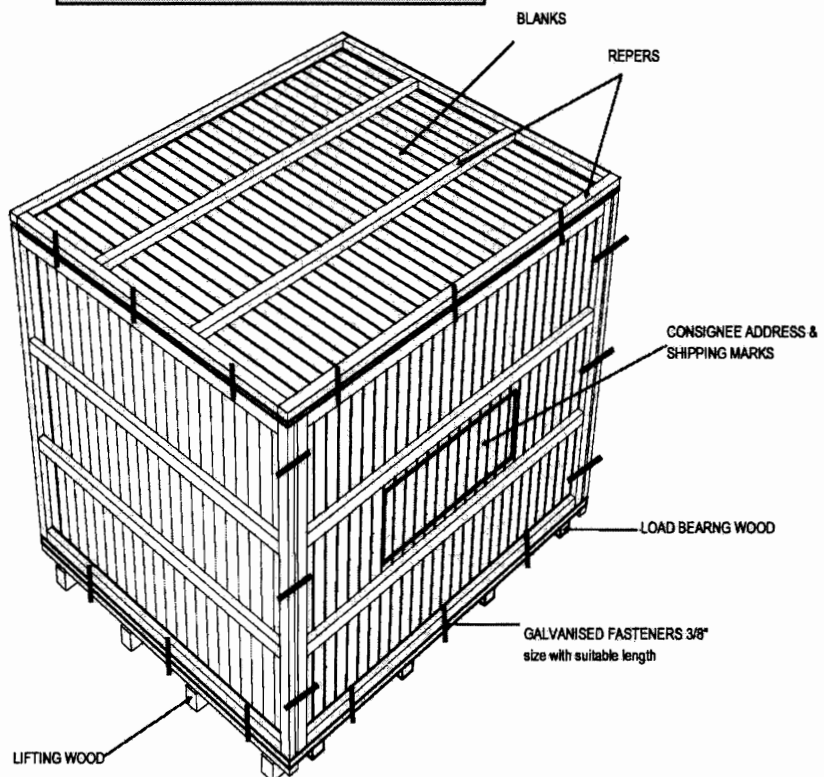
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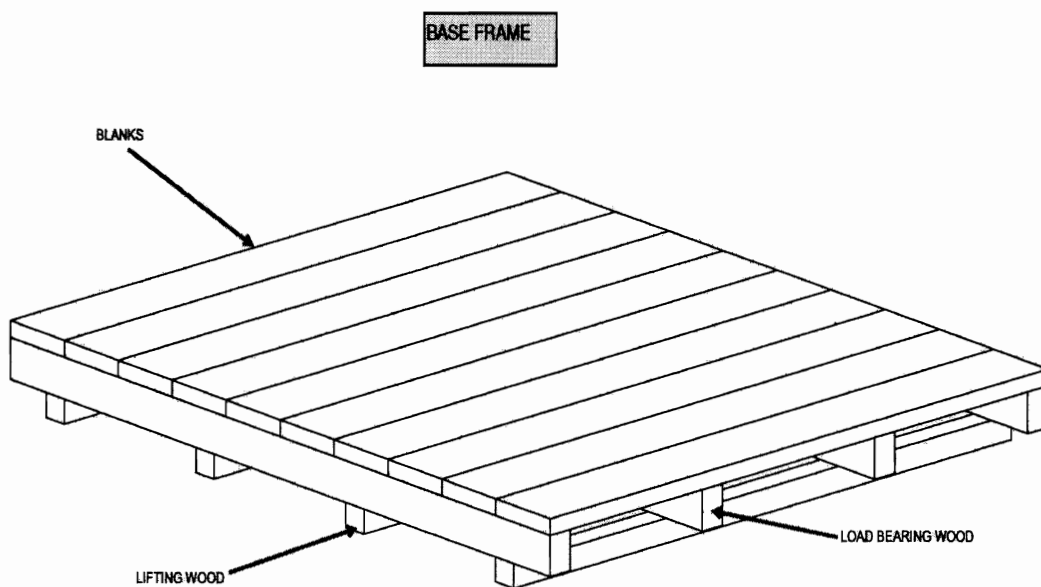
MODEL: FASTNERS TYPE (BASE, SIDE & TOP
ATTACHED WITH BOLT, NUT & WASHER)

This Type of case to be used for
following items:

1. BALL SEPERATOR
2. BALL COLECTOR SKID



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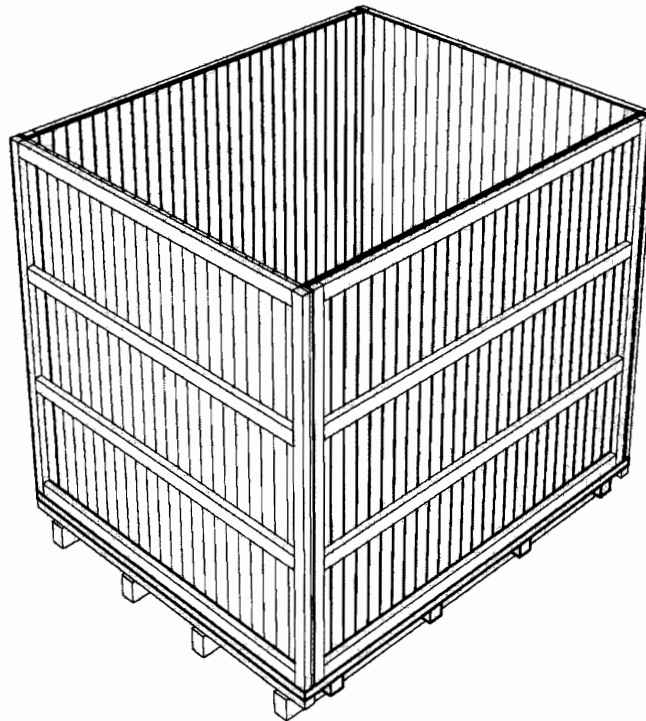
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MODEL: FASTNERS TYPE - WITHOUT TOP





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MODEL: NAILING TYPE
(FRAME & INSIDE REEPER 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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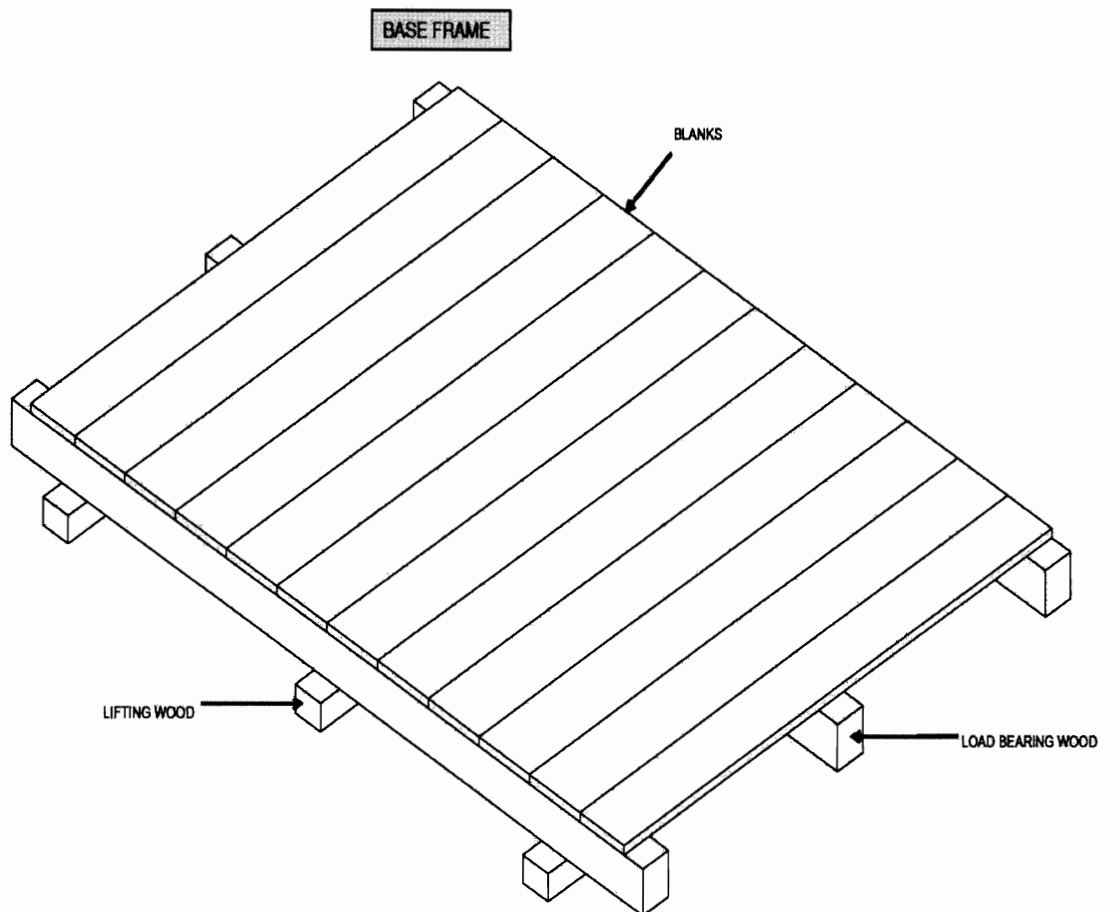
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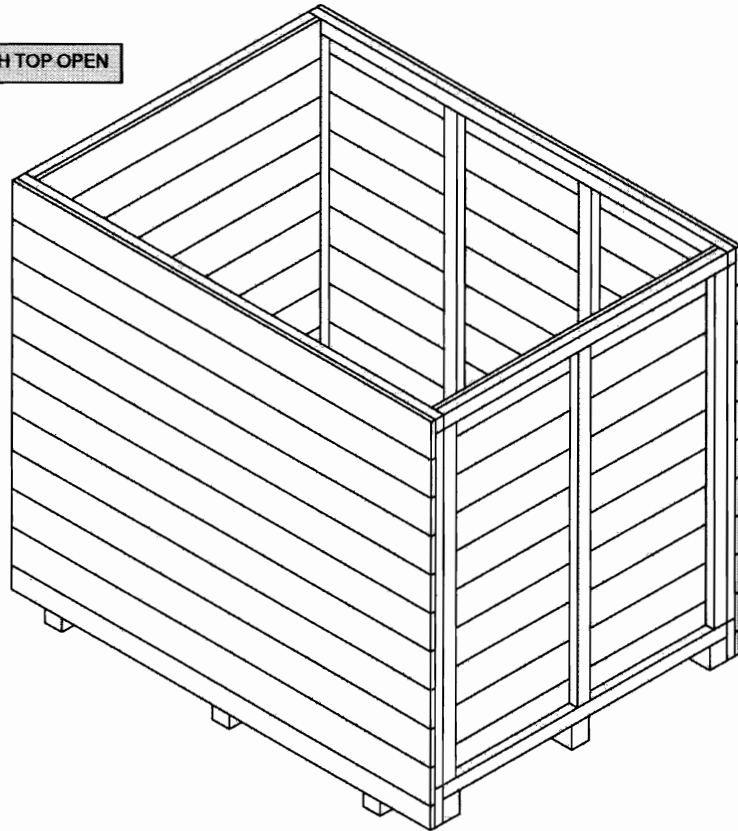
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NAILING TYPE MODEL WITH TOP OPEN



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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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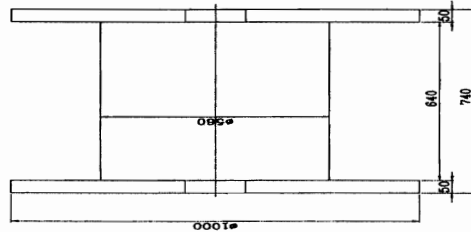
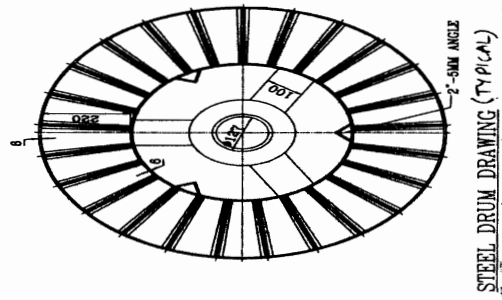
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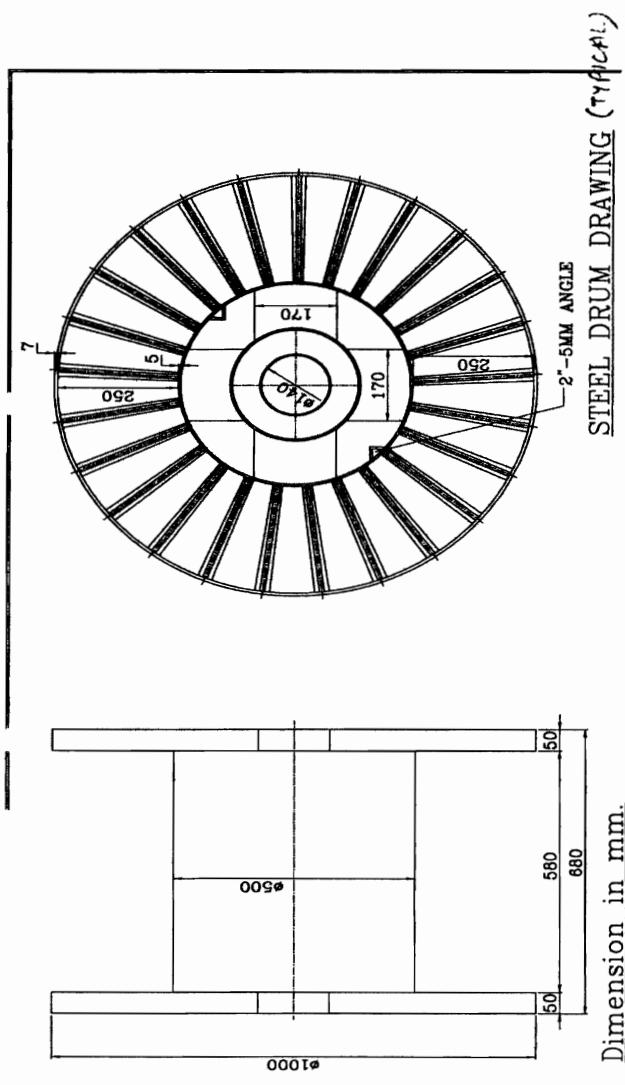
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Dimension in mm.

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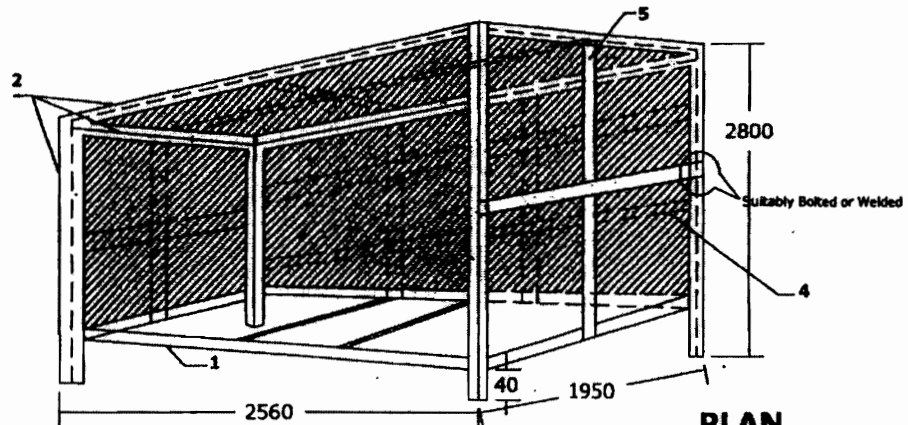
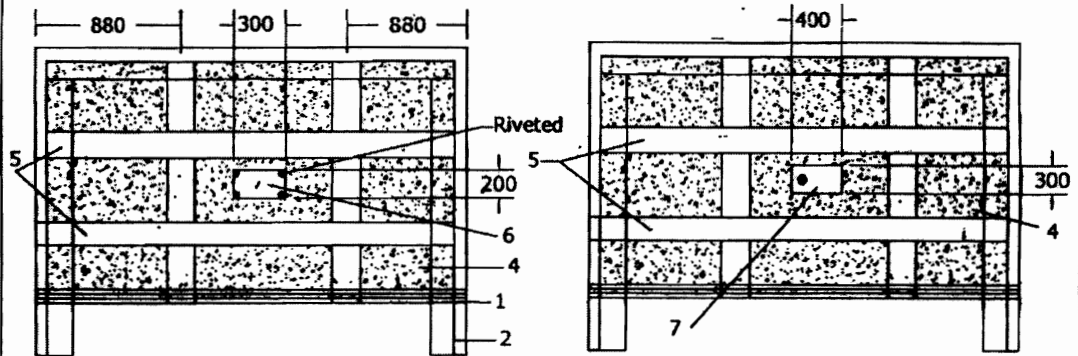
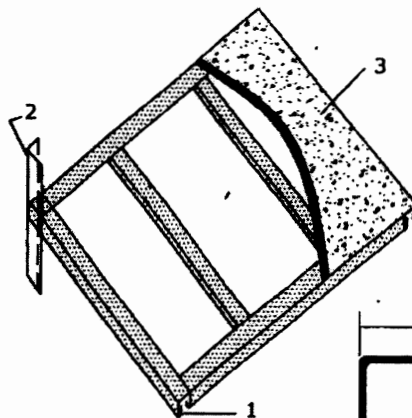
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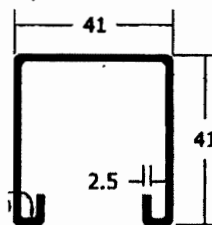
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STEEL PACKING (TYPICAL DETAILS)**PLAN****FRONT SIDE OF BOX****BACK SIDE OF BOX****BOTTOM FRAME ARRANGEMENT****Note:**

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.

**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

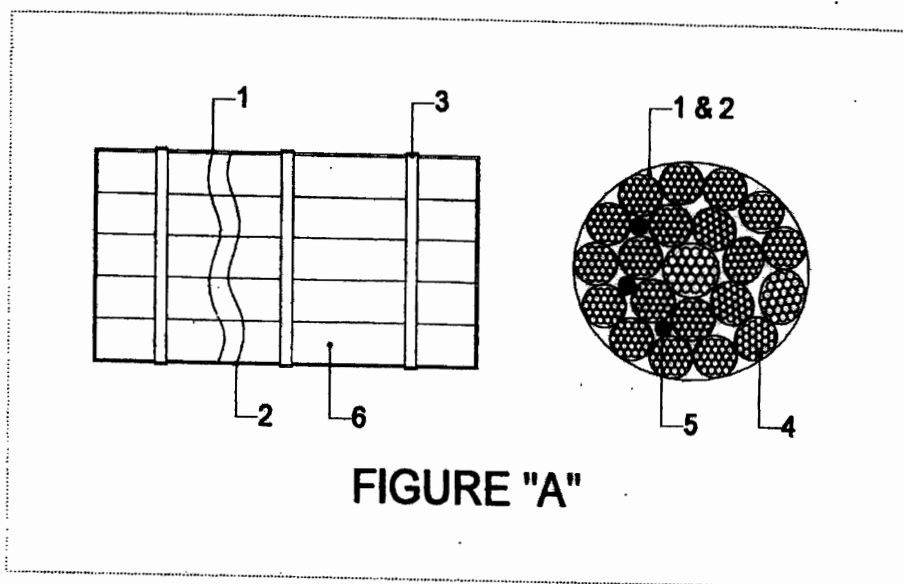
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Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

- 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



- 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.

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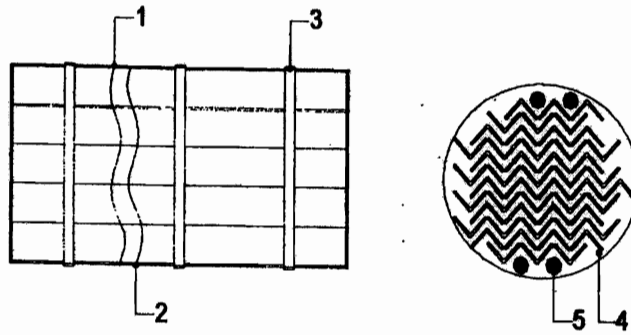
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PACKING PROCEDURE FOR STRUCTURAL STEEL**FIGURE "B"**

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



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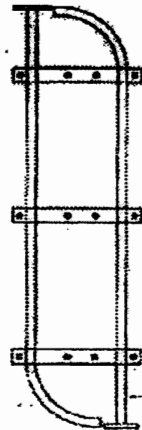
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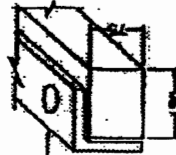
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packing procedure for poles



POLES WRAPPED WITH POLYTHENE SHEET &
EXTRUDING COATED HESSIAN CLOTH



TOP WOODEN BATTEN TO BE
FIXED WITH 150x80x6 MM ON TOP
OF IT FOR TIEING THE ROD
25 MM DIA



BOTTOM WOODEN BATTEN TO BE
FIXED ON 150x80x6 MM ANGLE

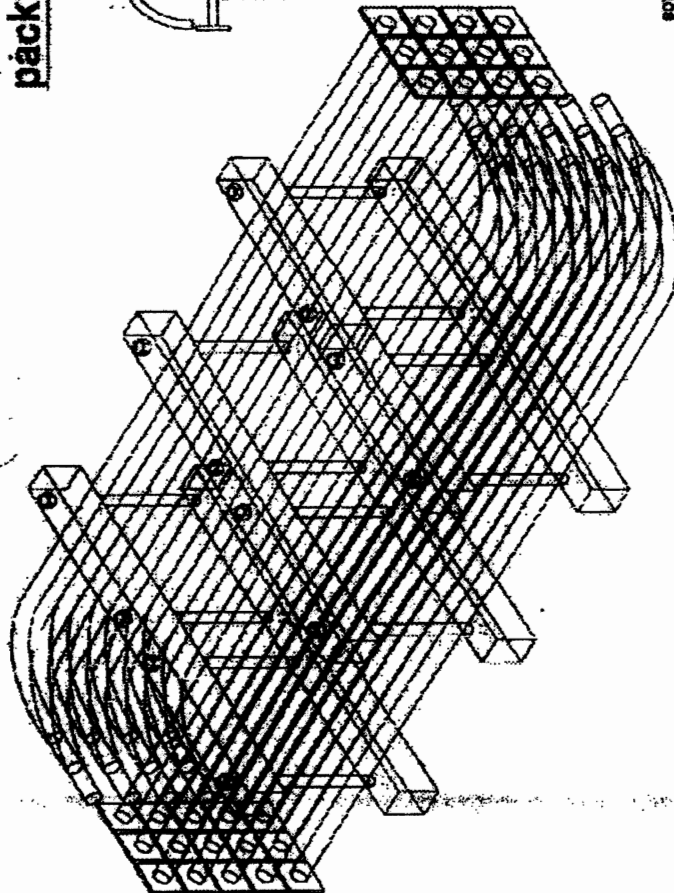


FIGURE "C"

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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.

CLAUSE NO.	TECHNICAL REQUIREMENTS			
ANNEXURE-IX Instrument Spec				
3.00.00	Temperature Elements and accessories			
3.01.00	Thermocouple			
	Sr. No.	Features	Essential/Minimum Requirements	
	1	Type of Thermocouple.	: 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type).	
	2	No. of element	: Duplex	
	3	Housing/Head	: IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well.	
	4	Insulation and Sheathing of Thermocouple	: Swaged type mineral (magnesium oxide) insulation and SS316 sheath.	
	5	Calibration and accuracy	: As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C.	
	6	Accessories	: Thermo well and associated fittings	
	7	Standard	: IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well	
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-4410-109-2		SUB-SECTION-III-C2 MEASURING INSTRUMENTS PAGE 7 OF 30

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
3.02.00	Resistance Temperature Detector (RTD)			
	Sr. No.	Features	Essential/Minimum Requirements	
	1	Type of RTD.	: Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).	
	2	No. of element	: Duplex	
	3	Housing/Head	: IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well	
	4	Insulation and sheathing of RTD	: Mineral (magnesium oxide) insulation and SS316 sheath,	
	5	Calibration and accuracy	: As per As per IEC-751/ DIN-43760 Class-A for RTD	
	6	Accessories	: Thermo well and associated fittings	
	7	Standard	: IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.	
	NOTES :			
1)	The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.			
2)	The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.			
3.03.00	Metal Temperature Thermocouples			
	Measuring Medium	Metal Temperature		
	Material of Thermocouple.	Chromel Alumel Type K		
	Type of Thermocouple	Duplex with ungrounded separate hot junctions		
	Insulation	Mineral Insulation (Magnesium Oxide).		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
3.04.00	Thermocouple wire gauge	16 AWG		
	Protective sheath	SS 321		
	Protective sheath dia	8 mm OD		
	Calibration & accuracy	As per IEC-584/ ANSI-MC-96.1 (special limits of error) for T/C		
	Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310. Adjustable gland fitting for connection at the junction box end as per manufacturer's standard.		
	Cold end sealing	SS pot seal with colour coded PTFE Insulated flexible tails. Sealing compound- Epoxy resin. Length of PTFE insulated flying leads shall be minimum 750 mm.		
	Minimum bending radius	30 mm		
	Length of T/C	On as required basis considering location of measurement point and the JB/TTJB location.		
	Notes :			
	1) The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.			
3.05.00	Thermo well (for all process temp. elements)			
	(a)	Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3, 1974)		
	(b)	For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.		
	(c)	For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if required based on the specified boiler design parameters).		
	(d)	For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.		
3.05.00	TEMPERATURE TRANSMITTER (TT)			
	Following types of 2-wire (loop powered) temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself. a. Single Input Head mounted Temperature Transmitter These shall be suitable for mounting in the head of temperature element itself. Temperature transmitter and associated temperature element shall be factory fitted. b. Single Input DIN-rail mounted Temperature Transmitter These shall be suitable for mounting on DIN-rails in JBs. The specifications of the JBs shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category. c. Dual-input Temperature Transmitter With integral Indicator: These shall be suitable for mounting on pipes/ support. Both elements of the duplex thermocouple/ RTD shall be wired to a single transmitter. Integral indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed. Protection class shall be IP65 minimum. d. Common requirements for each of the above type of temperature transmitters. Output : 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal. Input : Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K & R types (input type to be selectable at site through HART terminal). Isolation : Min. 500 V AC. EMC compatibility : As per EN 61326. Operating ambient temperature : 0 to 85 deg C (without indicator). 0 to 70 deg C (with indicator). Power supply : 24V DC +/- 10%. Accessories : Mounting arrangements including clamps etc. Composite Accuracy (i) For head mounted and DIN-rail mounted types: (Refer note 2) RTD =<0.4% of 0-250 deg C span T/C-K type =<0.4% of 0-600 deg C span T/C-R type =<0.4% of 0-1000 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C (ii) For dual-input type:			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
4.00.0	RTD = <0.25% of 0-250 deg C span T/C-K type = <0.2% of 0-600 deg C span CJC accuracy (for thermocouples) shall be = < 1 deg C Notes (Common for a) to d) above):- 1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output. 2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters are to be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input specified in (i) & (ii).				
	SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.				
	Sl. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
			Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
	1	Sensing Element	Bourdon for high pressure, Diaphragm/ Bellow for low pr.	Inert gas actuated/ Liquid filled other than mercury	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
	2	Material of sensing element	SS 316	SS 316	
	3	Material of movement	SS 304	SS 304	
	4	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
	5	Dial size	150mm	150 mm	Tubular covering entire range
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	6	End connection	1/2 inch NPT (M)	1/2 inch or 3/4 inch NPT (M).	Process connection as per ASME PTC and drain/vent 15 NB
	7	Accuracy	±1% of span	± 1% of span	± 2%
	8	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
	9	Range selection	Shall cover 125% of max. operating press	Shall cover 125% of max. operating temp	Shall cover max. Operating level.
	10	Over range	125% of FSD	125% of FSD	-
	11	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
	12	Zero/span adjustment	Provided	Provided	--
	13	Identification	Engraved with service legend or laminated phenolic name plate		
	14	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.
	Notes:-				
	*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.				
	Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.				
	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
5.00.00	PROCESS ACTUATED SWITCHES			
	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
		Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application)	Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application. .
	Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
	End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
	Over range/ proof pressure	150% of maximum operating pr.	-	150% of maximum operating pr.
	Repeatability	+/- 0.5% of full range		
	No. of contacts	2 No.+2NC. SPDT snap action dry contact		
	Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)		
	Elect. Connection	Plug in socket.		
	Set point adjustment	Provided over full range.		
	Dead band adjustment	Adjustable/ fixed as per requirement of application.		
	Enclosure	Weather and dust proof as per IP-55, metallic housing.		
	Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
	Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.00.00	Power Supply (wherever required)	As per Contractor's Standard practice.		
	Notes :-			
	1) Where the process fluids are corrosive, viscous, solid bearing or slurry type diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. 2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications. 3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range. 4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.			
	SOLENOID VALVES			
7.00.00	Solenoid valves shall fulfill the following requirements: -			
	a) Type 2/3/4 way SS 316/ forged brass (depending on the application subject to Employer's approval during detailed engg.) b) Power supply 24V DC. c) Plug in connector connection. d) Insulation : Class "H"			
	Limit switches			
	e) Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of Fire alarm Control System subject to a minimum of 60V, 6VA rating. Protection class shall be IP-55.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
8.00.00	SPECIFICATION FOR CORIOLIS FLOW TRANSMITTER		
	Type	Coriolis	
	Material of Wetted Parts	316 SS	
	Material of Housing	304L SS	
	Accuracy	± 0.2% of Rate	
	Repeatability	± 0.1% of Rate	
	Output	4-20 mA DC, HART Compatible	
	Power Supply	230 VAC or 24VDC operated	
	Process Temperature range	0-200 degree Celsius	
	Others	Drain / purging arrangement shall be provided as per standard practice.	
Viscosity range of Fluid	0-500cst for HFO		
The offered Coriolis type flow transmitter shall be suitable for intended application. Contractor shall submit flow and sizing calculation for Employer's approval. For each type of Coriolis type flow transmitter general arrangement and assembly drawing and cable wiring diagram shall be submitted for Employer's approval.			
9.00.00	SPECIFICATION FOR FLOW ELEMENTS		
9.01.00	Orifice Plate		
	Features	Essential/Minimum Requirements	
	Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167	
	Material	316 SS	
	Thickness	3 mm for main pipe diameter up to 300 mm and6 mm for main pipe dia above300 mm.	
	Material of branch pipe	Same as main pipe	
	Root valve type	Globe	
	Root valve material	Same as pipe material	
	Root valve size	1 / 2 inch or 1 inch (as applicable)	
	Impulse pipe of same material up to root valve	Required	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
9.02.00	Tappings	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings. However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.	
	Beta Ratio	0.34 to 0.7	
	Beta Ratio calculation to be submitted	Yes	
	Assembly drg. and flow Vs DP Curves	Yes	
	Accessories	Root valves, flanges, Vent/drain hole(As required)	
	Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval.		
	Flow Nozzle		
	Features	Essential/Minimum Requirements	
	Type	Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042	
	Material	316 SS	
	Thickness	Suitable for intended application.	
	Material of branch pipe	Same as main pipe	
	Root valve type	Globe	
	Root valve material	Same as pipe material	
	Root valve size	1 inch	
	Impulse pipe of same material up to root valve	Required	
	Tapping	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings. However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.	
	Beta Ratio	Around 0.7	
	Beta Ratio calculation to be submitted	Yes	
	Assembly drg. and flow Vs DP Curves	Yes	
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-4410-109-2	SUB-SECTION-III-C2 MEASURING INSTRUMENTS
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC				
9.03.00	Accessories		Root valves, vent and drain hole.				
	Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval.						
	Venturi (For Liquid applications)						
	Features		Essential/Minimum Requirements				
	Type		Rough Welded (for Pipe dia between 200mm to 1200mm) or Machined (for Pipe dia 50mm to 250mm) as per ISO 5167-4:2003,				
	Material		Same as Main Pipe				
	Thickness		Same as Main Pipe.				
	Root valve type		Globe Type				
	Root valve material		Same as Pipe material				
	Root valve size		1 inch				
	Impulse pipe of same material up to root valve		Required				
	Tapping		3 pairs of tappings for each Venturi as per ISO 5167-4:2003, However for some areas like CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.				
	Beta Ratio		0.4 to 0.7				
	Beta Ratio calculation to be Submitted		Yes				
9.04.00	Assembly drg. and flow Vs DP Curves		Yes				
	Accessories		Root valves, vent and drain hole.				
	Contractor shall submit certified flow calculation and differential pressure vs. Flow curves for each element for employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for employer's approval.						
	ROTAMETERS						
	Sr. No.	Features	Essential / minimum requirements				
	1.	Type	Variable Area Metal Tube				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
10.00.00	2.	Fluid media	Water/oil	
	3.	Tube body	SS316	
	4.	Material of float	316 SS	
	5.	Indicator	Linear scale	
	6.	Accessories	Flange, orifice in case of bypass Rota meter (for line size above 100 mm)	
	7.	Housing protection class	IP-55	
	8.	Accuracy	± 2% of measured value.	
	ANALYSER INSTRUMENTS (OTHER THAN CEMS):			
	Common Requirements			
	1	Output signals		
	Analog	4-20 mA DC galvanically isolated. If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to PC based station.		
	Binary	2 NO + 2 NC for high alarm		
2	Zero & span Adjustment	To be provided with range selection facility.		
3	Ambient temp.	50°C		
4	Indication	Digital Alphanumeric Display. Display of reading in engineering units shall be provided.		
5	Enclosure Type/Material	Weather & Dust proof (IP 55) Die cast Aluminium/SS.		
6	Type of Electronics	Microprocessor based with self diagnostic.		
7	Digital transmission	Signal	HART / RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for communication with plant control system.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.01.00	SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS				
	Sl.No.	Features	Essential/Minimum Requirements		
	1.	Type of Transmitter	Microprocessor based 2 wire type (loop powered), Hart protocol compatible.		
	2	Output signal	4-20 mA DC (Analog) along with superimposed digital signal based on HART protocol		
	3	Accuracy	± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc. +0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2. ± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc		
	4.	Turn down (minimum)	50:1 for greater than or equal to span of 400mmwcl. 20:1 for span below 400mmwcl. 10:1 for span greater than 250 kg/cm2		
	5.	Stability	0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer. 0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer. 0.15% of calibrated range for 5 years for static pressure greater than 250 kg/cm2.		
	(Above mentioned (3,4,5) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).				
	6.	Zero and span drift	+/- 0.015 per degC at max span +/-0.11% per degC at min. Span		
		Power Supply	24V DC ± 10%.		
	7.	Load impedance	500 ohm (minimum)		
	8.	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating		
	9.	Over Pressure	150% of max. Operating pressure		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.05.00		10. Electrical Connection Plug and socket type except in hazardous area 11. Process connection 1/2 inch NPT (F) 12. Span and Zero Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility. 13. Accessories -Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. Diagnostics and Display Self-Indicating feature and digital display 14. Accessories 2 valve manifold for absolute & Gauge pressure transmitters, 3-valve manifold for Differential Pressure and 5 valve manifold for Level /Flow applications. The valve manifold shall be non integral type (except Fuel Oil area). -For hazardous area, enclosure as described in NEC article 500 -2 inch pipe for mounting with Enclosure /Rack/Canopy 15. Certification SIL 2 or Better 16. Adjustment/calibration/maintenance From hand held HART calibrator	
	Notes LVDT type is not acceptable. For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement below range of 2000 mmwc Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.	TEMPERATURE TRANSMITTER (TT) Following specifications are applicable for Dual input/ Single input temperature transmitter. Temperature transmitter shall be 2-wire (loop powered) directly powered from 4-20mA input cards of DDCMIS. TT shall be fully compatible with thermocouples and RTDs being	
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CLAUSE NO.	TECHNICAL REQUIREMENTS																																																							
	provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself. <table><thead><tr><th>S No.</th><th>Features</th><th colspan="2">Essential/Minimum Requirements</th></tr></thead><tbody><tr><td>1.</td><td>Output</td><td colspan="2">2-wire (power supply from input card of control system) with 4-20mA output with superimposed HART protocol signal</td></tr><tr><td>2.</td><td>Input</td><td colspan="2">Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types (Selectable through HART terminal/calibrator)</td></tr><tr><td></td><td>Isolation</td><td colspan="2">Min 500 VAC</td></tr><tr><td></td><td>EMC compatibility</td><td colspan="2">As per EN 61326</td></tr><tr><td></td><td>Power supply</td><td colspan="2">24 V C +/- 10%</td></tr><tr><td>3.</td><td>Housing</td><td colspan="2">Weather proof as per IP-67, metallic housing with durable corrosion resistant coating</td></tr><tr><td>4.</td><td>Electrical connection</td><td colspan="2">Plug and Socket connector except hazardous area</td></tr><tr><td>5.</td><td>Diagnostics display</td><td>&</td><td>Self-Indicating feature and digital display on transmitter</td></tr><tr><td>6.</td><td>Operating Ambient temperature</td><td colspan="2">85 deg C without display. 70 deg C with display.</td></tr><tr><td>7.</td><td>Mounting</td><td colspan="2">2 inch pipe mounting with Canopy.</td></tr><tr><td>8.</td><td>Accessories</td><td colspan="2">As required by service and operating condition.</td></tr><tr><td>9.</td><td>Composite Accuracy</td><td colspan="2">(Refer note 2) RTD =<0.25% of 0-250 deg C span T/C-K type =<0.2% of 0-600 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C</td></tr></tbody></table> Notes: - In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output. - Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed in control system. - Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., A/D accuracy, basic accuracy, digital accuracy, etc.) and temperature effect on these				S No.	Features	Essential/Minimum Requirements		1.	Output	2-wire (power supply from input card of control system) with 4-20mA output with superimposed HART protocol signal		2.	Input	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types (Selectable through HART terminal/calibrator)			Isolation	Min 500 VAC			EMC compatibility	As per EN 61326			Power supply	24 V C +/- 10%		3.	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating		4.	Electrical connection	Plug and Socket connector except hazardous area		5.	Diagnostics display	&	Self-Indicating feature and digital display on transmitter	6.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.		7.	Mounting	2 inch pipe mounting with Canopy.		8.	Accessories	As required by service and operating condition.		9.	Composite Accuracy	(Refer note 2) RTD =<0.25% of 0-250 deg C span T/C-K type =<0.2% of 0-600 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	एनटीपीसी NTPC accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above. 4. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only. 5. Dual input temperature transmitters can also be accepted in place of single input TT.		
12.00.00	Vibration Monitoring System The Vibration Monitoring System shall be furnished on a system basis including, vibration transducers, phase marker sensor with low noise flexible cables in flexible conduit, terminated in local terminal boxes, necessary pre-amplifier/electronics mounted in local weather proof boxes, vibration monitors, mounting racks and cabinets etc. The vibration monitoring system shall include all power supplies, interconnecting cabling, calibration equipment, indicators, integrating units, signal conditioning devices and all other accessories, erection hardware required for monitoring of Vibration at each point. The contractor shall provide the vibration pads. Contractor can offer up to Four Channel Vibration monitors. The allocation of channels shall be such that loss of one monitor shall not affect more than one side of the bearing of one machine. In the case of more than two channel Vibration monitors being provided by the Contractor, then one spare monitor shall be provided mounted in the panel to take care of immediate replacement of any failed monitors. Offered vibration monitors shall be modular in construction, plug in type. Eddy current / piezoelectric type transducers shall be used. The sensors shall be either proximity or velocity or accelerometer type. However, the finally selected sensor type shall also depend on recommendation of the equipment manufacturer & suitable for application requirement which shall be finalised during detail engineering and without any extra price. Transducers shall be furnished in weatherproof housing suitable for field conditions. Cables/cabling from transducers local JB to Vibration Monitoring system in Control Room/Control Equipment Room shall be provided by the Contractor. Vibration monitoring system shall give one no. buffered output of 4-20 mA DC and two no. of buffered raw signal for each point monitored and one no. of buffered raw signal for each phase marker sensor. The 4-20mA signal shall be suitable for use as an input to DDCMIS, linear in proportion to vibration velocity or displacement. Raw buffered signal(s) shall be suitable for archiving and analysis. Monitor shall provide vibration indication calibrated in velocity units along with provisions of changing to displacement unit (field-programmable) for each measurement point in both horizontal & vertical planes. The generation of alarm and trip signals is not envisaged in vibration monitoring system, the same shall be derived in DDCMIS. However in case of vibration initiated protection of equipments, OEM standard and proven practices shall also be considered.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC							
	The vibration monitor racks with power supplies shall be mounted in a separate self standing cabinet to be located in control room. The number of racks and power supplies shall be such that on failure of a single power supply/module, not more than four monitors shall be affected. The vibration monitoring cabinet shall be fed from redundant 24V DC feeders with auto changeover scheme. The power supply arrangement for monitors shall ensure that failure of one power supply shall not affect any monitoring function in the system. Also any power supply failure /earth fault in any of the monitors will be isolated without affecting other monitors/ common power supply. If 230 V AC UPS power supply is required for panel PC/ desktop PC, UPS/Mini UPS for the same shall be provided by the contractor. The functional requirement for vibration monitoring system shall include but not be limited to the following: - Vibration monitor front face status indications shall be available for indications of healthy conditions of pick up circuit, monitor circuit and power supply. On sensor fault/wire break in the sensor circuit, the system shall have the feature of identifying the same through suitable means like the signal forced to a value less than 4 mA. In case, such a feature is not available then suitable contact shall be provided from the monitor for sensor fault. - The facility shall be available for online functional checking of monitors. - All vibration monitoring equipment shall be functionally tested for circuit continuity and output response. All the components & interconnection cables shall be tested to ensure compliance with the specification requirements & all other applicable codes & standards. In case it is the proven standard practice of a Contractor to provide vibration monitoring PC with TFT LCD monitor, instead of dedicated monitors with the signal conditioning equipment in control equipment room, the same shall also be acceptable. However, all relevant functional requirements detailed above shall be met and the system shall be subject to Employer's approval.								
13.00.00	FIELD INSTRUMENTS BASED ON FIELDBUS								
	The following instruments shall be connected to DDCMIS through fieldbus i.e. FOUNDATION Fieldbus/PROFIBUS PA protocol complying to IEC 61158 directly from transmitter.								
13.01.00	Electronic Transmitter for Pressure, Differential Pressure and DP based Flow / Level measurements.								
	<table><tr><th>S No.</th><th>Features</th><th>Essential/Minimum Requirements</th></tr><tr><td>1.</td><td>Type of Transmitter</td><td>FOUNDATION Fieldbus/PROFIBUS PA based output</td></tr></table>	S No.	Features	Essential/Minimum Requirements	1.	Type of Transmitter	FOUNDATION Fieldbus/PROFIBUS PA based output		
S No.	Features	Essential/Minimum Requirements							
1.	Type of Transmitter	FOUNDATION Fieldbus/PROFIBUS PA based output							
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	2	Accuracy	± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc. +0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2. ± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc.	
	3.	Stability	0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer. 0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer. 0.15% of calibrated range for 5 years for DPT with static pressure greater than 250 kg/cm2.	
	4	Turn down	50:1 for greater than or equal to span of 400mmwcl. 20:1 for span below 400mmwcl. 10:1 for span greater than 250 kg/cm2 (Above mentioned (2,3,4) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).	
	5	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating	
	6.	Electrical connection	½” NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible	
	7.	Process connection	½” NPT (F)	
	8.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.	
		Overpressure	150% of max operating pressure	
	9	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & gauge pressure transmitters, -3-valve for DP and 5 valve manifold for level/flow applications. -The valve manifold shall be non-integral type. -For hazardous area, enclosure as described in NEC article 5.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC																					
	10.	Mounting	2 inch pipe mounting with Enclosure/Rack/Canopy.																					
	11.	Diagnostics & display	Self-Indicating feature and digital display on transmitter																					
	Notes																							
	- For primary air/ secondary air/flue gas/ furnace pressure applications, DP type transmitters shall be provided for pressure measurement below 2000 mmwc. - LVDT type is not acceptable. - Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.																							
13.02.00	Temperature Transmitter																							
13.02.01	Single Input /Dual Input Temperature transmitter																							
	Temperature transmitter shall be provided which shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself. Transmitters shall be capable of withstanding ambient temperature up to 85 deg C. Following specifications are applicable for dual input/single input temperature transmitter. <table><tr><th>S No.</th><th>Features</th><th>Essential/Minimum Requirements</th></tr><tr><td>1.</td><td>Output</td><td>FOUNDATION fieldbus /PROFIBUS PA</td></tr><tr><td>2.</td><td>Input</td><td>Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types</td></tr><tr><td>3.</td><td>Housing</td><td>Weather proof as per IP-67, metallic housing with durable corrosion resistant coating</td></tr><tr><td>4.</td><td>Electrical connection</td><td>½” NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible</td></tr><tr><td>5.</td><td>Diagnostics & display</td><td>& Self-Indicating feature and digital display on transmitter</td></tr><tr><td>6.</td><td>Operating Ambient temperature</td><td>85 deg C without display. 70 deg C with display.</td></tr></table>			S No.	Features	Essential/Minimum Requirements	1.	Output	FOUNDATION fieldbus /PROFIBUS PA	2.	Input	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types	3.	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating	4.	Electrical connection	½” NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible	5.	Diagnostics & display	& Self-Indicating feature and digital display on transmitter	6.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	7.	Mounting	2 inch pipe mounting with Canopy.
	8.	Accessories	As required by service and operating condition.
	9.	Composite Accuracy	(Refer note 2)
		RTD	=<0.25% of 0-250 deg C span
		T/C-K type	=<0.2% of 0-600 deg C span
		CJC accuracy (for thermocouples) shall be =< 1 deg C	
	Notes:		
	1. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.		
	2. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed.		
	3. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above.		
	3. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.		
	4. Dual input temperature transmitters can also be accepted in place of single input TT.		
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SUB-SECTION-II-E8

ELECTRICAL ACTUATORS WITH

INTEGRAL STARTERS

NORTH KARANPURA SUPER THERMAL POWER PROJECT
(3X660 MW)
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-4410-109-2

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	CODES AND STANDARDS:			
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and codes, standards, etc, the former shall prevail.			
2.00.00	ELECTRIC ACTUATORS WITH INTEGRAL STARTERS			
2.01.00	TYPE:			
2.01.01	The actuators shall have integral starters along with over load relays with built in SPP (Single Phasing Preventer). Alternatively Smart non-intrusive actuators are also acceptable. A 415, 3 phase 3 wire power supply shall be given to the actuator from switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.			
2.01.02	In case supplier's standard control voltage for Open/Close contactors is 110V AC, the same is acceptable if suitable Opto Isolation circuit is provided with coupling relays for 24 V DC command inputs.			
2.02.00	INTERFACES:			
2.02.01	Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator. (a) For Binary Drive (both ON-OFF and INCHING type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided. Interface with the control system shall be through hardware signal only. Inter posing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system. (b) For Modulating Drive:- The command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided. Also these actuators shall be Continuous modulating type. (c) Open/close command termination logic shall be suitably built inside actuator.			
2.03.00	RATING: (a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%. (b) Sizing:- Open/Close at rated speed against designed differential pressure at 90% of rated voltage. For isolating service:- Three successive open-close operations or 15 mins, whichever is higher. For regulating service 3000 starts per hour or required cycles, whichever is higher.			
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-4410-109-2	SUB SECTION-II-E8 ELECTRIC ACTUATORS WITH INTEGRAL STARTERS	PAGE 1 OF 5

CLAUSE NO.	TECHNICAL REQUIREMENTS	
2.04.00	CONSTRUCTION: (a) Enclosure: Totally enclosed weatherproof minimum IP-55 degree of protection. (b) Gear Train : Metal (Fibre gears are not acceptable)) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energized. (c) Manual Wheel: Shall disengage automatically during motor operation.	
2.05.00	MOTOR : (a) Type : Squirrel cage induction motor suitable for Direct On Line (DOL)starting. (b) Enclosure: Totally enclosed, self ventilated IP-55 degree of protection. (c) Insulation Class B or better. Temperature rise 70 Deg C. over 50 Deg C ambient (d) Bearings: Double shielded, grease lubricated antifriction. (e) Earth Terminals: Two (f) Protection: Single Phasing Protection, Over heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be provided over and above other protection features standard to Contractor's design Suitable means shall be provided to diagnose the type of fault locally.	
2.06.00	POSITION/TORQUE SWITCHES:	
2.06.01	Four nos. (2 each in open and close position) position limit switches/contacts and two nos. (one in open and other in close direction) torque switches/contacts each having two nos. NO and two nos. NC contacts shall be provided. Torque switches/contacts shall be bypassed in both the end positions with the other end Limit switches/contacts.	
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-4410-109-2	SUB SECTION-II-E8 ELECTRIC ACTUATORS WITH INTEGRAL STARTERS PAGE 2 OF 5

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Limit switches/contacts Limit switches shall be Silver plated with high conductivity and non –corrosive type. Contact rating shall be sufficient to meet the requirement of Control System subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP-55. Limit switch/contacts and disturbance signals shall be available to DCS even when the power supply to the actuators is not available. 2.07.00 LOCAL OPERATION: 2.07.01 It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator. 2.08.00 POSITION INDICATOR : 2.08.01 To be provided for 0 to 100% travel. 2.09.00 POSITION TRANSMITTER (FOR MODULATING/INCHING TYPE) : 2.09.01 As required. Suitable for stabilized 4-20 mA signal, 2 wire inductive type, External 24 volts DC operated. 2.10.00 WIRING : 2.10.01 Suitable voltage grade copper wire. 2.11.00 TERMINAL BOX : (i) 9 pin plug and socket (1 no. per actuator to suit 4 pair 0.5 sq.mm. copper overall shielded (16 mm OD), instrumentation cable) suitably mounted in the starter box itself to terminate open/close command and status feedback signals with external control systems. (ii) Additional one number 9 pin plug and socket (to suit 4 pair 0.5 sq.mm copper (16 mm OD) individual and overall shielded instrumentation cable) suitably mounted in the starter box itself for actuators with 4-20 mA position transmitters. (iii) Necessary glands for power cables shall be provided. 2.12.00 TERMINAL BLOCK : 2.12.01 650V grade. For power cables. 2.13.00 SPACE HEATER : 2.13.01 Space heater of suitable rating. The supply shall be derived from the main power supply available in the actuator.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.14.00 2.14.01 3.00.00	TYPICAL WIRING DIAGRAM : Refer Tender Drawing No. 0000-999-POI-A-063. TRAINING Contractor shall provide training on Integral Actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.			
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