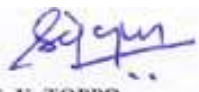


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		REVISION : 01 <u>Reason for Revision:</u> Vibration Analysis System for STG have been removed from the scope of supply.		APPROVED BY  S. K. TOPPO <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td data-bbox="853 1877 1098 2065" style="width: 33%;"> PREPARED BY  D. GHOSH </td> <td data-bbox="1098 1877 1289 2065" style="width: 33%;"> ISSUED 416 </td> <td data-bbox="1289 1877 1492 2065" style="width: 33%;"> DATE 05/11/2019 </td> </tr> </table>			PREPARED BY  D. GHOSH
PREPARED BY  D. GHOSH	ISSUED 416	DATE 05/11/2019					



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B	PRE-QUALIFICATION REQUIREMENTS	CE / 416 / RMCMA S / YAD / PQ
C	SPECIFICATION FOR ROTATING MACHINE CONDITION MONITORING & ANALYSIS SYSTEM (RMCMA S)	CE / 416 / RMCMA S / YAD / PS
D	PACKING SPECIFICATION Enclosure: CE/409-416/TSS-VMS/PKG	CE / 416 / RMCMA S / YAD / PG

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GENERAL INSTRUCTIONS TO BIDDERS :

- 1.0 ALL REQUIRED DOCUMENTS AGAINST THIS TENDER / SPECIFICATION SHALL BE SUBMITTED IN ENGLISH ONLY.
 - 2.0 Introduction : Bidders are required to offer Rotating Machine Condition (Vibration) Monitoring and Analysis System for certain critical Pumps & Fans with their respective motors (HT drives) and Vibration Analysis System for Steam Turbine Generators & Boiler Feed Water Pump Drive Turbines.
 - 3.0 In order to accept the Technical offers / proposals from Bidders for the projects mentioned in Section-C of this Specification, certain Pre-qualification criteria are required to be met by Bidder.
 - 4.0 Pre-qualification requirements (PQR) are clearly mentioned in Section-B of this Specification. Bidder to read the same carefully and submit the details required for BHEL's acceptance.
 - 5.0 The detailed guidelines for packaging is provided in Section-D.
 - 5.1 For vibration monitors, rack etc. being dispatched from OEM (countries other than India in to India) packing which is suitable for transportation by Lorry and Storage at site for extended periods up to 24 months shall be used. For this a reference standard ED 490092 Rev 05 clause 3.1.2 is attached. OEMs shall follow this standard at minimum. If any other OEM standard packing is available same shall be submitted to BHEL for review and acceptance as part of Technical offer.
 - 5.2 For Panels etc (i.e. typically from Indian manufacturers) packing which is suitable for transportation by Lorry and Storage at site for extended periods up to 24 months shall be used. For this a reference standard ED 490092 Rev 05 clause 3.1.1 is attached. OEMs shall follow this standard at minimum. If any other OEM standard packing is available same shall be submitted to BHEL for review and acceptance as part of Technical offer.
 - 5.3 The packing shall be separate for each unit of the project, Main & Mandatory spares separately.
 - 6.0 In case Bidder does not include the details or meet the requirements of Pre-qualification requirements, their offer will be summarily Rejected and Bidder's Technical offers will not be Evaluated.
 - 7.0 Evaluation methodology: BHEL shall initially open Bidder's PQR documents only as per Section-B of this specification for review & acceptance. Only after acceptance of PQR documents, BHEL shall open Bidder's technical offers for evaluation. Commercial bids of only accepted and approved Bidders by End users/Customers, shall be considered by BHEL for further processing.

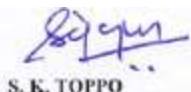
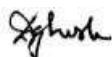
BHEL shall review PQR documents and submit Vendor Credentials of accepted vendors to End User / Customer for their approval and await decision for a maximum of one month from the date of opening of bid. If approval is not received within the above period, BHEL shall treat the offer as "NOT Meeting PQ Criteria" and offer shall be rejected.
-

8.0 Bidders are required to submit offers as detailed below :

- aa. Documents pertaining to Pre-Qualification requirement (CI AA of Section B of this Specification) shall be in a Separate folder/cover with reference no. "CE/416/RMCMAS/YAD/PQ / CI AA of Section B" marked on it.**
- bb. Documents pertaining to Pre-Qualification requirement (CI BB of Section B of this Specification) shall be in a Separate folder/cover with reference no "CE/416/RMCMAS/YAD/PQ / CI BB of Section B" marked on it.**
- cc. Technical offers/proposals for the Project, whose requirements are mentioned in in sub-sections of Sections-C of this specification will be submitted in separate covers with Project name & reference marked on it.**

9.0 Whenever required during evaluation of PQR and Technical offers/bids, vendor is required to be present at BHEL Electronic Division, Bangalore, for discussions. Further in the event of order, during approval of the Vendor documents by Endusers/Customers, Vendor shall accompany BHEL representative for discussions.

10.0 Deviations (if any) shall be discussed with only those vendors who quote for this tender.

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				PREPARED  D GHOSH			ISSUED 416	DATE 05/11/2019		

AA.Pre-Qualification Requirements (PQR) of Bidders for RMCMAS, as a part of Offer :

Note : All documents shall be compiled clause wise and submitted with proper tagging in following order.

1.0 Submit Reference List of Projects wherein offered system is supplied & commissioned, along with details of machines & similar measurements and Year of Commissioning of the system. Reference list shall contain name of end user, latest contact email id and contact telephone number.

2.0 Qualifying Criteria:

- i. Vendor shall give the list of installations where the systems supplied by them are working satisfactory for last 1 year as on Bid opening date.
- ii. Vendor shall have supplied this system (as offered) to minimum 1 no. of 200 MW or bigger (rating) power plant units. In support of above requirements vendor shall give copies of
 - Purchase order (un-priced)
 - Commissioning report
 - Performance report (for minimum 6 months of satisfactory continuous operation) for the offered system from end-user.
- iii. The vendor shall have adequate after sales support (maintenance, trouble shooting, spares supply etc.) in India.
- iv. Bidders who are participating in this tender, for supply and services (such as design & engineering, procurement, erection & construction, commissioning, trial operation etc.) shall be such a manufacturer / service provider who have been in the field of manufacture / these activities, of these items in India/ abroad, which are equal to or superior than this specification in Section – C.

Note: Full documentary evidence in support of above claims shall be enclosed in the PQR Offer document by the Vendor. If documents furnished by vendor, with end user contact details provided above, is found invalid, then the offer will be rejected.

3.0 Submit List of Project/s (rating of > or = 200 MW Power Plants) for which Erection & Commissioning has been carried out by Subsidiary / Authorised Indian representative for last 1 year & at least for 1 system. Bidder has to submit signed commissioning protocol from the end-user/s, in support of the same.

4.0 Submit duly-filled Source Request Form (SRF), which will be accessible by Bidder from our website “www.bhel.com”.

5.0 Vendors who are making offer for this tender shall have authorized representatives in India for support related to Documentation, Erection, Commissioning and any other co-ordination work.

6.0 BHEL shall submit vendor credentials to customer and await customer’s decision for one month from the date of PQ bid opening. If approval is not received within above period, BHEL shall treat the offer as “NOT Meeting PQ” criteria and offer shall be rejected.



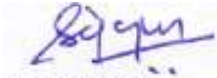
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BB. Alongwith the documents related to PQR above, following details shall also be included in the Offer :

- 1.0 Technical literature / Manuals of offered Vibration modules, power supplies & other electronic modules etc.**
- 2.0 Name & registered address of the Indian branch office or Indian representative for support of Erection & Commissioning and after sales service, with Organization chart.**
- 3.0 Details of Manufacturing, testing & inspection facility.**
- 4.0 Bidder shall have facility in India for Engineering activities, preparation of Documents, Servicing of offered System, Stocking of Spares..etc.. Submit these details.**
- 5.0 If Bidder is not Original Equipment Manufacturer (OEM), than Bidder to include Authorization letter from OEM for Design, Engineering, Manufacture, Testing, Supply, Erection, Commissioning and Servicing of the offered System. This Authorization letter provided by OEM to Bidder shall indicate the Type and Duration of the agreement. The validity of authorization letter shall be at least upto the end of warrantee period.**

Important note : In case Bidder does not submit details mentioned in above clauses or meet the requirements of Pre-qualification requirements, Offers will be summarily Rejected and Bidder's Technical offers/proposals will not be Evaluated. Please read carefully the General instructions in Section-A of this specifications.

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										REVISION : 01				APPROVED  S. K. TOPPO	
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AA Project Synopsis: TSGENCO – YADADRI (5x800 MW) STPS

Plant is located near Veerlapalem village in Dameracherla Mandal, Nalgonda district in Telangana, India. Nalgonda is the nearest well connected city and is located at about 69 kilometres from the power station. Damarcherla is the nearest Railway Station and Nalgonda railway station is the nearest well-connected Railway Station. Rajiv Gandhi International Airport of Hyderabad is the nearest international airport.

BB Note to Bidders:

- Make and model nos. of VMS including sensors, monitors racks etc. shall be same for of all equipment mentioned in this specification.
- Any change in scope / specification, during technical evaluation of the offers, will be communicated only to the participating bidders for this tender.
- Bidders to submit their offer meeting the specification requirements. However, any product specific limitations / deviations with respect to API 670 standard, shall be informed by the bidder in their offer; also the bidder has to submit declaration that there is no other option for them to make good the deviation. BHEL will evaluate the product specific limitations / deviations.
- Vendors need to offer all components/accessories required to meet the intent of the specification. If it is found, at any stage of procurement / commissioning, that some components / accessories have not been offered / supplied, same shall be supplied without any cost / time implication to BHEL to meet the system / product requirement.

CC Scope:

Vendor shall offer standalone, proven and state of the art microprocessor based, Rotating Machine Condition Monitoring and Analysis System (RMCMAS) for continuous vibration monitoring & analysis of the mechanical health of rotating equipment for the machines listed in Machine Data section – A under Technical Requirement clause DD.

This RMCMAS shall take buffered vibration signals of BFPDT from third party Turbine Supervisory System/s (TSS) to provide a unified **Condition monitoring and management system**, specified in clause DD 20 of Technical Requirement of this specification. Details of buffered vibration signals of BFPDT is listed in Section – A5 under Technical Requirement clause DD.

The RMCMAS system shall be offered separate for each Unit of the Plant.

Scope of Supply shall include Engineering, Manufacturing & Testing, and Erection for sensor installation, fiber optic cable splicing & termination, Supervision of balance Erection activity, Commissioning & Training activities as per this specification and final handing-over to End-user.

Exclusion: Scope of supply does not include Turbine Supervisory System (TSS) for BFPDT.

DD Technical Requirement:

1. The system shall be complete with vibration transducer, mounting pads , necessary preamplifier / electronics mounted in local junction boxes, extension cable, monitoring rack, cable from transducer to junction box, between mounting racks and online analysis system, networking components, Ethernet switches, power supplies, communication Processors, rack-interfacing modules, monitoring modules, annunciation and trip relay modules and configuration Laptop & licensed software, calibration equipment (total 2 nos.) etc., Erection Hardware required for mounting vibration monitoring & analysis system and completeness of the work shall also be provided.
 2. Cables between junction boxes and monitoring panels (TB), between monitoring panels (TB) and DDCMIS will be provided by BHEL. The field instrumentation cable from local junction boxes to monitoring panels (TB) provided by BHEL will be 4 Pair x 0.5 Sq. mm – PVC, FRLS, Individual & Overall shielded Pair Copper Cable, suitable for X & Y direction sensors per bearing. 2 Triad x 0.5 Sq.mm Individual & Overall shielded Pair Copper Cable will be provided by BHEL for Proximity/ Phase measurement/ Axial shift sensors.
-



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3. Sensors, proximity sensors and monitors shall be fully compliant to API.
 4. Critical alarm & trip relay output shall be configured in 2 of 3, 2 of 2 or 1 of 2 voting logic as required for the machine criticality. **Offer system shall provide three (3) binary contacts for each bearing, for very high vibration trip of drive.**
 5. Bidder shall supply all hardwired and licensed version of all the applicable software in run & edit mode for the system and for integration of his system with third party device such as DDCMIS & Analysis system. Redundant Bi-directional OPC connectivity with DDCMIS shall be provided.
 6. All the sensors shall have wide frequency response to monitor the harmonics and be housed in stainless steel enclosure conforming to protection degree of IP-65. Sensor shall be provided with all accessories like mounting plate, Low noise cables & conduits, Extension cables, Junction boxes, Prefab connectors etc.
 7. System mounting racks shall be furnished to house monitor modules, indicating / display units, dual redundant power supplies, relay modules, interface modules, test and calibration equipment. Grouping of modules in racks shall be equipment wise. The mounting racks shall be fully factory wired.
 8. The front of each mounting rack shall house a monitor test-switch, test condition indicating lamp and power on indication lamp.
 9. A separate four-channel vibration monitor shall be provided for each pump / fan / motor.
 10. Monitoring module shall be fully software configurable. Each channel shall have up to two set points.
 11. The system shall have feature to bypass a relay contact in the event of sensors/ proximity sensor failure. Also, it shall be possible to test all the monitors in the rack. The trip and alarm relay shall be automatically bypassed during testing to prevent alarm and trip.
 12. Removal & replacement of module shall be possible to carry out in system power on condition. Each monitor and mounting rack shall have nameplate engraved to indicate the main equipment to which the module is catering and the bearing details.
 13. Bidder shall ensure that 20% spare slot shall be provided in cabinet for future extension and modification.
 14. This unit shall also have the ability to communicate to on line analysis system and DDCMIS / Turbine protection system / PLC / through hardwired connection (4 - 20mA & relay output) for monitoring & alarm / protection and through software link (raw buffer signal) on line analysis system.
 15. All racks shall be connected in a network and some of the racks shall be located in remote location such as at CW pump house area. . Networking shall be made through optic fiber cable & Ethernet data highway cable.
 16. Input power supply to the system shall be provided by BHEL through redundant 230 V AC, 50 Hz UPS system in the respective control rooms. Offered systems shall include redundant power supply units (modules).
 17. **Installed Spare Philosophy:**
 - 17.1 10 % spare channel shall be provided in each type of input / output unit.
 - 17.2 10% hot spare for each type of I/O modules (installed) shall be provided in each functional group, fully wired upto the marshalling/ termination TBs.
-



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17.3 Wired-in "usable" space for 20% modules along with Field Terminal assemblies, PCB/Connectors (if any in the offered system) in each of the system cabinets for mounting electronic modules shall be provided for future use; same is also specified in clause DD13 above.

17.4 Twenty (20) percent spare relays of each type and rating, mounted and wired.

17.5 Twenty (20) percent spare terminal blocks in each cabinets shall be provided.

18. Specification of Cabinet / Panel:

- 18.1. Material of Construction: Cold Rolled Coal Annealed (CRCA) steel sheet
- 18.2. Thickness of Sheet: a) 2.0 mm for faces supporting instruments / terminals
b) 1.6 mm for other sides and top
- 18.3. Construction: Welded throughout as per approved National Standards
- 18.4. Post welding operation: a) Grounding of all welds to smoothness
b) Rounding of corners
c) Cleaning of weld spatters
- 18.5. Panel size: 750 mm W X 800 mm D X 2067 mm H (including top canopy- 60 mm + Bottom frame 50 mm + Antivibration pad 15mm)
- 18.6. Corners: 7 mm inner radius
- 18.7. Dimensional Tolerances: a) In height & length - 3 mm
b) In height between adjacent sections - 2 mm
c) Total for a group - 6 mm
- 18.8. Protection Class: IP-32
- 18.9. Paint: Epoxy based Powder coated
i) Exterior: Opaline green shade 275 of IS: 5
ii) Interior: Brilliant Glossy White.
- 18.10. Doors: Double, recessed, turned back edges, full height front & rear
i) Thickness of Sheet: 2 mm
ii) Hinges: Stainless steel
iii) Door latches: Three point type
iv) Door gaskets: Neoprene rubber on fixed frame to result dust proof/ weatherproof enclosure
v) Opening of the doors: Outward
vi) Louvers: With removable wire mesh to ensure dust and vermin proof
vi) Glass partisan shall be provided on the front door for viewing rack.
- 18.11. Gland plates: Removable in sections 4 mm thick (bottom)
- 18.12. Cable entry: Bottom
- 18.13. Hardware: a) Anti vibration pad- 15 mm
b) Predrilled base channel ISMC – 100 or equivalent for all sides
c) Stainless steel buff- finished 2 mm thick kick plate for all sides
d) Stainless steel scratch strips along desk edges fixed with pan head recessed screws
e) Rubber strips to ensure air tightness between kick plate and finished floor
f) Lifting hook / Eye bolt
g) Drawing pocket
h) Door switch, lamps, thermostat, heaters and industrial grade cooling fans, illumination fixtures
- 18.14. Name Plate: Both at front and back surface of the panel
- 18.15. Fixing of name plate: Stainless steel pan head screws
- 18.16. Name plate material: Laminated phenolic (3 layers)
- 18.17. Lettering: Black with white engraved
- 18.18. Mounting of terminal blocks: Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure.



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19. Specification of Junction Box:

- | | |
|------------------------------|--|
| 19.1. Type of Enclosure: | Dust tight & weatherproof conforming to IP 65 |
| 19.2. Material: | 3 mm sheet steel / fiberglass reinforced polyester (UV stabilized) |
| 19.3. Type of Cover: | Solid unhinged with retention chain / Screwed at all four corners |
| 19.4. Paint: | i) Exterior: Opaline green shade 275 of IS: 5
ii) Interior: Brilliant Glossy White. Surface / Two (2) inch Pipe stanchion |
| 19.5. Cable Entry: | 3 mm (min) Bottom / side Gland plate |
| 19.6. Gasket: | Neoprene |
| 19.7. Grounding: | Brass earth lug with green screw head
External-2 nos., Internal-1no. (M6) |
| 19.8. Number of Drain Holes: | Two at bottom capped |
| 19.9. Identification: | Label for JB and Tags for cable |
| 19.10. Accessories: | a) Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
b) Cable gland (Brass) & raceways
c) Ferrules & lugs (Brass)
d) Aluminum back panel
e) Canopy at top
f) Mounting brackets
g) Bolts and nuts made of brass etc. |

20. Specification of Condition monitoring and management system:

- 20.1 The system shall acquire & analyse static, dynamic and transient machine data to guide the maintenance engineer and operator to detect fault and take corrective action as required.
- 20.2 The system shall dual redundant interface with the RMCMAS racks and DDCMIS and monitoring systems to acquire raw data for further analysis and alarms.
- 20.3 The system shall be provided with redundant server, workstation and 24 inch TFT monitor, A3 laser printer and one no. Laptop.
- 20.4 Machine Vibration Analysis server shall be capable of running several software including client software, on single platform and interfacing with multiple machinery protection racks using communication link. Configuration and downloading of programs for different modules shall be executable from this server with at least two levels password protection.
- 20.5 Display features provided in the system shall not be limited to the Graphical plant and machine area presentation with location of sensors and their current value, Bar graph and point display indicating the set points, Multiple Trends - transient and historical including process value for data correlation, Bode / Polar / Nyquist / Cascade plots, Waterfall, Diagnostic of the system and machine data, Spectral band and waveform plotting including Lissajous waveform, Harmonic analysis, Orbit and time base plotting, Shaft centerline plot indicating position of a machine, for machines listed in Machine Data section – A & A5 in this specification.
- 20.6 The system shall have capability for Log & Report generation and there shall be provision for beeping icon in case of appearance of alarm.
- 20.7 The Advanced Automated Diagnostic System shall utilize both vibration and process information from the Data Acquisition software plus programmed rules to provide clear analysis and recommendations for effective machinery management. Rule generator shall reject any rule, which is not syntactically correct. It shall be an extensive and accurate knowledge base to enable quick determination of the condition of a machine by providing alarm notification or advisories of the machinery malfunction. It shall also have the capability to send advisories through pagers and e - mails in addition to the RC.



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- 20.8 Presence of the frequently occurring machine malfunctions / occurrence to be detected by the system shall be, but not limited to, High synchronous vibration, Misalignment, Unbalance, Shaft bow / crack, Fluid induced instability (Whirl and Whip), Radial pre-load forces (including misalignment), Vector change, Rotor rub, Looseness of rotating parts, Gear mesh problems, pump cavitation, resonance with critical speed etc. for machines listed in Machine Data section – A & A5 in this specification.
- 20.9 Data collected in the system shall also be accessed on the plant wide area network for condition based maintenance.
21. **Specification of Main Server:**
- 21.1 Intel Xeon /Quad Core Processor, 1.9 GHz (min.) processor
 - 21.2 Min 2TB hard disc with mirroring type hard disc to ensure data integrity
 - 21.3 Minimum 2 x 4GB (min.) DDR RAM
 - 21.4 Combo Drive, DVD R/W 16x or higher,
 - 21.5 RAID level 5, SAS-channels
 - 21.6 Time synchronization Card for IRIG-B protocol
 - 21.7 4 nos. USB ports. (2nos. on front side)
 - 21.8 Redundant hot-swappable power supply
 - 21.9 Network card (2 Nos.),
 - 21.10 Necessary Cables with accessories for inter connecting and connecting to Redundant Server / VMS panels and DCS/ DAS Panel/s. Software CDs with License/s.
 - 21.11 24" colored TFT/ LCD monitor for each server
 - 21.12 QWERTY Keyboard,
 - 21.13 Optical mouse
 - 21.14 Third party operating system, graphical users interface, Firewall, Anti-spam, Anti-virus & spyware for Gateways.
22. **Specification of Client PC / Redundant Server:**
- 22.1 Processor: Latest , minimum Intel Core i5; Tower, 3.2 GHz (min.), 32 bit
 - 22.2 Video Card: PCI
 - 22.3 Hard drive: 500 GB SATA; Cache : 512 KB Level 2
 - 22.4 RAM: 4 GB (Minimum) DDR
 - 22.5 CD - Both Read & Write for OWS. Both CD & DVD Read & Write for ES
 - 22.6 Operating system: Latest , Window
 - 22.7 Graphic accelerator: 8MB (min.)
 - 22.8 Communication ports: 2nos. (min.) Ethernet ports (1000 MB).
 - 22.9 4 nos. USB ports (min.)
 - 22.10 Necessary Cables with accessories for inter connecting and connecting to Main Server / VMS panels and DCS/ DAS Panel/s. Software CDs with License/s.
 - 22.11 24" colored TFT/ LCD monitor for each server
 - 22.12 QWERTY Keyboard,
 - 22.13 Optical mouse
 - 22.14 Firewall, Anti-spam, Anti-virus & spyware for Gateways.
23. **Specification of Printer:**
- 23.1 Type : Laser jet, tabletop, network ready
 - 23.2 Printer Memory : 256 MB (min.)
 - 23.3 Speed : Color 6 ppm - A3
 - 23.4 Resolution : 1200 x 1200 DPI in color
 - 23.5 No. of color (Basic) : 4 (four) minimum
 - 23.6 Power supply : 240 V, 50 Hz, 1 phase
 - 23.7 Ambient temperature : 0-50 Deg C
 - 23.8 Humidity : 95% non-condensing
 - 23.9 Size of paper: Letter, A4, Legal, Ledger, A3
 - 23.10 Print media: Plain paper, transparencies, thick stock, glossy stock, envelopes
 - 23.11 Accessories: Adapters, Connector Cable, Multiplexer switch (4 point)
-



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24. Specification of Managed Ethernet Switches:

- 24.1 Data highway shall be of high speed Ethernet and full duplex configuration. Network shall be built on the Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the process or equipment. Failure reporting shall be available at HMI. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.
- 24.2 All Ethernet switches to be used in the plant shall be of same type and shall conform the specification requirements.
- 24.3 All managed switches shall work in IEC-61850-3 protocol environment and shall support IEC-62439 standard ring redundancy topology (MRP) and also fast MRP. It shall also support IEC-62439-3 standard PRP& HSR technology with 0 ms recovery time and also support IEC-61850 switch (RSP & MSP switches)
- 24.4 Switch shall have the capacity for maximum of 4 Giga bit fiber port and 24 fast ethernet port.
- 24.5 Switch shall act as IGMP-querier and minimum 2 alarm contacts shall be available
- 24.6 It shall have High MTBF value
- 24.7 It shall support ACA adaptor for reconfiguration of the switch in case of failure to reduce MTTR value to less than one minute and shall have minimum of 4 fibre and 4 copper din rail switch RSPL.

25. Specification of Laptop:

- 25.1 Processor: i7 or latest.
- 25.2 Hard Disk: 2 TB
- 25.3 RAM: 16 GB DDR 3
- 25.4 Screen: 15 inch with touch.
- 25.5 Wifi: 802.11 ac OR higher.
- 25.6 Wifi model: Intel Centrino Wireless - AC 3160.
- 25.7 Blue tooth: 4
- 25.8 USB ports: 3
- 25.9 Hard Drive Speed: 5400 pm
- 25.10 Graphics Card: Intel HD Graphics 4400
- 25.11 Operating System: Windows 10 and Office 10 or latest versions.
- 25.12 Softwares: Acrobat Reader Professional 10, AUTOCAD 10 or latest versions.
- 25.13 Antivirus: Licensed for 4 years

26. Requirement of Optical Fiber Cabling:

Optical Fiber redundant bidirectional data highways shall be offered for vibration analysis system. Fibre optic redundant cables shall run in two physically separate conduits optical fiber distribution box, patch cord / pigtail, converter, terminators, taps, heavy duty conduits etc. shall be included in the offer. Vendor to consider both side termination of optical fiber cables.

Cabling distances between various offsite control room is as below:

- a) CW Water Pump House (CWP) to Main CER Unit-1 / 2 = 600 meters separate for each Unit
- b) CW Water Pump House (CWP) to Main CER Unit-3 / 4 / 5 = 1000 meters separate for each Unit
- c) Main CERs to respective Computer Room = 100 meter separate for each Unit

Vendor shall offer required redundant networking components for Condition monitoring and management system.



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27. **Indigenous / Bought-out** items shall be from following sub-vendors:

SN	ITEM	SUPPLIER	PLACE
1	BLANK CABINETS / PANEL	M/S. PYROTECH	UDAIPUR
		M/S. RITTAL	BANGALORE
		M/S MPP	BANGALORE
2	DISPLAY UNIT	ORIGINAL SYSTEM MANUFACTURER	
		M/S PORTWELL LAXSON	
		M/S ADITECH	
		M/S SCHNEIDER ELECTRIC	
3	NETWORKING COMPONENTS/ ETHERNET SWITCH	M/S GARRET	USA
		M/S HIRSCHMANN	GERMANY
		NETGEAR MAKE	
		BROCADE (FOUNDARY	
		CISCO MAKE	
		ALLIED TELESYN MAKE	
		M/S D LINK	GOA
		M/S JUNIPER	USA
4	FRP JUNCTION BOX	M/s DEVI POLYMER	CHENNAI
		M/S KS INSTRUMENTS	BANGALORE
		M/S BALIGA LIGHTING	CHENNAI
		M/S SHRENIK & COMPANY	AHMEDABA
		M/S FICOM ENGG. PVT. LTD.	BANGALORE
		M/S SUCHITRA INDUSTRIES	BANGALORE
		M/S.MANISHA ENTERPRISES	PUNE
5	FIBRE OPTIC CABLE	M/S AKSH FIBRE	BHIWANDI
		M/S BIRLA ERICSON	REWA
		M/S D LINK	SWITZERLA
		M/S FINOLEX	PUNE / GOA
		M/S TERRACOM	
		M/S HFCL	GOA
6	SERVER / CLIENT PC / LAPTOP	DELL	
		HP	
		IBM-LENOVO	
7	TFT MONITOR	DELL	
		IBM-LENOVO	
		NEC	
		SAMSUNG	
		HP	
8	PRINTER	CANON	
		EPSON	
		HP	
		IBM	
		XEROX	
		LEXMARK	



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Section – A: Machine Data for Vibration Monitoring System

Sl. No.	Machine	Machine Qty./ Unit	Installation (Horz/ Vert)	Machine RPM	Measuring Parameter	No. of Brg. for mtrng. vibration (in X & Y axis)	Vib. Alarm Level (mm/sec-RMS)	Vib. Trip Level (mm/sec-RMS)	No of Vibration Sensors/ Unit	No. of Phase Marker/ Unit
1	Boiler Feed Pump - BFP (2xTDBFP & 1xMDBFP)	3	Horz	800-6500	Relative Shaft Vib.	2	90 μ m ^{P-P}	150 μ m ^{P-P}	12	3
					Absolute Brg. Vib.	2	11.0	18.0	12	
					Axial Shift 3 probe NDE, range -0.35 to +0.35mm				9	
2	MDBFP - Motor	1	Horz	1500	Absolute Brg. Vib.	2	4.5	7.1	4	3
3	Booster Pump	3	Horz	1495	Relative Shaft Vib.	2	90 μ m ^{P-P}	150 μ m ^{P-P}	12	
4	Hydraulic Coupling Housing	1	Horz	Input-1495 Primary-3760 Secondary-3651 Output-5227	Abs. Brg. Vib. Input side- X,Y,Z directions. Abs. Brg. Vib. Primary side-X,Y,Z directions. Abs. Brg. Vib. Secondary side- X,Y,Z directions. Abs. Brg. Vib. Output side-X,Y,Z directions.	NA	X,Y- Vrms>8 Z- Vrms>11	X,Y- Vrms>11 Z- Vrms>18	12	--
5	Hydraulic Coupling Bearing Cover Input	1	Horz	1495	Relative Shaft Vib. DE- X & Y direction	1 No. (Brg-1)	Spp>110 μ m ^{P-P}	Spp>155 μ m ^{P-P}	2	--
6	Hydraulic Coupling Bearing Cover Output	1	Horz	5227	Relative Shaft Vib. NDE- X & Y direction	1 No. (Brg-12)	Spp>59 μ m ^{P-P}	Spp>83 μ m ^{P-P}	2	--
7	Cond. Extn. Pump-CEP	3	Vert	1485	Absolute Brg. Vib.	1	11.0	18.0	6	3
8	CEP - Motor	3	Vert	1500	Absolute Brg. Vib.	2	4.5	7.1	12	
9	Drip Pump	2	Horz	1485	Absolute Brg. Vib.	1	11.0	18.0	4	2
10	Drip Pump Motor	2	Horz	1500	Absolute Brg. Vib.	2	4.5	7.1	8	
11	TG DMCW Pump	3	Horz	1500	Absolute Brg. Vib.	2	7.0	11.0	12	3
12	TG DMCW Pump Motor	3	Horz	1500	Absolute Brg. Vib.	2	5	8.5	12	
13	SG DMCW Pump	2	Horz	1500	Absolute Brg. Vib.	2	7.0	11.0	8	2
14	SG DMCW Pump Motor	2	Horz	1500	Absolute Brg. Vib.	2	5	8.5	8	
15	Mill Motor	8	Horz	1000	Absolute Brg. Vib.	2	4.5	7.1	32	8
16	ID Fan	2	Horz	595	Absolute Brg. Vib.	1	7.0	14.0	4	2
17	IDF - Motor	2	Horz	600	Absolute Brg. Vib.	2	4.5	7.1	8	
18	FD Fan	2	Horz	1490	Absolute Brg. Vib.	1	4.5	9.0	4	2
19	FDF - Motor	2	Horz	1500	Absolute Brg. Vib.	2	4.5	7.1	8	
20	PA Fan	2	Horz	1490	Absolute Brg. Vib.	1	4.5	9.0	4	2
21	PAF - Motor	2	Horz	1500	Absolute Brg. Vib.	2	4.5	7.1	8	
22	ACW Pump - ACWP #	3	Vert	1500	Abs. Brg. Vib. X,Y,Z dir.	1	7.0	11.0	9	3
23	ACWP - Motor #	3	Vert	1500	Abs. Brg. Vib. X,Y,Z dir.	2	5	8.5	18	
24	CW Pump - CWP #	5	Vert	420	Absolute Brg. Vib.	1	7.6	11.9	10	5
25	CWP - Motor #	5	Vert	500	Absolute Brg. Vib.	2	4.5	7.1	20	
TOTAL PER UNIT		66							260	38

Note: 1) KKS Tag Nos. for transducers will be provided during detailed Engineering.

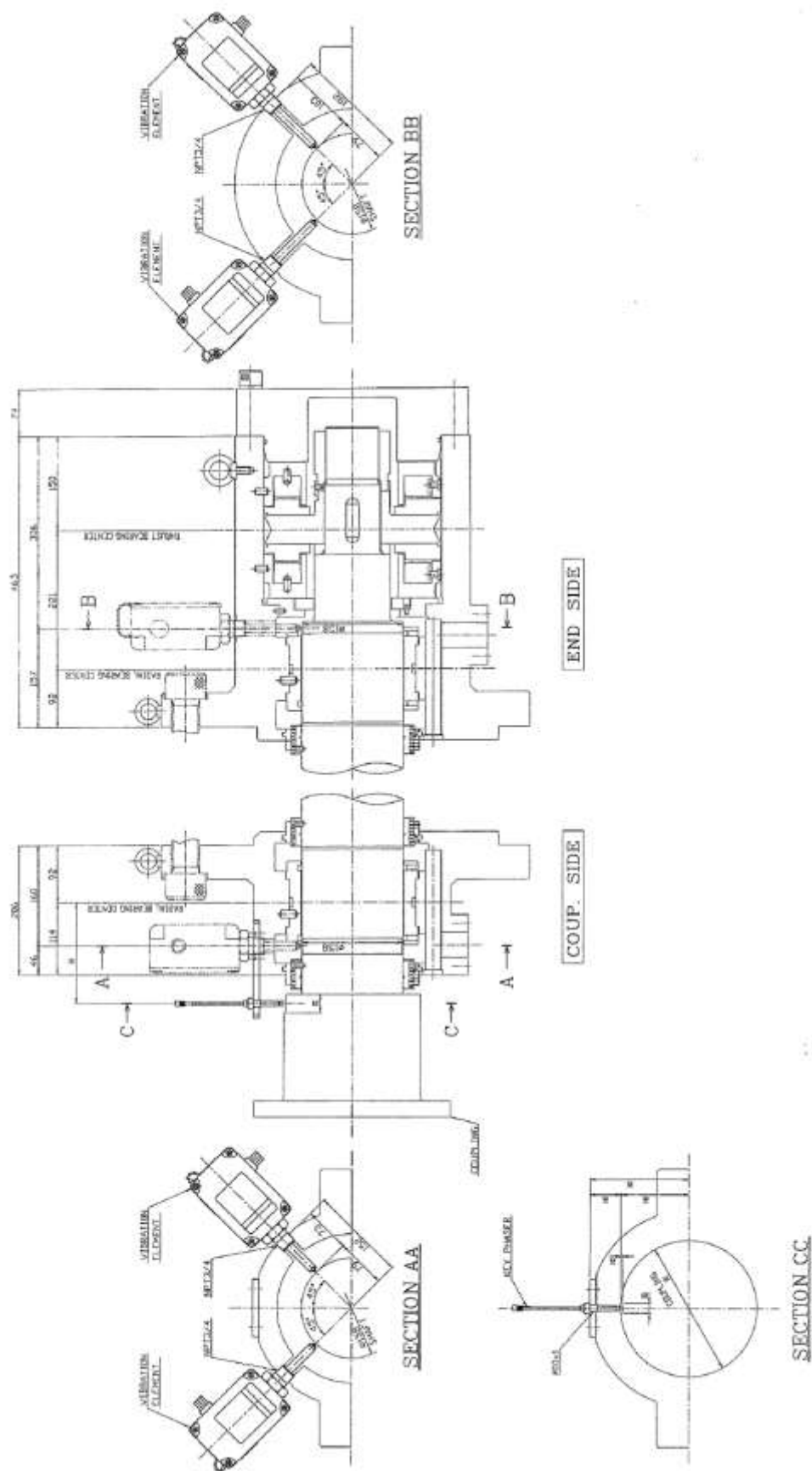
2) In addition to above listed machines, Condition monitoring and management system shall be provided for BFPDT, taking the buffered vibration signals from third party BFPDT TSS systems for which signal list in Section- A5 of this specification.

3) The vibration monitoring system panels for m/c at sl. no. 22, 23, 24 & 25 in above list, shall be placed at CW Pump House.

VMS panel for all other machines including buff. list in Section- A5 shall be placed in Main control equipment room.

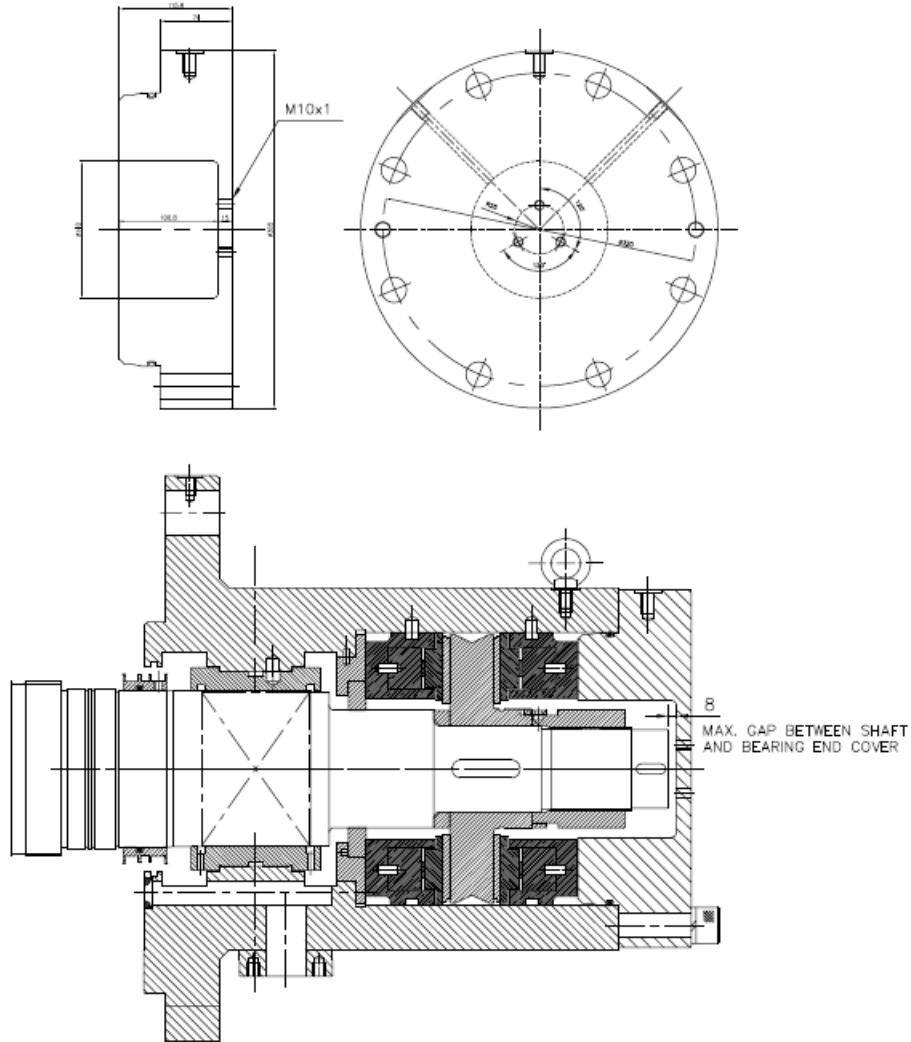
4) Two position (X & Y) sensor mounting block of dimension 40mm x 40mm x 40mm shall be provided for all absolute bearing casing vibration sensors, except for BFP, Hydraulic Coupling & Booster Pump. Sensor mounting provision drawings of BFP, Booster Pump, Hydraulic Coupling & other specific machines are provided in Section - A1, A2, A3 & A4 of this specification.

Section – A1: Sensor mounting provision drawing for Boiler Feed Pump



Section – A2: Axial Shift Sensor mounting provision drawing for Boiler Feed Pump

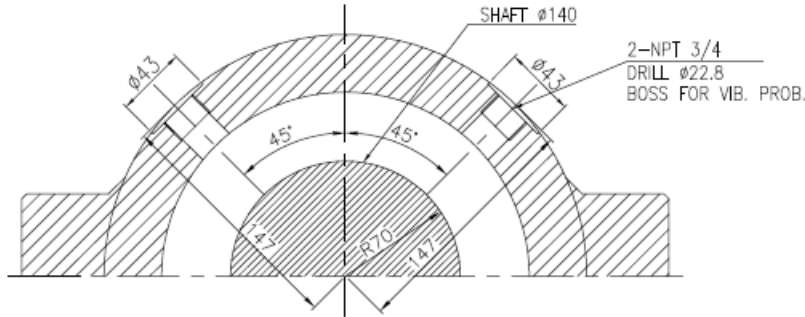
VIBRATION SENSOR ARRANGEMENT,
AXIAL SHIFT MEASUREMENT FOR BFP



Eddy-current probe shall be forward mount type, M10x1 body thread, 70 mm threaded length. The probe shall be directly mounted on BFP NDE side casing without any bracket arrangement.

Section – A3: Sensor mounting provision drawing for Booster Pump

VIBRATION SENSOR ARRANGEMENT,
SHAFT VIBRATION MEASUREMENT
FOR BOOSTER PUMP



BP BEARING HOUSING

(VIBRATION PROBE)

PROBE SHALL BE REVERSE MOUNTING TYPE

Section – A4: Sensor mounting provisions for Hydraulic Couplings & other machines

1. Hydraulic Couplings Bearing Cover Input side: 3/4" NPT provisions will be provided on bearing cover of Hydraulic coupling
2. Hydraulic Couplings Bearing Cover Output side: 3/4" NPT provisions will be provided on bearing cover of Hydraulic coupling
3. Hydraulic Couplings Housing: 1/4" - 28 UNF thread provisions will be provided on housing of Hydraulic coupling for measuring horizontal, vertical and axial vibrations on shafts.
4. BFP Pump Bearing Casing Vibration: 40x40x40mm Pad with one M8 X 1 threaded hole for mounting horizontal probe & one M8 X 1 threaded hole for vertical probe, will be provided on the DE & NDE bearing housing of BFP.
5. CEP Pump Thrust Bearing Casing Vibration: 40x40x40mm Pad with one M8 X 1 threaded hole for mounting horizontal probe & one M8 X 1 threaded hole for vertical probe, will be provided on the thrust bearing base plate of CEP.
6. Drip Pump Bearing Casing Vibration: 40x40x40mm Pad with one M8 X 1 threaded hole for mounting horizontal probe & one M8 X 1 threaded hole for vertical probe, will be provided on top of bearing housing.

Note: Bidders to include grub screws in the offer, for required quantity of sensors, as per above specified machine provisions (at A4: 3, 4, 5 & 6 above), for direct mounting of sensors on the machine casing.



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Section– A5: Buffered Vibration Signal List of BFP Drive Turbine (BFPDT) per Unit, for Condition Monitoring and Management System

Sl. No.	Tag No.	Signal Description	Sensor Range	Sensor Part No. (M/s Shinkawa make)
BFPDT-A				
1	XKD14CY042A	GEAR BOX LSS (RJB) RELATIVE SHAFT VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
2	XKD14CY042B	GEAR BOX LSS (RJB) RELATIVE SHAFT VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
3	XKD11CY041A	GEAR BOX HSS (FJB) RELATIVE SHAFT VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
4	XKD11CY041B	GEAR BOX HSS (FJB) RELATIVE SHAFT VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
5	XAD12CY041A	TURBINE F.J.B. VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
6	XAD12CY041B	TURBINE F.J.B. VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
7	XAD11CY042A	TURBINE R.J.B. VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
8	XAD11CY042B	TURBINE R.J.B. VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
9	XYA12CY021A	FRONT BRG. HOUSING VIBRATION	0-25 mm/s	CV-861
10	XYA12CY021B	FRONT BRG. HOUSING VIBRATION	0-25 mm/s	CV-861
11	XAD11CY021A	REAR BRG. HOUSING VIBRATION	0-25 mm/s	CV-861
12	XAD11CY021B	REAR BRG. HOUSING VIBRATION	0-25 mm/s	CV-861
13	XAD12CY021	TURBINE KEYPHASER	0-360deg	FL-202F08R-U2-00-03-10
14	XKD14CY021	GEAR BOX KEYPHASER	0-360deg	FL-202F08R-U2-00-03-10
BFPDT-B				
15	XKD24CY042A	GEAR BOX LSS (RJB) RELATIVE SHAFT VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
16	XKD24CY042B	GEAR BOX LSS (RJB) RELATIVE SHAFT VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
17	XKD21CY041A	GEAR BOX HSS (FJB) RELATIVE SHAFT VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
18	XKD21CY041B	GEAR BOX HSS (FJB) RELATIVE SHAFT VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
19	XAD22CY041A	TURBINE F.J.B. VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
20	XAD22CY041B	TURBINE F.J.B. VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
21	XAD21CY042A	TURBINE R.J.B. VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
22	XAD21CY042B	TURBINE R.J.B. VIBRATION	0-200 μ m	FL-202F08R-U2-00-03-10
23	XYA22CY021A	FRONT BRG. HOUSING VIBRATION	0-25 mm/s	CV-861
24	XYA22CY021B	FRONT BRG. HOUSING VIBRATION	0-25 mm/s	CV-861
25	XAD21CY021A	REAR BRG. HOUSING VIBRATION	0-25 mm/s	CV-861
26	XAD21CY021B	REAR BRG. HOUSING VIBRATION	0-25 mm/s	CV-861
27	XAD22CY021	TURBINE KEYPHASER	0-360deg	FL-202F08R-U2-00-03-10
28	XKD24CY021	GEAR BOX KEYPHASER	0-360deg	FL-202F08R-U2-00-03-10



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EE Mandatory Spares (Bidders to submit offer with unit price):

- a) Vibration pick-up & Phase Sensors with extension cable and signal conditioner (as a combined set) = 2 X (10 % of quantity for Unit-1) OR minimum 8 nos., whichever is higher, for each type & range,.
- b) Axial shift probe with extension cable & signal conditioner = 2 no. each for each type.
- c) Power Supply Modules = 2 X (10 % of quantity for Unit-1) OR minimum 4 nos., whichever is higher, of each rating.
- d) Vibration Monitor = 2 X (10% of quantity for Unit-1) OR minimum 4 nos., whichever is higher, for each type/rating.
- e) Interface Cards and all other Electronic Cards = 2 X (10% of quantity for Unit-1) OR minimum 4 nos., whichever is higher.
- f) Alarm / Trip Relay Module = 2 X (10% of quantity for Unit-1) OR minimum 4 nos., whichever is higher.

FF Quality Requirements:

1. Following minimum test requirements to be met by the bidders for their offered system:

- Calibration report of Sensors for the selected / approved Range with curves shall be furnished.
- For Vibration Sensors, Frequency response curves and for Proximity probes, Gap v/s voltage data to be furnished. Sample reports shall be included as a part of Quality plan.
- Calibration of Monitors for the approved Range shall be submitted.

The above documents shall form part of Acceptance documentation.

2. TESTING & INSPECTION:

- The equipment covered under this specification shall be subject to vendor's Quality Plan to be approved by customer before start of manufacture. To ensure that quality is in-built in each equipment the Quality Assurance System manual & Quality Plan indicating the system followed by the vendor shall be submitted to purchaser for his review along with the offer.

- The Testing shall include following Type test, in addition to the Routine Tests,

3. TYPE TEST:

The Vendor shall furnish the type test reports for the Vibration Monitoring System, after receipt of order; confirmation for submission of type test report shall be mentioned in the offer. Type test results and certificate shall be acceptable provided it meets the following:

- i) The same has been carried out by the Vendor on exactly the same model / rating of equipment.
- ii) There has been no change in the components from the offered equipment & tested equipment.
- iii) The test has been carried out as per the latest standards along with amendments as on the date of bid opening and as indicated below

4. SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS

The minimum type test reports, which are to be, submitted for each of the major C&I systems shall be as indicated below:

- i) Surge Withstand Capability (SWC) for Solid State Equipment Systems

All solid state systems/ equipment shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipment shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEC-255.4. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as



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defined in ANSI 37.90.1/ IEC-255.4. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of IEC-255-4 which is equivalent to ANS/37.90.1/IEEE-472 may also be adopted for SWC test.

- ii) Dry Heat test as per IEC-68-2-2 or equivalent.
- iii) Damp Heat test as per IEC-68-2-3 or equivalent.
- iv) Vibration test as per IEC-68-2-6 or equivalent.
- v) Electrostatic discharge tests as per IEC 801-2 or equivalent.
- vi) Radio frequency immunity test as per IEC 801-6 or equivalent.
- vii) Electromagnetic Field immunity as per 801-3 or equivalent.

Test listed at item no. v, vi, vii, above are applicable for electronic cards only.

GG Documentation:

- All documentation shall be in English language.
 - Following documents shall be supplied along with offer.
 - a) Bill of material of the offered system.
 - b) Allocation of vibration monitors with respect to machines being monitored.
 - c) Configuration diagram of the offered system with networking details.
 - d) Specification / data sheets of various devices offered.
 - e) Reference list of users for vibration analysis & diagnostics system for coal fired Turbine generator set of similar rating along with details of Plant auxiliaries monitored.
 - After award of contract, following documentation in no. of copies as mentioned below shall be supplied.
 - a) Manufacturing Quality plan
 - b) Field Quality Plan for Storing, Handling, Erection, Pre commissioning and Commissioning activity
 - c) Configuration diagram & Machine train diagram
 - d) Mounting details for sensors
 - e) Wiring and cabling diagrams for Cabinets & other devices
BOM, GA drawing & Rack layout drg
Loop scheme and cable schedule
Mounting blocks and JB Drawings
Datasheet and technical literatures
 - f) Test certificate & test results
 - g) Calibration results for sensors
 - h) Test reports for Cables
 - i) Type test results
 - j) Operation & maintenance manual for the system including wiring diagram, circuit diagrams, Sensor details, Server, Printer, Panel display, Calibration equipment etc.
- Soft-copies, within 2 weeks of placements of P.O
- 2 copies After completion of tests along with the equipment
- 2 copies along with the equipment + Soft-copy to BHEL



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Also one set of soft copy on CD ROM for all the datasheet/drawings/test reports are to be furnished to BHEL after placement of Purchase order.

The drawings under (a),(c),(d),(e),(f) & (i) will be for approval & others are for information & records.

HH Training:

Vendor shall provide necessary training on the operation & application to BHEL / End-User. The training shall cover the basic aspects of Vibration monitoring, details of the System supplied, Analysis method, Operation and Maintenance.

Training shall be provided minimum for below man-days at vendor's office in India.

6 no. of End-user's Control Engineers for two weeks each on operation.

6 nos. of End-user's C&I engineer for two weeks each on system maintenance.

II Erection & Commissioning (E & C) Scope:

1. Scope of E&C for Vibration Monitoring System:

Vendor shall provide separate offers for Erection activity (as applicable), Supervision of Erection and total Commissioning of the offered Vibration Monitoring System as detailed below.

- Verification of Bill of material as per packing list at site
- Collection of material from stores
- Checking and calibration of sensors using portable shaker table.
- Mounting of offered vibration sensors with its mounting block on the machine bearing casing and terminate the sensor cable to Local Junction box supplied.
- Mounting of proximity / phase measurement sensor and its bracket shall be suitably installed by Vendor at site and terminate the sensor cable to Local Junction box supplied.
- Supervision of balance Erection activity of offered System
- Commissioning of offered System
- Loop check between VMS Panel to DCS
- Handing Over the system to End-User
- Training the operation personnel on operation and maintenance aspects while carrying out the above E & C activities.
- **Relevant documentation for commissioning of this system inline with specification requirement.. such as signed protocol with end user to be furnished along with calibration data, as applicable.**

Note: The total responsibility of E&C for the offered system shall rest with the vendor. Vendor shall offer for above mentioned E&C activities on as required basis. Limitation of number of days / visit for E&C activities is not acceptable.

2. Scope of E&C for Condition monitoring and management system:

Vendor shall provide separate offers for Erection activity (as applicable), Supervision of Erection and total Commissioning of the offered Analysis & Diagnostics system, as detailed below

- Fiber optic cable splicing and termination at both ends, between Panel to Panel at various control rooms, Panel to Server/User PC and Server to DDCMIS.
- Carrying out pre-commissioning checks, energizing Cabinets & PC.
- Commissioning of individual services.
- Installing various software packages on PC & establishing the operation.
- Checking for all functions of hardware and software when the plant is totally commissioned with all auxiliaries

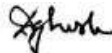


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-
- Commissioning of Diagnostics / Expert system
 - Training the operation personnel on operation and maintenance aspects while carrying out the above E & C activities.
 - Handing over the offered system/s to End-User.
 - **Relevant documentation for commissioning of this system in-line with specification requirement, such as signed protocol with end user to be furnished along with calibration data, as applicable.**

Note: The total responsibility of E&C for the offered system shall rest with the vendor. Vendor shall offer for above mentioned E&C activities on as required basis. Limitation of number of days / visit for E&C activities is not acceptable.

		 A4-10	SECTION – D		REF. : CE / 416 / RMCMA S / YAD / PG				
							REV. NO. : 01		
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			REVISION : 01	APPROVED  S. K. TOPPO					
			PREPARED  D GHOSH	ISSUED 416	DATE 05/11/2019				



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REF. : CE/409-416/TSS-VMS/PKG

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PACKAGING SPECIFICATION FOR TURBINE SUPERVISORY SYSTEM (TSS), VIBRATION MONITORING SYSTEM (VMS), ANALYSIS & DIAGNOSTICS SYSTEM

REVISION : 00

APPROVED

[Signature] 3/6/14
(R. PAADHAN)

[Signature]
(S.M. PATEL)

PREPARED

ISSUED

DATE

[Signature]
D. Ghosh (MADHU CHANDRA)
Sr Engrg-BPE

409-416

03/06/2014



**Packaging Specification for
Turbine Supervisory System (TSS),
Vibration Monitoring System (VMS) &
Analysis & Diagnostics System**

Ref.: CE/409-416/TSS-VMS/PKG
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1.0 Packaging Guidelines

The detailed guideline for packaging is provided in specification reference ED 0490092, Rev. 05. The packing shall be separate for TSS & VMS, in separate boxes.

- 1.1** For Vibration sensors, Monitors, rack, special cable and signal conditioners being dispatched from OEM (countries other than India to India) packing which is suitable for transportation by Lorry and storage at site for extended periods up to 24 months, shall be used. For this a reference standard ED 490092 Rev 05 clause 3.1.2 is attached. OEMs shall follow this standard at minimum. If any other OEM standard packing is available same shall be submitted to BHEL for review and acceptance as part of Technical offer.
- 1.2** Imported items shall be packed in best fit boxes and total number of boxes per unit of TSS shall not exceed 1 box and for VMS shall not exceed 2 boxes.
- 1.3** For Panels, Server PC, Printer, Junction boxes, mounting pad / bracket, field cables etc (i.e. typically from Indian manufacturers) packing which is suitable for transportation by Lorry and storage at site for extended periods up to 24 months, shall be used. For this a reference standard ED 490092 Rev 05 clause 3.1.1 is attached. OEMs shall follow this standard at minimum. If any other OEM standard packing is available same shall be submitted to BHEL for review and acceptance as part of Technical offer.
- 1.4** Indigenous items, except for bare panels & cables, shall be packed in best fit boxes and total number of boxes per unit of TSS shall not exceed 2 box, for VMS shall not exceed 4 boxes and for Analysis & Diagnostics system shall not exceed 1 box.
- 1.5** Packing shall be separate for each unit of the project, TSS, VMS & Mandatory spares separately.
- 1.6** Packing of the items shall be such that they can be repacked properly after material verification at customs / site.
-



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ISSUED: DATE:
STDS GROUP 30/03/13

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3.1.1.3

Plywood for general purposes i.e. moisture resistance or MR grade (Commercial ply wood) and termite, fungus proof as per IS: 303 of 9 mm / 12 mm thick for control cubicles, single and multi cubicles, loose items and spares cases. The plywood shall be bonded with high quality Phenol Formaldehyde Synthetic Resin and specially treated with preservatives to repel termites and wood destroying organisms. The plywood shall withstand the stress caused by cyclic changes in weather conditions. It shall be durable and resistant to heat, sun and moisture. The sheets so procured shall have IS mark IS 303 and MR grade stamped on it. 9 mm thick plywood can be used with additional plywood support/ reinforcement suitable battens both for small cases and also for panels. Support batten as indicated at 3.1.1.4 shall be used.

Sample drawings of panels & loose boxes are attached for ready reference.

[Fig : 10 to 13]

3.1.1.4 Support Battens:

Ply wood sheet of cross section 18 mm x (100 mm) for support batten for loose items, spares, and plywood sheet of cross section 18 mm thk x 100 to 150 mm width as support batten for standard panels up to 2450 x 1350 x 2500 mm panels. Support batten of plywood cross section 12 thk x 75 to 100 mm can also be used for small cases apart from 18 mm x 100 mm cross section. These plywood support battens can also be used in place of silver oak support battens as referred in clause 3.1.1.2. Additional support battens/ cross battens of suitable sizes are to be provided on need basis.

Sample drawings of panel's i.e. single suit, two suite and three suit cubicles are attached for ready reference [Fig: 10 to 13].

Special support battens for Rlys and similar panels:

Plywood of cross section 18 mm x 75mm x 3 no's at both bottom end and top end of front and back shock's , and also at top portion of both corner shock's for fixing with bolt and nut/ clamps, and 18 mm x 150 mm x 2 nos cross section as support batten/ slanting reinforcement batten on all sides. On need basis 18mm x 125 mm x 2 to 3 no's of plywood cross section can also be used additionally depending upon the size and weight of the panel.

Plywood shock's can be fixed with both Bolts and mechanical latching clamps or combination of both as the case may be.

Sample drawings of panels are attached for ready reference.

[Fig : 8 & 9]

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3.1.2 For Export Contracts

- 3.1.2.1 Plywood of Marine grade as per IS: 710 of 9 / 12 mm Thick for control cubicles of single / two / three suite for loose items and spare cases. For suit of four and longer cubicle sections, 19mm thick is to be used.

It shall be highly resistant to attacks from fungi, termites and wood destroying organisms including marine borers. The plywood shall withstand the stress caused by cyclic changes in weather conditions. It shall be durable and resistant to heat, sun and moisture. The sheet shall have IS: 710 and marine grade marking.

3.1.2.2 Same as clause 3.1.1.2.

- 3.1.3 BHEL EDN will be carrying out test on ISI marked ply Wood whenever required.

- 3.2 Fasteners: M8 x 130 mm and M8 x 150 long zinc plated Bolts and M8 zinc plated nuts for fixing, and spring Washers or suitable size can also be used.

- 3.3 Nails: Nails of dia 3.15 mm and about 40 mm for nailing of plywood and silver oak batten. Suitable smaller size is to be used for other nailing.

- 3.4 Polyethylene sheet: The polyethylene sheets are used to make covers for the jobs individually. The material shall have a minimum thickness of 0.175 mm (175 microns).

The polyethylene sheet shall be clear and transparent manufactured out of virgin material. Reprocessed material shall not be used.

- 3.5 Bituminised water proof kraft paper - used for lining the inside of shookees of cubicles.

- 3.6 Bitumen coated Hessian polyethylene kraft paper used for lining the inside of top cover for cubicles and all inner and top sides for small boxes.

- 3.7 Rubberised Coirs- used for cushioning and to fill the gap inside packing boxes. The coir shall be about 100 mm wide and 25mm thick.

- 3.8 Foam rubber/U Foam - This is used for covering the delicate items. This material is normally provided by BHEL.

- 3.9 Thermocole (Expanded polystyrene) sheets - This is used for covering delicate items. This material is normally provided by BHEL.

- 3.10 Silica gel - shall be of indication type to conform to IS: 3401: shall be blue in colour while usage.

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- 3.11 Cotton bag - These are used for holding silica gel. The bags shall have the following matter indicated on them:

-----		-----
BHEL-EDN		BANGALORE-560026
SILICA GEL		
INDICATING TYPE		
BLUE	: ACTIVE	
ROSE	: REDUCED ACTIVITY	
WHITE	: NO ACTIVITY. TO BE REPLACED	WITH FRESH
	SILICA GEL	

- 3.12 Cotton / Plastic tape-This is used for tying small items and also to prevent vibrations of moving parts within the cubicles.
- 3.13 Polyethylene bags - These are to be used for keeping the packing slips. The bag shall be of size 70 mm X 100 mm (minimum).
- 3.14 Hessian cloth, twine thread, paint will have to be used in packing certain items.
- 3.15 Marking plate - This shall be of anodized aluminium sheet. Details and specifications are given in Fig-3.
- 3.16 Marking ink - Ink used shall be normally black in colour. The ink shall be indelible, non fading and non washable in water.
- 3.17 Packing Slip Holder - This shall be of galvanised iron tinned sheet / aluminium sheet.
- 3.18 Mechanical Latching clamps : For CLW Railway panels and similar Panels self locking clamps can also be used on need basis in conjunction with or apart from regular bolt and nut fixing arrangement. Sample drawing attached [refer Fig.7]. For reusable boxes, these clamps provides easy locking and unlocking arrangement. These clamps will be made available from BHEL in some cases.
- 3.19 Flex/Vinyl digital print media for labeling:
Labels made out of Flex/Vinyl/ other digital media shall be used for export contracts & some prestigious domestic contracts on need basis apart from existing present marking/ labeling system.
- 3.20 Aluminium foil for packing:
On need basis, suitable size & thickness of aluminium foil shall be used for packing of electronic panels and loose items for both indigenous & export contracts.
- 3.21 Pallets :
All cubicles are mounted on the pallets by BHEL. For loose items, HMI items & small cabinets for which no pallets are available, suitable size pallets have to be arranged by the contractor.

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4.0 Chemical treatment for silver oak preservation

- 4.1 The silver oak battens are to be treated with ASCU solution. For plywood wood treatment is not required.
- 4.2 The chemical used shall be ready mix ASCU paste. This consists of Arsenic, copper sulphate, sodium dichromate. This paste shall be mixed at the rate of 1 kg of paste per 10 liters of water. Alternate to this CCA can also be used as indicated at para 4.4
- 4.3 The chemical treatment shall be done at the premises of the contractor. A cement concrete tank of capacity to hold a minimum of 2000 liters of solution shall be constructed. The solution shall be prepared in the presence of BHEL- EDN's representative by contractor. The wooden battens shall be soaked in the solution for a minimum of 12 hours.

The solution shall be replenished after treating a maximum of 12 cubic meters of wood for 2000 liters of solution. A log book shall be maintained by the contractor to give the details of date of preparation of solution, quantity of solution prepared, quantity of chemicals used, quantity of wood treated and the details of replenishment.

Samples of solutions [only paste before mixing] shall be tested at the laboratories designated by BHEL. The testing fees to be paid to the laboratories will have to be borne by the contractor. The solution [paste] shall be tested as and when required.

4.4 Specifications for water soluble type wood preservatives: Copper - Chromium - Arsenic [CCA]:

Copper - Chromium - Arsenic preservative formulation shall be as per IS : 10013 Part - II - 1981 shall consist of following active ingredients in nominal proportions by weight as shown below:

Arsenic Pentoxide	$As_2O_5 \cdot 2H_2O$	12.5
Copper Sulphate	$CuSO_4 \cdot 5H_2O$	37.5
Sodium Dichromate	$Na_2Cr_2O_7 \cdot 5H_2O$	50.0
Or		
Potassium Dichromate	$K_2Cr_2O_7$	

- 5.0 Jointing of plywood- to the extent possible, single plywood sheet shall be used in case of equipment of large size, jointing is allowed as bellow.
- 5.1 The joining shall be as close to the center of equipment as possible, but not less than 500 mm from one edge.
- 5.2 While joining (2 or more plywood sheets), care shall be taken to fix the sheets in the direction of the grain structure.
- 5.3a For joining Plywood and Silver oak wooden batten:
While joining, 2 sheets shall be kept close to each other and treated

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silver oak batten of 100 mm width and 45 mm thick to be used and nailed to both plywood sheets alternately (2 numbers) in zig-zag manner.

5.3b For Joining plywood with plywood sheets :

While joining, 2 sheets shall be kept close to each other and plywood sheet batten of minimum 100 to 200 mm width and 18 mm thick to be used depending upon the size of the box/ case and nailed to both plywood sheets alternately (2 numbers) in zig-zag manner. Suitable size nails to be used.

5.4 Jointing of silver oak batten : Only single length silver oak batten shall be used. In case of height or width of equipment is more than 2400 mm, jointing of batten is acceptable. The jointing of batten shall be such that two batten are kept together and one more batten of width & length of about 200 mm to be nailed on both the planks as in Clause 5.3 above.

5.5 The above jointing is to be done close to center of equipment.

6.0 Packing procedure

6.1 Packing of cubicles for inland contracts.

6.1.1 Packing to be done using materials given in clause 3.0.

6.1.2 The cubicles are fixed on wooden pallets. Hence the contractor need not arrange the bottom pallets.

6.1.3 Loose parts : All loose parts in the cubicles, shall be tied using cotton/ plastic tape. Wooden battens shall be provided wherever necessary.

6.1.4 Additional loose items which may be kept inside the cubicle.

- a. The components which are removed from cubicle for loose shipping, such as meters shall be kept inside the cubicle individually kept in wooden box and tied firmly to the bottom of cubicle.
- b. Other items which are given loose in addition to cubicle, shall be packed in separate boxes (like cables).
- c. For transformer cubicles loose items shall be packed in separate boxes and these boxes may be tied firmly in bottom of cubicles.
- d. Items which are bigger in size such as impulse tubes may be kept at the top of cubicles firmly bunched and tied.

6.1.5 Wooden batten : This batten shall be silver oak wood .In case of Cubicle which are not rectangular in shape like control desks, sufficient number of wooden rafters/ battens of proper size shall be provided to give strength to the package.

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- 6.1.6 Silica gel: Silica gel (as in 3.10) packed in cotton bag (as in 3.11) shall be kept at different place inside the cubicle as per BHEL-EDN directions. Each suit of cubicle shall provided with 1 kg of silica gel (for a suit of 4 cubicles, 4 kg of silica gel shall be used).
- 6.1.7 Polyethylene sheet covering: Cubicles shall be covered with polyethylene petticoat (sheet as in 3.4). This shall be tailor made to fit the cubicle. The sealing shall be such as not to allow any moisture to enter the cubicle. This sheet is to be folded to the bottom pallet with wooden planks on 2 larger sides.
- 6.1.8 After completion of this, the arrangement is as shown in Fig.1.
- 6.1.9 Rubberised coir: (as in 3.7) to be nailed from inner side of plywood after pasting kraft paper for full length with a pitch less than 500mm with a min. of 2 rows of cover is to be used.
- 6.1.10 Bituminised water proof kraft paper: (as in 3.5) to be pasted with glue on 4 inner sides of plywood. Whenever 2 pieces of kraft paper are used, the joint shall have an over lap of min 20 mm.
- 6.1.11 Bitumen coated Hessian polyethylene kraft paper (as in 3.6) to be nailed using nails (as in 3.3) on top cover inner surface. This sheet shall project outside on 4 sides by atleast 100 mm and shall be folded and nailed on to the sides. Joining of 2 sheets shall have an overlap of min 20 mm.
- 6.1.12 After completion of above steps, the arrangement shall be as given in Fig.2.
- 6.1.13 Marking Plate : One no (as in 3.15) shall be nailed to the front side of case, item as shown in Fig.3.
- 6.1.14 Case Marking : After complete packing, marking of various details and symbols as given by EDN shall be done using indelible ink (as in 3.16)
- 6.1.15 Packing Slip : Packing slip kept in polyethylene bag (as in 3.18) shall be placed inside the box at appropriate place before closing the top. in addition one more packing slip covered in polyethylene cover and packing slip holder (as in 3.17) shall be nailed to front or rear of shook.
- 6.1.16 At the end of this stage, the arrangement is as shown in Fig.4. Front and rear shook fixing arrangement to the bottom of the pallet is as shown in Fig.5
- 6.1.17 The lifting arrangement of the packed case is shown in Fig.6
- 6.2 Packing of cubicles for export contracts Procedure is same as that given in 6.1 except for the following changes:
- Two Polyethylene petticoat (as in 6.1.7) instead of one
 - Fumigation may have to be done if required (BHEL Scope).

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- 6.3 Packing of empty Cubicles Procedure is same as that given in 6.1 except For following changes
- Bituminised kraft paper, bitumen coated Hessian polyethylene paper, silica gel need not be used.
- 6.4 Packing of loose items/spares for inland contracts
- 6.4.1 All the materials and procedure are same as in 6.1 except that :
- No joining of plywood and silver oak batten
 - Inner sides of all 6 sides shall be nailed with bitumen coated Hessian polyethylene kraft paper (as in 3.6) using nails.
 - Kraft paper (as in 3.5) is not required
 - Silica gel quantity is 100 gm approx per box.
 - Rubberised coir is to be nailed to inner surfaces of bottom 4 sides of box.
 - Bottom plywood sheet / pallet shall be of 18 mm thick for all practical purposes and 12 mm thick for smaller boxes on need basis. Suitable bottom beams made out of plywood/ any other wood of suitable cross section 75x36 mm, 75x54 mm, 75x75 mm, 100x100 mm.
 - Support battens of cross section 12x75 mm, 12x100mm, 18x75 mm, 18x100 mm can be used depending upon the size of the boxes. Plywood support battens can be used in the place of silver oak battens.
 - Clause 6.1.10 is not applicable. Individual items to sealed with polyethylene sheet(as in 3.4) and one full cover of polyethylene sheet covering of all items is to be made.
- 6.4.2 In few cases gabled roof (single or double gable) may have to be made, details of which will be given by EDN.
- 6.4.3 Internal Packing: Items that go into the box shall be packed using polyethylene sheet/ U foam/ thermocol sheets/air bubbled sheets/ paper cartoons and cotton tape. Any space left between the job and the sides and the top of the box shall be filled with rubberised coir/air bubbled sheet /thermocole to get proper cushioning effect. Certain items like transformers, reactors, breakers, etc shall be bolted to the bottom of the box using bolts, nuts and washers.
- 6.5 Packing of Loose items/ Spares for Export Contracts: Procedure is same as that given in 6.4 except for following changes:
- Two polyethylene covers to be provided,
 - Fumigation may have to be done, if required, for which payment will be made by EDN.
- 6.6 Any other changes/ new methods/ alternative packing systems can be undertaken with prior information and approval from the dept. For other parameters and further details concerned agency may please be contacted.

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7.0 ACCEPTANCE CRITERIA OF PLYWOOD :

**PLYWOOD FOR GENERAL PURPOSE
GRADE FOR PACKING - AS PER IS:303**

1. Plywood sheets shall have IS:303 & BWR / MR grade stamped on each sheet.
2. Packing/contractor should give a certificate to this effect.
3. Contractor shall identify each sheet with their name/firm in suitable place.
4. Visual checks to be done by packing contractor and EDN-QC CE shipping.
5. For other parameters, testing will be done at authorised laboratories/institutions by EDN on sample basis.

7.1 FOR BWR GRADE : TABLE-1 QUALITY REQUIREMENTS OF PLYWOOD

Sl NO	Defect Category	Maximum Number of Defect Permitted on any one surface of panel (as applicable to Type A Surface of IS:303)
1.	Blister	Nil
2.	Check	Individual check not more than 50mm in length and the total length not more than 300mm/m ²
3.	Discoloration	Nil
4.	Dote	5cm/m ²
5.	Insect hole	Scattered up to 12 holes/m ²
6.	Joints	One joint for every multiple of 200mm provided no individual piece is less than 100mm in width
7.	Knots(dead)	2 up to 12mm dia/m ²
8.	Pin knots(dead)	2/m ²
9.	Pin knots(live)	No restriction
10.	Knots(tight)	6 up to 25mm dia/m ²
11.	Patches	4 patches/m sq provided they are all tight patches & do not mar the appearance

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12. Splits. 2 splits each not more than 1mm wide and length not more than 100mm provided they are filled with suitable filler

13. Swirl Unlimited provided they do not mar the

7.2 FOR MR GRADE : TABLE -2 QUALITY REQUIREMENTS OF PLYWOOD

Sl NO	Defect Category	Maximum Number of Defect Permitted on any one surface of panel (as applicable to Type A Surface of IS:303)
1.	Blister	Nil
2.	Check	Individual check not more than 100mm in length and the total length not more than 1000mm/m ²
3.	Discoloration	5 %
4.	Dote	15cm/m ²
5.	Insect hole	Scattered up to 24 holes/m ²
6.	Joints	: No restrictions
7.	Knots (dead)	4 up to 20mm dia/m ²
8.	Pin knots (dead)	: 6/m ²
9.	Pin knots (live)	No restriction
10.	Knots (tight)	: No Restrictions
11.	Patches	Any number provided they are all tight patches & do not mar the appearance
12.	Splits	3 splits each not more than 4 mm wide and length not more than 150 mm provided they are filled with suitable filler
13.	Swirl	NO restrictions

7.3 Thickness of Plywood sheets:

The plywood boards shall be of uniform thickness within specified tolerance limit specified. The faces of plywood boards shall be reasonably smooth.

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7.4 PERMISSIBLE DEFECTS:

Gaps in cores and cross-bands may be permitted except for 3 ply plywood, provided the width of the gap does not exceed 1mm in case of and 2 mm in case of plywood of more than 5 ply and provided such gaps, if more than one, shall be spaces not less than 80mm away from each other and are staggered not less than 50mm away as between ply, the next ply having the same grain direction.

7.5 WORKMANSHIP AND FINISH:

The plywood boards shall be of uniform thickness.

The faces of plywood boards shall be reasonably smooth and face veneers shall be reasonably uniform thickness.

7.6 TESTS:

For testing any other mechanical property of general purpose plywood, Subject to agreement between the purchaser and the supplier, reference shall be made to the provisions of IS 1734 Part 1 and 20)

8.0 Details of Drawings / Figures attached:

Fig- 1	:	Packing of panel - Preparation
Fig- 2	:	Shookes preparation
Fig- 3	:	Marking Plate
Fig- 4	:	Packed panel with plywood and silveroak battens
Fig- 5	:	Detailed joining of pkg shookes with battens
Fig- 6	:	Lifting of packed case
Fig- 7	:	Mechanical Latching clamps
Fig 8 & 9	:	CLW Railway panel packing
Fig 10 to 13:	:	Packing of panels and spares packing cases.
Fig 14	:	All Units supplying Initial and O & M spares (Recommendations from Corporate Systems & IT)

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Additional points to be taken care for :

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

(Recommendations from Corporate Systems & IT)

Sl	Activity
1	All Initial and O&M spares preferably supplied in one lot to site and progressive inventory till all spares are accumulated could be kept at units.
2	Spares (Initial and O&M) should be supplied in separate Boxes / Containers and not mixed in main supply boxes.
3	i) Initial spares Box / Container to be labeled as "INITIAL SPARES " in RED. Ref fig: 14 (Page-26). ii) O & M spares Box /Container to be labeled as" O&M SPARES " in GREEN. Ref fig: 14 (Page-26).
4	iii) Initial Spares Box to have red Color strip as per diagram. Ref fig: 14 (Page-26). iv) Majority of spares (initial and O&M) are for indoor storage at site. v) O&M spares box to have green Color strip as per diagram. Ref fig: 14 (Page-26).
5	vi) Spares (Initial and O&M) Packing list kept inside the boxes and affixed securely outside the box to contain vii) Custom name viii) Project / Power station Name ix) Customer PO No and date x) Sl no of customer PO. xi) Quantity total & dispatched. xii) Unit work order number xiii) All above to be developed from Unit IT System
6	xiv) All spares (Initial and O&M) items to have tags (wono, item customer order no, customer item.description)
7	xv) Supply of spares by Vendor should also be instructed for following point 2,3,4,5,6 mentioned above.

Action By : Sites on arrival of spares (Initial and O&M)Receipt .

	Activity
1	Material utilized if any from Initial and O&M spares , should have prior written approval of concerned MUs. Such MUs shall also confirm replacement dates which should be entered in the system for creation of repository.



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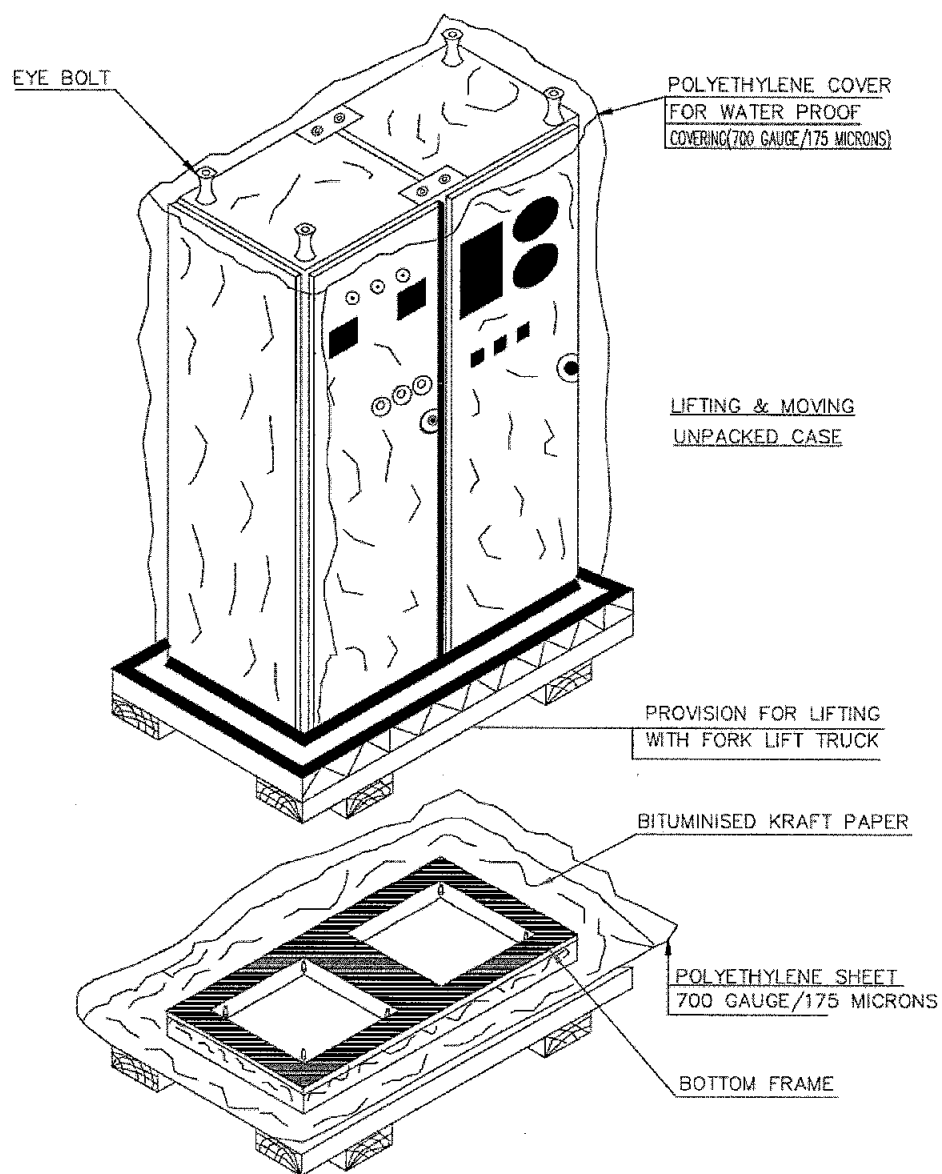


FIGURE-1



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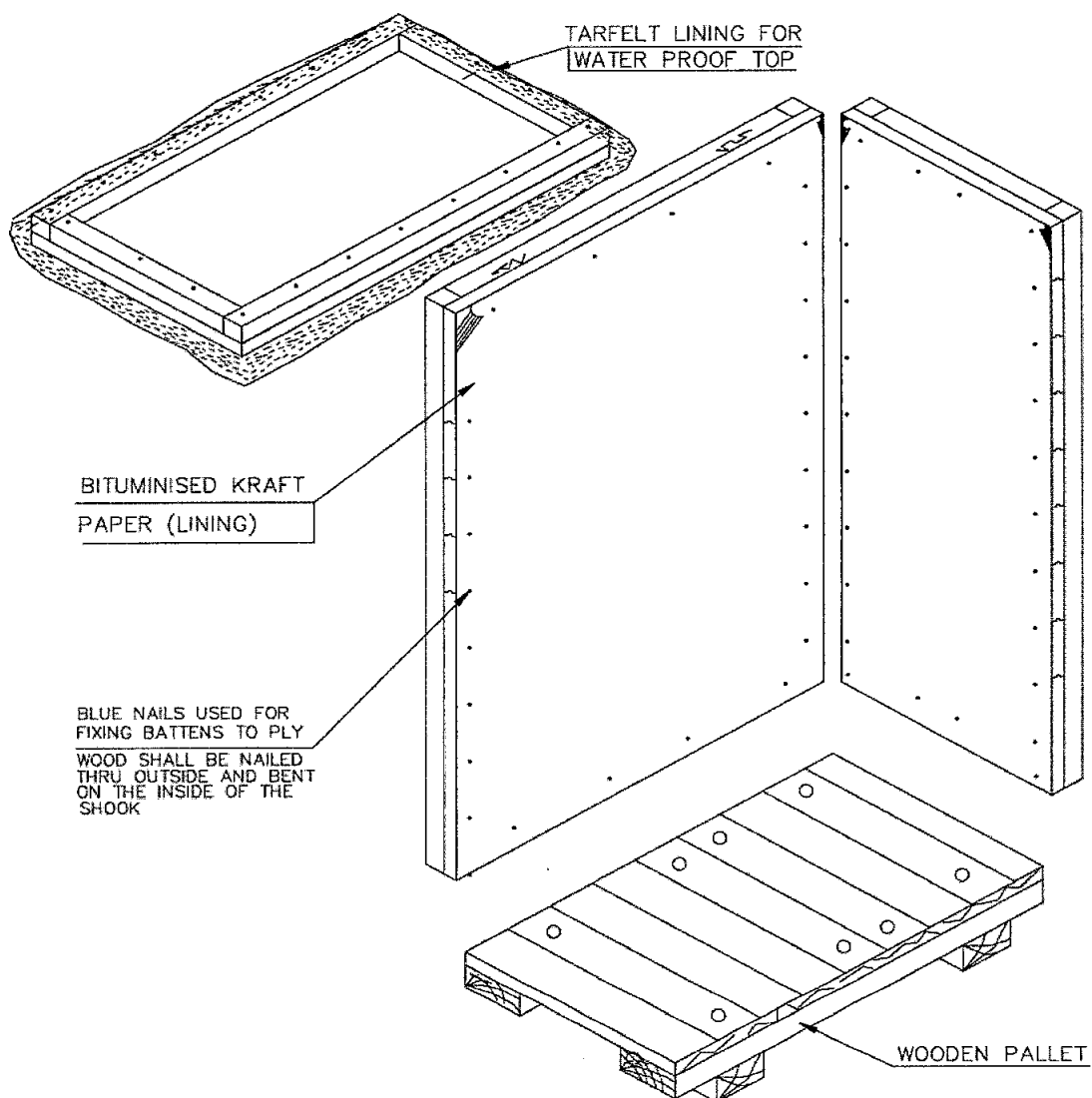


FIGURE-2



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		BHEL-EDN-BANGALORE-26					
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					

225

170

FIG-3 : MARKING PLATE



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PLYWOOD SHOOKS BOLT TYPE WITH SILVER OAK BATTONS

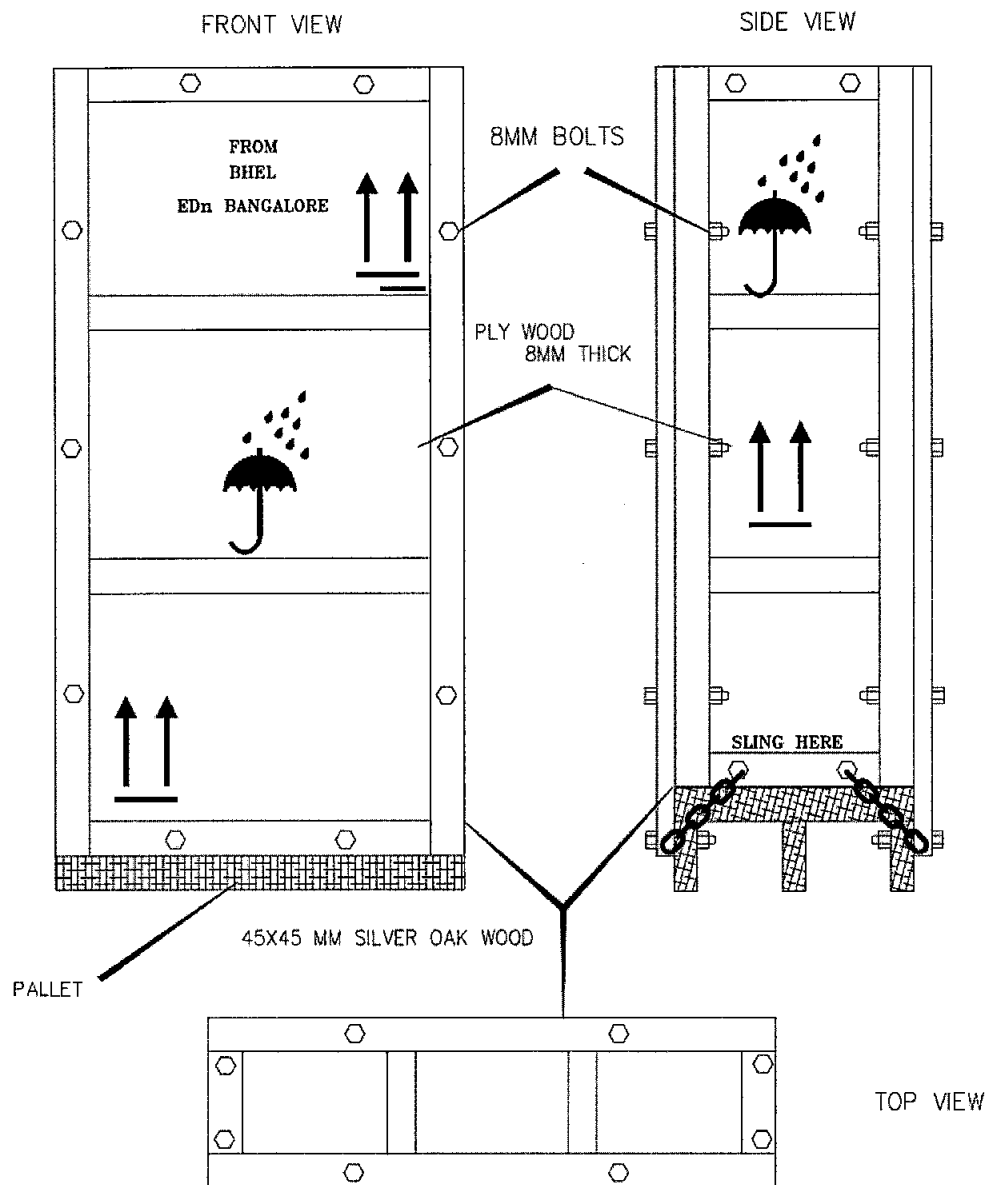


FIG-4



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LAP JOINTS

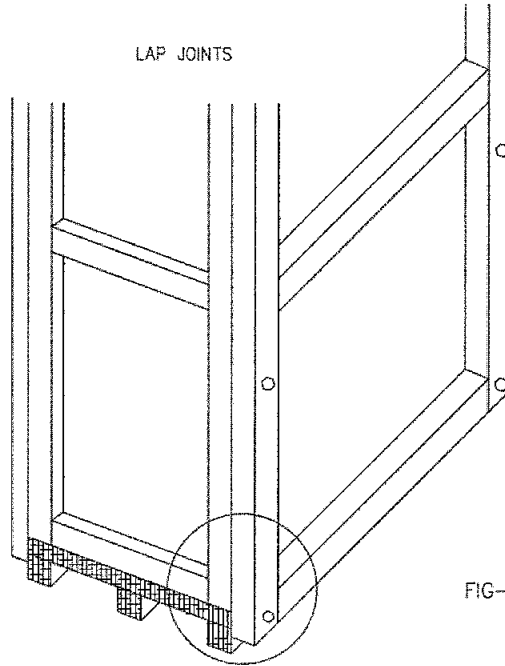
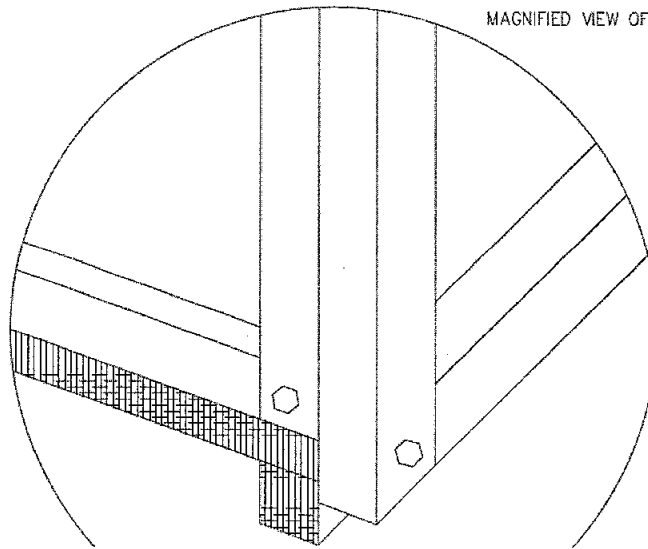


FIG-5

MAGNIFIED VIEW OF THE LAP JOINT





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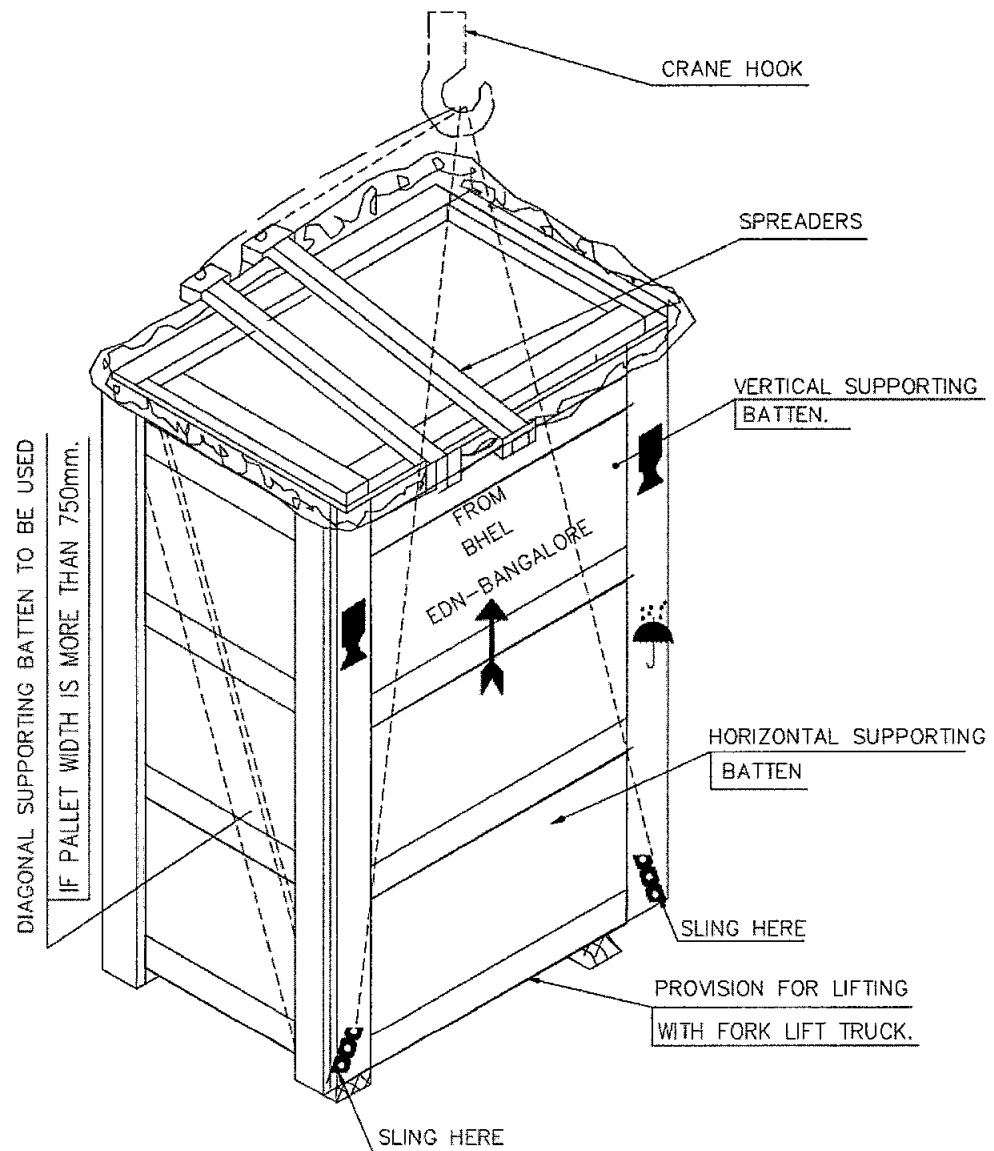


FIG-6 : LIFTING OF PACKED CASE



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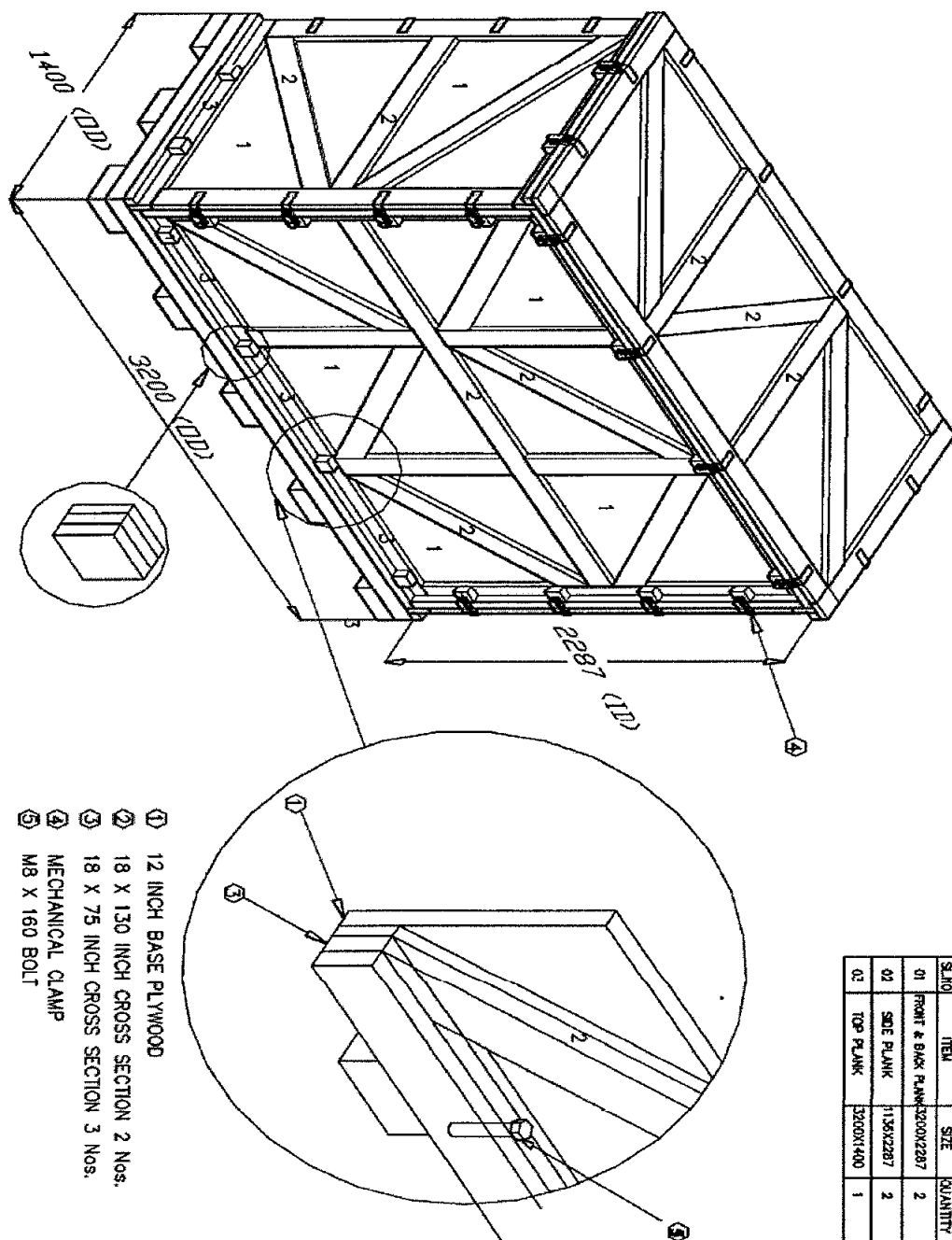


Fig - 8 : CLW Railway Panel Packing with Plywood & Plywood Support Battens

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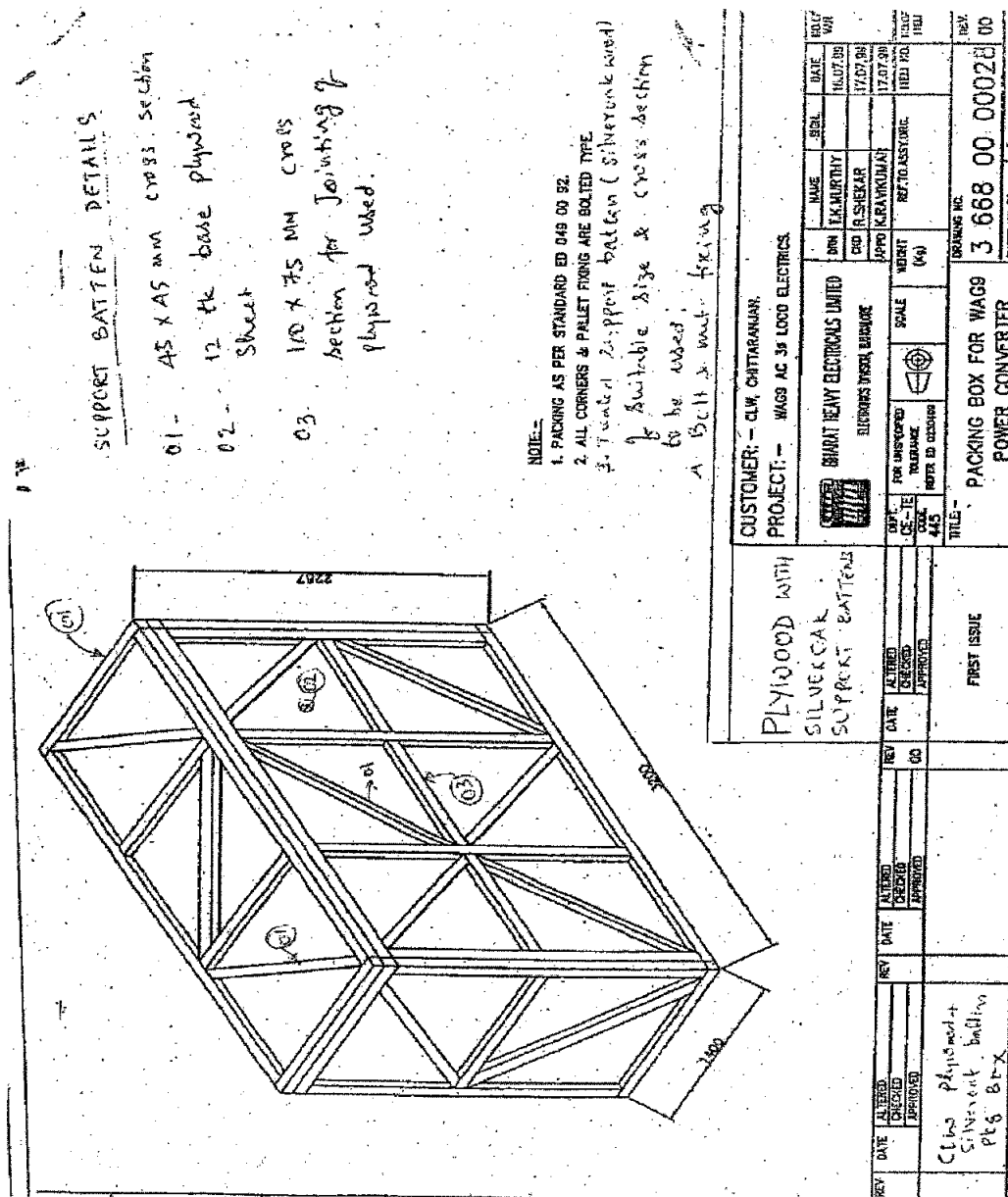


Fig – 9 : CLW Railways Panel Packing with Plywood & Silver Oak Battens



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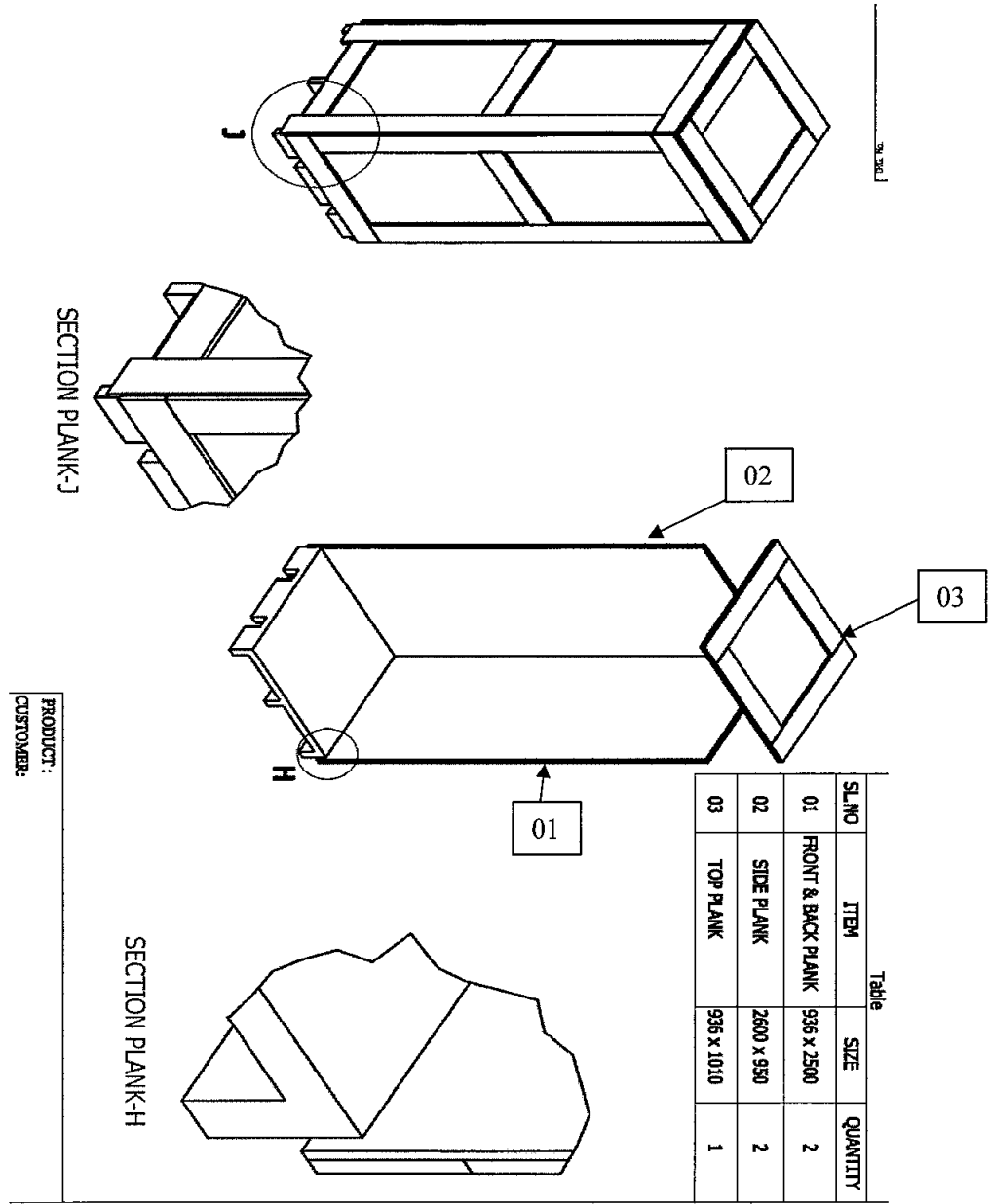


Fig-10 : Plywood Packing for Single Suit Panel.



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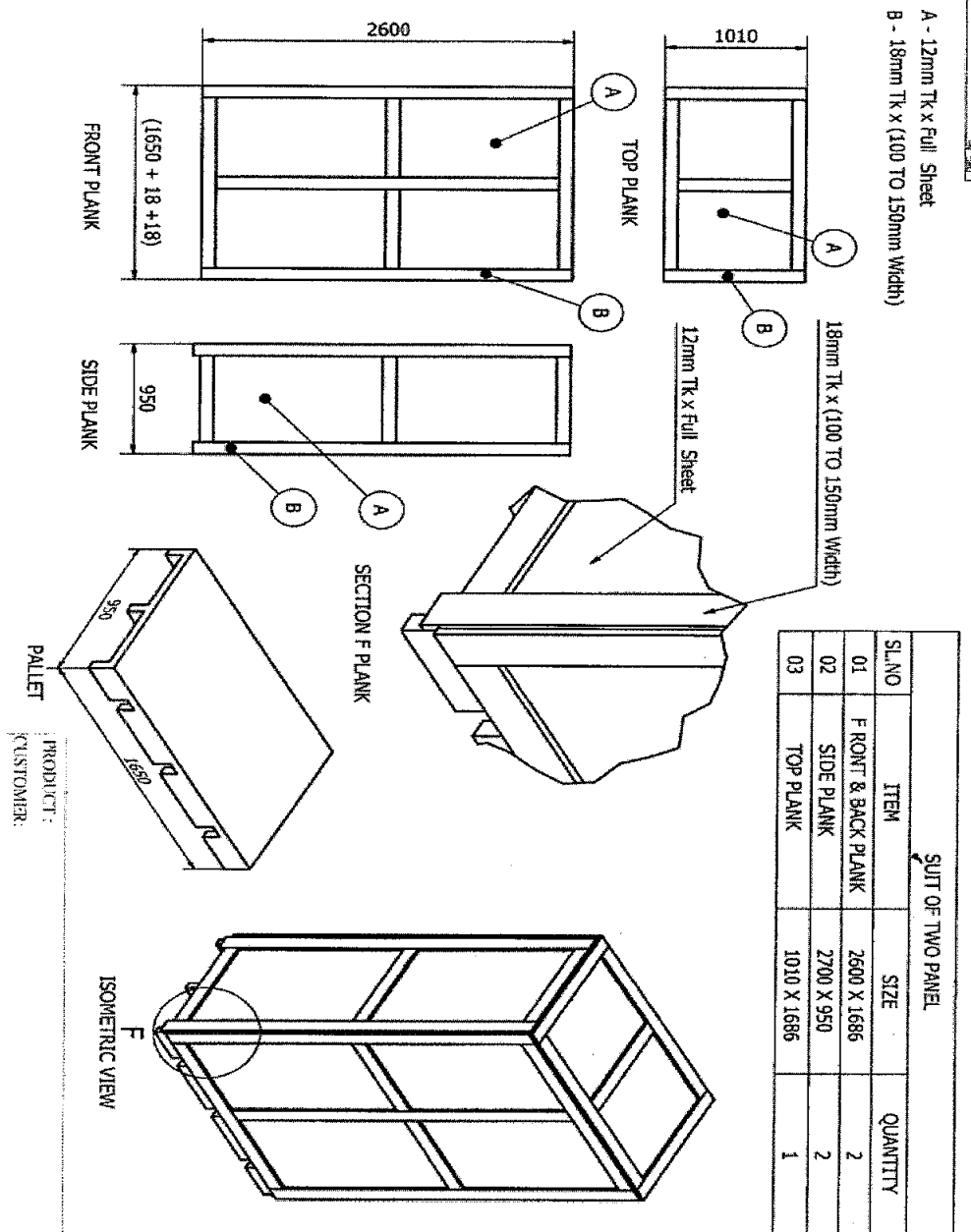


Fig - 11 : Plywood Packing for 2suit panel.



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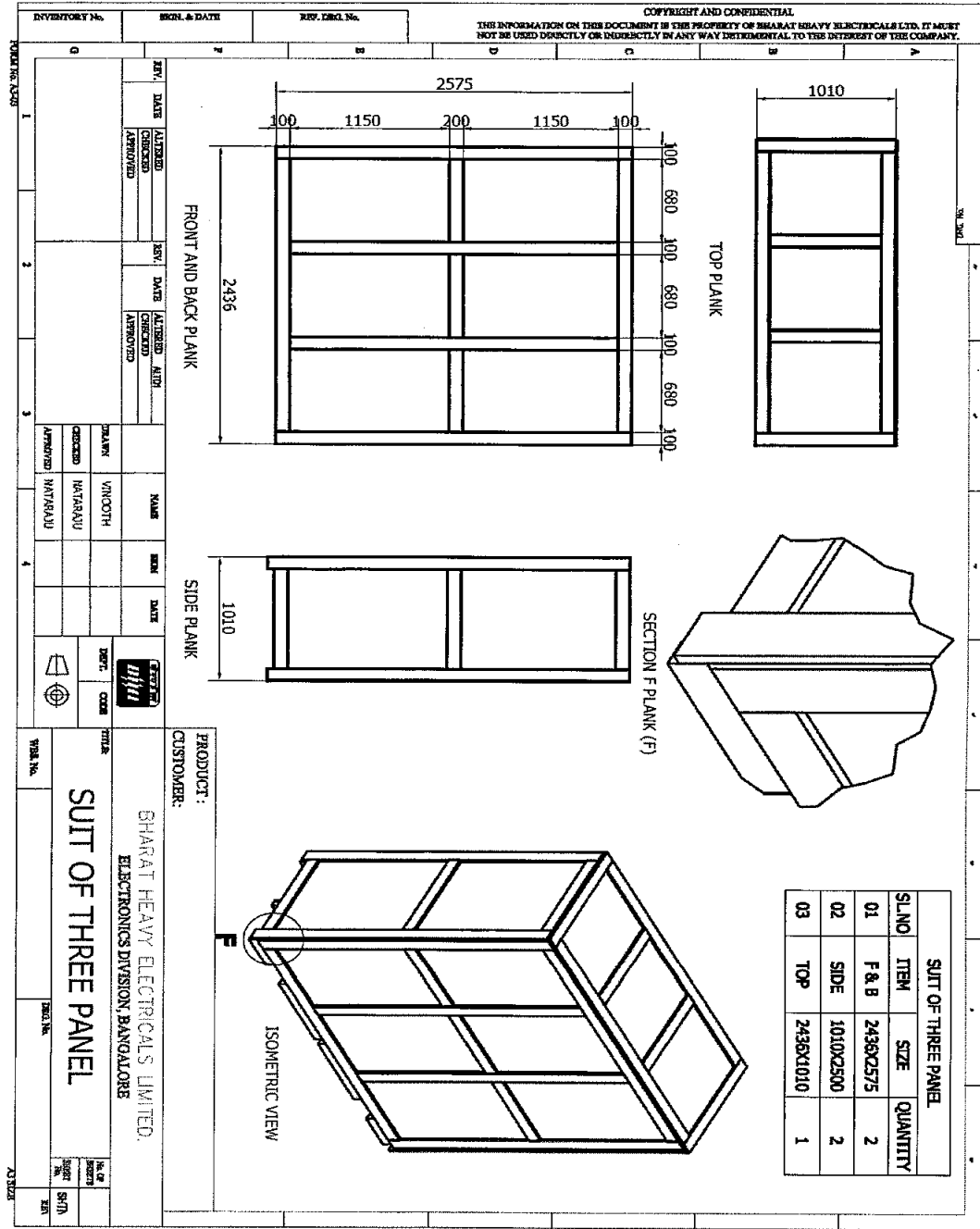
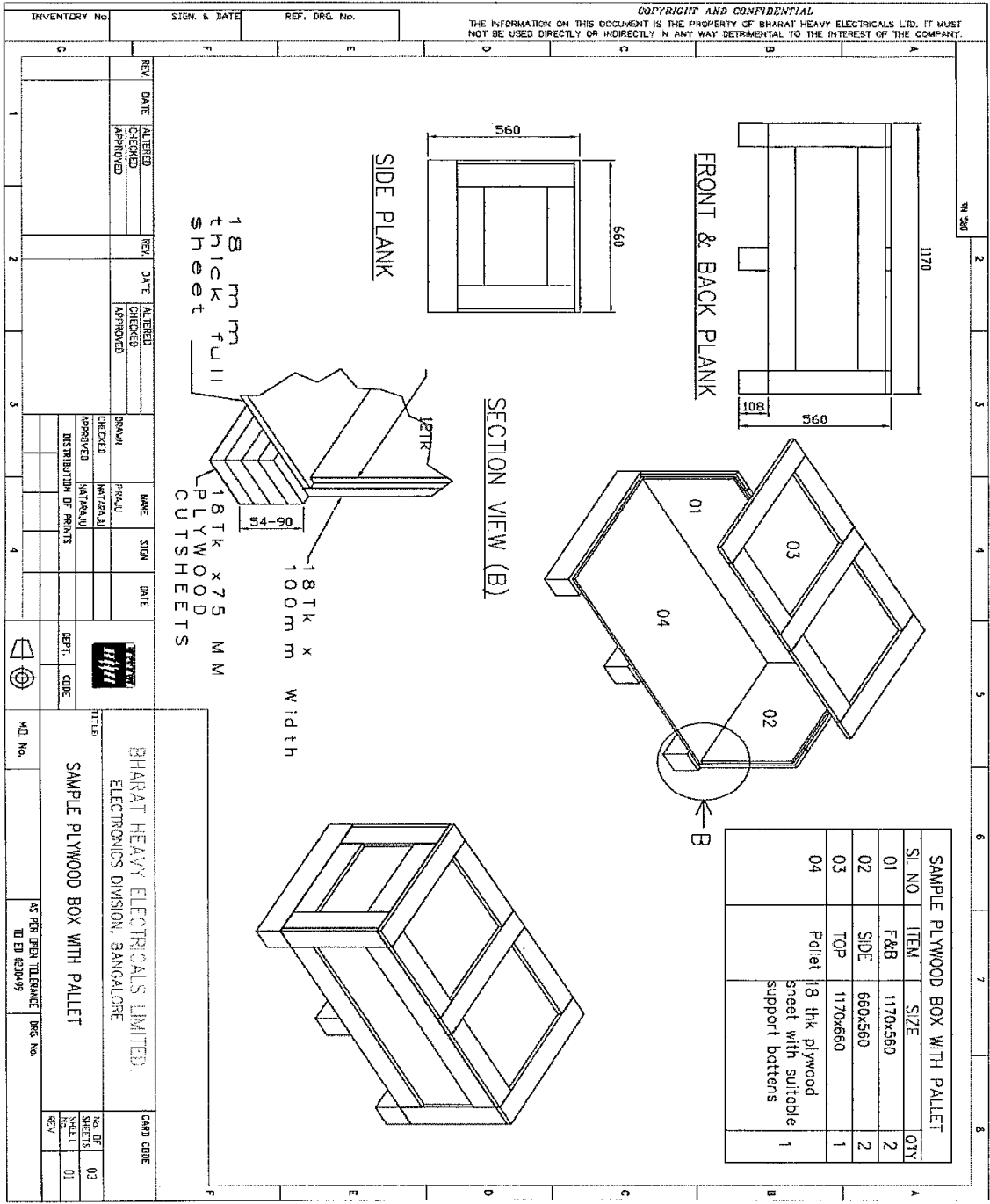


Fig - 12 : Three Suit Panel Packing

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FRONT & BACK PLANK

1170

560

108

SIDE PLANK

560

560

SECTION VIEW (B)

181k x 75 M M

181k x 100m m width

54-90

181k x 75 M M

PLYWOOD CUTSHEETS

01

03

02

04

04

Pallet

18 thk plywood sheet with suitable support battens

1

Fig – 13 : Plywood small case with Pallet

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Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

Fig: 14

