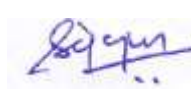


		 A4-10				REF. : CE/416/VMS/OT/PS REV.NO. : 00 PAGE : 1 OF 9	
		PURCHASE SPECIFICATION FOR VIBRATION MONITORING SYSTEM (VMS)					
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		REVISION : 00			APPROVED  S. K. TOPPO		
					PREPARED  D. GHOSH	ISSUED 416	DATE 05/01/2021



Purchase Specification for Vibration Monitoring System (VMS)

Ref.: CE/416/VMS/OT/PS
REV.NO.: 00
PAGE : 2 of 9

Note to Bidders: Any change in scope / specification, during technical evaluation of the offers, will be communicated only to the participating bidders for this tender.

AA Scope: Vendor shall offer Vibration Monitoring System (VMS) for Plant Auxiliaries namely Turbine Driven Boiler Feed Pump – TDBFPs, Motor Driven Boiler Feed Pump-MDBFP & its Motor, Cond. Extr. Pump – CEP & its motors, DMCW Pumps & its Motors, ACW Pumps & its Motors, ID Fans & its Motors, FD Fans & its Motors and PA Fans & its Motors, Mill motors, APH Was pumps & its motors, IAC Motors and SAC motors for 2 Units of Super Thermal Power Plant 660 MW or 800 MW project. Technical requirements for the above machines are as per Cl. DD of this Purchase specification. Scope of Supply shall include Engineering, Manufacturing & Testing, and Erection & Commissioning activities and Training as per this specification.

Note: The sensor mounting hardware, extension cables, junction boxes, panel, networking components, display unit are optional items. The supply requirement for these OPTIONAL items will be decided later.

BB Provenness Criteria:

Offered System for this package shall have at least one year's satisfactory operation in one power station having unit rating of 500 MW or above for similar application / ratings of machines.

Vendor shall furnish a complete list of bought out items (i.e., items not from manufacturing range) which the Vendor has included in his proposal along with the names of proposed sub-vendors as a part of his proposal.

Following documents are required for acceptance of proven track record (PTR) of the offered system:

1. Reference List of Projects wherein offered system, with model numbers of sensors & monitors, which are supplied & commissioned, along with details of machines & similar measurements and Year of Commissioning of the system specified in Projects. Reference list shall contain name of end user, latest contact email id and contact telephone number.
2. Minutes of meeting with end user for commissioning and handing over.
3. Unpriced purchase order copy
4. Certificate issued by end user mentioning the date of installation, model number of the supplied system and date issue of end user certificate

Note: If BHEL is unable to verify the PTR furnished, with end user contact details provided above, the offer will be liable for technical rejection.

CC Standardisation and Uniformity of Hardware:

Vendor shall ensure that all electronic monitors / transmitters / transducers, control hardware, and other instruments/ local devices etc. that are being furnished by the Vendor, are of the same make, series and family of hardware so as to ensure smooth and optimal maintenance, easy interchangeability and efficient spare parts management.

DD Technical Requirements:

1.0 Vibration Monitoring System (VMS) for Plant Auxiliaries :

- 1.1 Microprocessor based vibration monitoring system shall be provided for Power Plant auxiliaries such as fans/ pumps/ motors etc. Details of these machines are as detailed in Clause No. 1.10 of this specification.

-
- 1.2 The Vibration Monitoring System shall be furnished on a system basis including, vibration transducers & Key phasor /phase marker sensors 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, indicators, integrating units, signal conditioning devices and all other accessories, erection hardware required (OPTIONAL) for monitoring of Vibration at each point. Vendor shall provide the vibration pads (OPTIONAL).
- 1.3 Vendor 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 channels Vibration monitors being provided by the Vendor, 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.
- 1.4 Eddy current / Piezoelectric type transducers shall be used. The sensors shall be velocity type. However, the finally selected sensor type shall also depend on recommendation of the equipment manufacturer & suitable for application requirement which shall be finalized 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 BHEL which will be 4 Pair x 0.5 mm² individual & overall shielded cable for velocity pick-up type transducers and 2 Triad x 0.5 mm² individual & overall shielded cable for phase marker sensors (considering 50 % spare cores). Vendor to confirm the suitability of cable size & type for their offered VMS system.
- 1.5 Vibration monitoring system shall give one number buffered output of 4-20 mA DC and two numbers of buffered raw signals for each point monitored and one no. of buffered raw signal for each Key phasor/phase marker. One buffered signal for each point monitored & phase, shall be terminated to panel terminal blocks, which shall be taken to third party vibration analysis system. The signal shall be suitable for use as an input to DDCMIS as well as for analog recording & analysis, linear in proportion to vibration velocity as well as displacement. 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.
- 1.6 The Vibration monitor with power supplies shall be mounted in a separate self standing cabinet (as per Clause No. 1.8 – OPTIONAL) to be located in Control Equipment Room for the main plant auxiliaries and in respective offsite area control rooms for offsite auxiliaries as applicable. Vendor shall feed the vibration monitoring cabinet from redundant 24 V DC supply. The feeders from the respective 24 V DC chargers to vibration monitoring cabinet is in BHEL's scope. If 240 V AC UPS power supply is required for panel PC/ desktop PC, Mini UPS for the same shall be provided by the vendor at respective offsite area control rooms. Redundant UPS of 240 V AC for VMS cabinet at Control Equipment Room will be provided by BHEL. The power supply arrangement shall ensure that if external power supplies are used, 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. However, if any power supply modules internal to the monitors are envisaged, the failure of one such module should not affect more than one monitor.
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- 1.7 The functional requirement for vibration monitoring system shall include but not be limited to the following:
- 1.7.1 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 not forced to a value less than 4 mA. In case such feature is not available, then suitable contact shall be provided from the monitor for sensor fault.
- 1.7.2 The facility shall be available for functional checking of monitors.
- 1.7.3 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.
- 1.7.4 In case it is the proven standard practice of the vendor to provide vibration monitoring Server/computer 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 BHEL/End-user approval.
- 1.7.5 Vendor to provide 15" display panel PC.
- 1.8 **Panel / Cabinet for VMS (OPTIONAL):**
Vendor shall supply the panel for VMS as per below specification:
- a. Panel shall be of size 800 mm X 800 mm X 2415 mm H (including top canopy- 60 mm + Bottom frame 50 mm + Antivibration pad 15mm) in mm
 - b. Panel shall be made up of 2mm thick CRCA steel sheet.
 - c. Anti-vibration pad of about 15 mm shall be provided.
 - d. Panel protection class shall be IP – 32; Panel height shall be 2415 mms.
 - e. Door shall be provided in the front & rear sides, shall be of 2 mm thick CRCA steel sheet.
 - f. 3 point locking system
 - g. Paint shade/s shall be :
Exterior / Interior = RAL 9002
End Panel Colour (Exterior) = RAL 5012
 - h. Panel painting shall be powder coated 100 microns thick or more.
 - i. Cutout with cable-gland plates shall be provided on the bottom of the Panel, for Cabling.
 - j. Suitable Lifting Hooks shall be provided on the Panel.
 - k. Provision shall be made in the Panel to accept two power supply feeders with required MCB's.
 - l. Terminals shall be Clip-on type for cable termination. 20 % spare terminals shall be offered.
 - m. Illumination shall be provided in the panel.
- 1.9 **Local Junction Box (OPTIONAL):**
- a. No. of ways: As required with 20% spare terminals
 - b. Material & Thickness: 4 mm thick Fiberglass Reinforced Polyester (FRP)
 - c. Type: Screwed at all four corners for door. Gasket shall be of synthetic rubber.
 - d. Suitable Mounting Clamps and accessories shall be offered. Material shall be of SS.
 - e. Type of Terminal Blocks: Rail mounted cage clamp type suitable for conductor size up to 2.5 mm². A M6 earthing stud shall be provided.
 - f. Protection Class: IP – 65 minimum for outdoor applications and shall be provided with adequate No. of cable glands.
 - g. Grounding: To be provided
 - h. Separate JB for each of the Bearing shall be provided.
 - i. The JB arrangement drawing is to be furnished.
 - j. JB color exterior & interior shall be IS:5 631 Light Grey (Semi Glossy). Type Test for IP-65 to be included.
-

1.10 Machine Data for VMS:

Machine Data:												Ref.: CE/416/VMS-D					
Sl. No.	Machine	Machine Qty. 1st Unit	Machine Qty. 2nd Unit	Appx.Cabling dist. from CCR/ WSCR (in mtr)	No. of Bearings for monitoring vibration (in X & Y direction)	Installation Horizontal (H) / Vertical (V)	Measurement parameter	Machine RPM	Vibration Range-(mm/sec-rms)	Alarm Level (mm/sec - rms)	Trip Level (mm/sec - rms)	Mounting Details	No of Vib. Sensors 1-Unit	No. of Phase Marker 1-Unit	No of Vib. Sensors 2-Unit	No. of Phase Marker 2-Unit	
1	Boiler Feed Pump TDBFP	2	2	130	2	H	Rel Shaft	800-7000	0-200 ^{p-p}	0-90 ^{p-p}	0-150 ^{p-p}	C	8	2	8	2	
2	MDBFP	1	1	130	2	H	Rel Shaft	800-7000	0-200 ^{p-p}	0-90 ^{p-p}	0-150 ^{p-p}	C	4	1	4	1	
3	MDBFP Motor	1	1	130	2	H	Abs Brg	1485	0-25	4.5	7.1	B	4	1	4	1	
4	Cond. Extrn. Pump - CEP	3	3	120	1	V	Abs Brg	1490	0-25	6.45	8.6	A	6	3	6	3	
5	CEP - Motor	3	3	120	2	V	Abs Brg	1485	0-25	4.5	7.1	B	12		12		
6	DMCW TG Pump	3	3	150	2	H	Abs Brg	1480	0-25	10.0	15.0	A	12	3	12	3	
7	DMCW TG Pump - Motor	3	3	150	2	H	Abs Brg	1480	0-25	7.0	12.0	A	12		12		
8	DMCW SG Pump	2	2	150	2	H	Abs Brg	1480	0-25	10.0	15.0	A	8	2	8	2	
9	DMCW SG Pump - Motor	2	2	150	2	H	Abs Brg	1480	0-25	7.0	12.0	A	8		8		
10	Mill Motor	8	8	230	2	H	Abs Brg	1000	0-25	4.5	7.1	B	32	8	32	8	
11	ID Fan	2	2	460	1	H	Abs Brg	590	0-25	4.5	9.0	E1	4	2	4	2	
12	IDF - Motor	2	2	460	2	H	Abs Brg	600	0-25	4.5	7.1	B	8		8		
13	FD Fan	2	2	300	1	H	Abs Brg	990	0-25	4.5	9.0	E	4	2	4	2	
14	FDF - Motor	2	2	300	2	H	Abs Brg	1000	0-25	4.5	7.1	B	8		8		
15	PA Fan	2	2	290	1	H	Abs Brg	1490	0-25	4.5	9.0	E	4	2	4	2	
16	PAF - Motor	2	2	290	2	H	Abs Brg	1490	0-25	4.5	7.1	B	8		8		
17	ACWP	3	3	100	2	H	Abs Brg	1480	0-25	10.0	15.0	B	12	3	12	3	
18	ACWP Motor	3	3	100	2	H	Abs Brg	1480	0-25	7.0	12.0	B	12		12		
		46	46									Total	166	29	166	29	

Note: 1) Mounting Details:

A: 60 x 60 x 10 mm pad on bearing housing

B: 60 mm cube vibration pad welded on both end shields

C: Mounting arrangement of sensors for TDBFPs and MDBFPs are enclosed as Annexure-A to this specification.

E / E1: 80 x 80 mm / 70 x 80 mm machined pads screwed with bearing housing respectively.

2) Cabling distance from Unit Control Room (UCR) and VMS panel in Engineering Equipment Room (EER) shall be approx 200 meter.

3) Key slot of 30 mm (L) x 15 mm (W) x 3 mm (D) are provided on connecting coupling hubs for phase angle measurement.

4) KKS Tag Nos. for transducers will be provided during detailed Engineering.

2.0 Mandatory Spares: Vendor shall offer mandatory spares, as below with unit price:

2.1 Sensors with extension cables & Drivers: 20% or minimum 2 nos. whichever is more

2.2 Power supply module cards: 10% or minimum 2 nos. whichever is more

2.3 Driver/ Interface cards & all other electronic cards: 10% or minimum 2 nos. whichever is more

Note: In case of decimals value, next higher integer value shall be considered.

3.0 Start-up & Commissioning Spares:

Start-up and commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the plant is handed over to the employer shall come under this category.

The Bidder shall include in his scope of supply all the necessary, start up and commissioning spares and recommended spares and indicate these in their offer.

4.0 Indigenous / Bought-out items (OPTIONAL) shall be from following sub-vendors:

SL NO.	ITEM	SUPPLIER	PLACE
1	BLANK CABINETS / PANEL	M/S PYROTECH	UDAIPUR
		M/S RITTAL	BANGALORE
		M/S MPP TECHNOLOGIES	BANGALORE
2	TERMINAL BLOCK	WAGO MAKE	
		PHOENIX MAKE	
		M/S WIED MULDER	GERMANY
3	15" DISPLAY PANEL PC	ORIGINAL SYSTEM MANUFACTURER	
		M/S PORTWELL LAXSON	
		M/S SCHNEIDER ELECTRIC	
4	NETWORKING COMPONENTS	M/S GARRET	USA
		M/S HIRSCHMANN	GERMANY
		NETGEAR MAKE	
		FOUNDARY MAKE	
		CISCO MAKE	
		HP (3 COM, H3C) MAKE	
		M/S ENTERASYS	USA
		M/S AVAYA	USA
5	FRP JUNCTION BOX	M/s DEVI POLYMER	CHENNAI
		M/S KS INSTRUMENTS	BANGALORE
		M/S BALIGA LIGHTING	CHENNAI
		M/S HENSEL	CHENNAI
		M/S SUCHITRA INDUSTRIES	BANGALORE
		M/S.MANISHA ENTERPRISES	PUNE
6	FIBRE OPTIC CABLE	M/S AKSH FIBRE	BHIWANDI
		M/S BIRLA ERICSON	REWA
		M/S R&M	SWITZERLAN
		M/S FINOLEX	PUNE / GOA
		M/S HFCL	GOA
7	INSTRUMENTATION CABLES	M/S DELTON	INDIA
		M/S KEI INDUSTRIES LTD.	
		M/S THERMO ELECTRA	BHIWANDI
		M/S LAPP CABLES	GERMANY
		M/S POLYCAB	DAMAN
		M/S KERPEN CABLES	GERMANY
		M/S HABIA CABLES	SWEEDEN
		M/S CORDS	BHIWANDI
		M/S NICCO	KOLKATA
		M/S PARAMOUNT CABLES	KHUSHERA
		M/S UNIVERSAL CABLES	FARIDABAD
		M/S TFWC	USA
8	MINI UPS	M/S EMERSON (TATA LIBERT)	MUMBAI
		M/S APLAB	INDIA
		M/S DELTA	RUDRAPUR
		M/S APC	BANGALORE
		M/S HITACHI-HIREL	GANDHINAGA
		M/S DB POWER	PUNE/SATAR
9	CONDUITS (FLEXIBLE)	M/S PLICA	GHAZIABAD

5.0 Quality Requirements (for VMS) :

5.1 Following minimum test requirements to be met :

- 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.**

5.2 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, in addition to the Routine Tests, the Burn-in and Elevated Temperature Test on the Electronic Equipment as a complete system with all devices connected for a minimum period of 168 Hours continuously under Energised condition as per following cycle:
- Elevated Temp Test: During this test which shall be of 48 Hours of the total 168 hours of testing ,the ambient temp shall be maintained at 50 Deg.C. During this the system shall be interconnected to perform all the services equivalent to actual service. During this the Cabinet doors shall be closed and the inside temp in the zone of the highest heat dissipation shall be monitored and shall not exceed 10 Deg.C above the ambient temp. at 50 Deg.C.
- Burn-in Test: Followed by the Elevated Temp Test, 120 Hours of Burn-in at the Ambient temp prevalent at that time with simulated I/O.
- Simulation test to include the Disturbance simulation, its identification and generation of suitable operator guidance message.
- The vendor shall give at least 30 days written advance notice to purchaser for witnessing the tests/inspection at various stages. The expenses for all such test/inspection shall be to Manufacturer's account except for the expenses of purchaser's representatives witnessing the test. The purchaser shall attend such test/inspection or advice that the manufacturer may proceed with the test, which shall be deemed to have in purchaser's presence and shall furnish relevant test result and test certificates to the purchaser for his review who will then issue Material Dispatch Clearance Certificate (MDCC) enabling supplier to dispatch the equipment.

5.3 Type Test:

The Vendor shall furnish the reports of type tests carried out within last five (5) years from the date of bid opening, for the Vibration Monitoring System and the test requirement shall cover CMRR, NMRR Verification. Submission of type test results and certificate shall be acceptable provided.

- 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**

5.4 Special Requirement for Solid State Equipments/ Systems

The minimum type test reports, which are to be submitted, shall be as indicated below:

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

All solid state systems/equipments 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/equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472.Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power

supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. 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 EN 61000-4-12 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.

6.0 Documents :

- All documentation shall be in English language.
- Following documents shall be supplied along with offer.
 - a) Mounting details of the sensors, mounting blocks/pads and local junction boxes.
 - b) Configuration diagram of the system offered.
 - c) Specification / data sheets of various devices offered.
 - d) General arrangement drawing of the cabinet showing mounting details and dimensions, maximum length between cabinets, cabinet to PC are to be indicated.
 - d) Reference list of users for fossil fired Plant auxiliaries set of similar rating.
- 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	}	6 copies, within 2 weeks of placements of P.O
f) Test certificate & test results g) Calibration results for sensors h) Test reports for Cables i) Type test results	}	2 copies After completion of tests
j) Operation & maintenance manual for the system including wiring diagram, circuit diagrams, Sensor details, Server / Printer / Panel display, Calibration equipment etc.	}	2 copies along with the equipment + 1 copy to BHEL



Purchase Specification for Vibration Monitoring System (VMS)

Ref.: CE/416/VMS/OT/PS
REV.NO.: 00
PAGE : 9 of 9

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.

7.0 Packaging:

Packaging shall be as per specification ref. no. CE/409-416/TSS-VMS/PKG enclosed. Only VMS portion of the specification will be applicable.

8.0 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.

9.0 Erection & Commissioning (E & C) for Vibration Monitoring System (VMS) :

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.

- Collection of material from stores
- Sensor calibration for healthiness check before mounting.
- Mounting of sensors with its mounting block on the machine bearing and terminate the sensor cable to Local Junction box supplied.
- Mounting of Phase marker sensor and its bracket shall be suitably installed by Vendor at site and terminate the sensor cable to Local Junction box supplied.
- Supervision of Erection of offered System
- Commissioning of offered System
- 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.**

Note: The total responsibility of above activities on 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.

10.0 Vendor to note that any Item / services required to complete the Equipment to meet the Specification requirement shall be taken care without any Cost implication to BHEL.



A4-10

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

REV. NO. : 00

PAGE : 01 OF 02

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

REVISION : 00

APPROVED


3/6/14
(R. PAADHAN)
(S. M. PATEL)

PREPARED

ISSUED

DATE


D. Ghosh
Sr Engr - BPE
(MADHU CHANDRA)

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
REV. NO.: 00
PAGE: 2 of 2

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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Page 1 of 26

ISSUED: DATE:
STDS GROUP 30/03/13

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 2 of 26
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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 with stand the stress caused by cyclic changes in weather conditions. It shall be durable and resistant to heat, sun and moisture. The sheets such 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 shook's , and also at top portion of both corner shook'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 shook'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]

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 3 of 26
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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.

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 4 of 26
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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.

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 5 of 26
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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

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 6 of 26
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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.

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 7 of 26
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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).

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 8 of 26
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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 / thermocol 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.

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 9 of 26
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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

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 10 of 26
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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.

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 11 of 26
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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)

	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 12 of 26
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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.



A4 - 14

PLANT STANDARD

ED 049 00 92

REV NO 05

Page 13 of 26

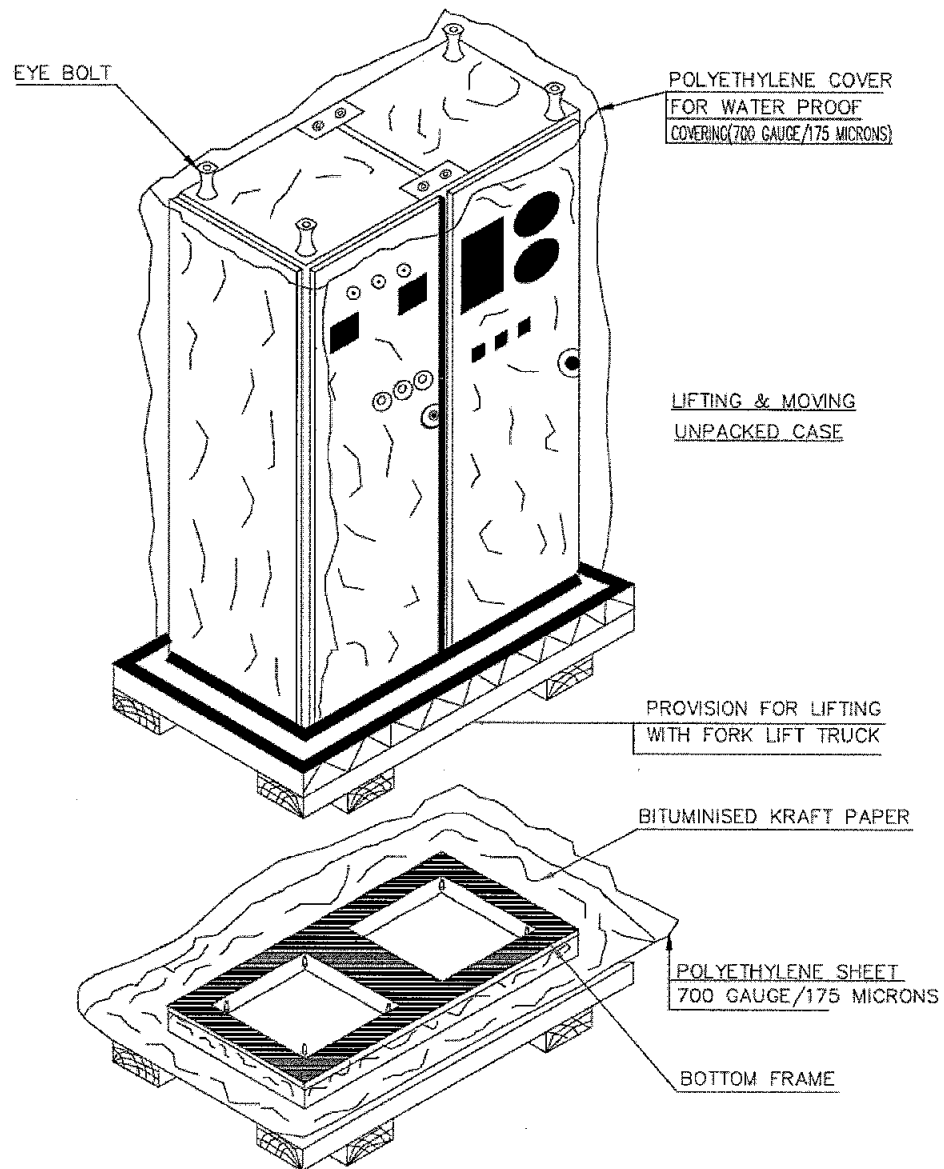


FIGURE-1



A4 - 14

PLANT STANDARD

ED 049 00 92

REV NO 05

Page 14 of 26

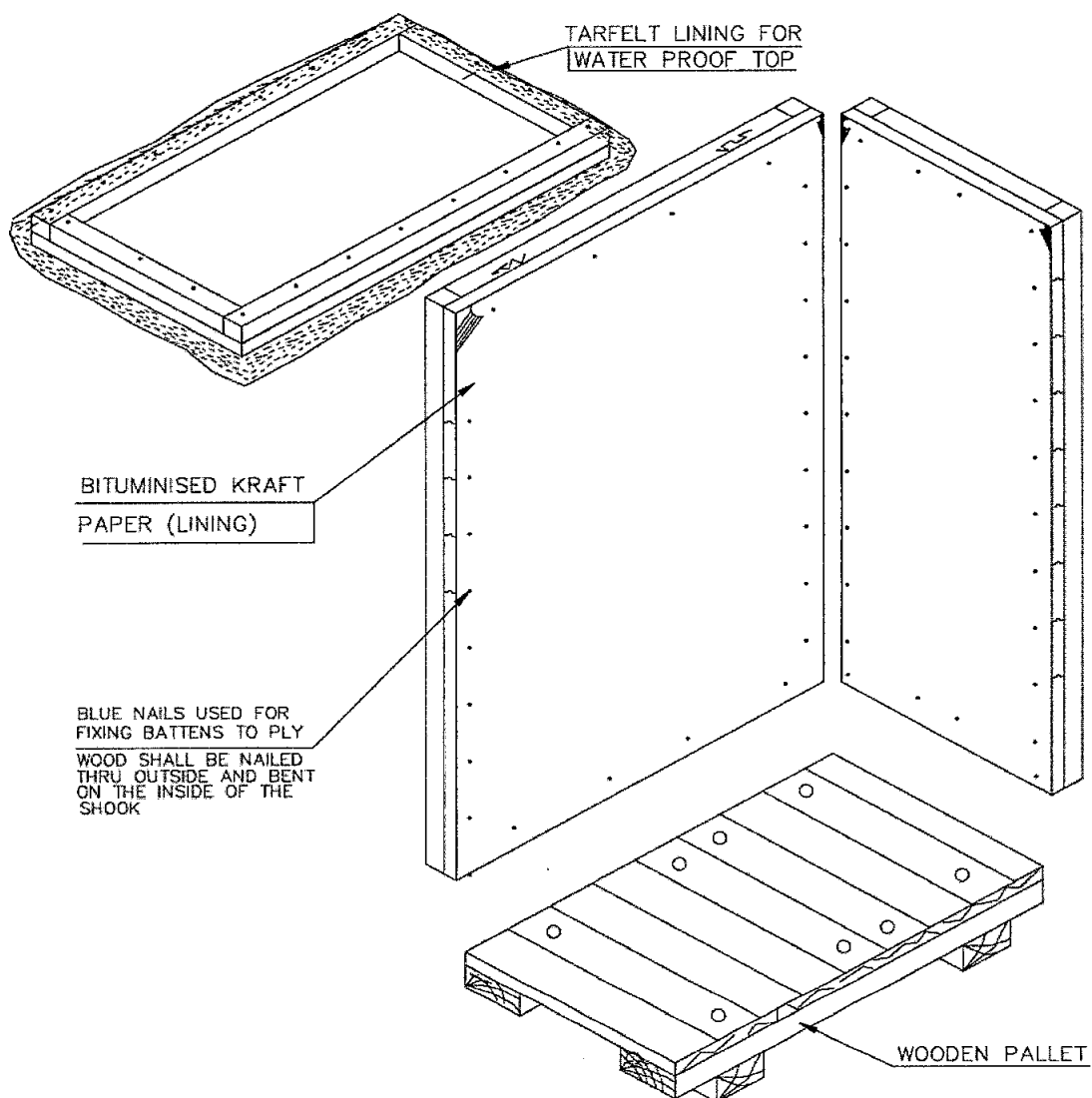


FIGURE-2



A4 - 14

PLANT STANDARD

ED 049 00 92

REV NO 05

Page 15 of 26

		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



A4 - 14

PLANT STANDARD

ED 049 00 92

REV NO 05

Page 16 of 26

PLYWOOD SHOOKS BOLT TYPE WITH SILVER OAK BATTONS

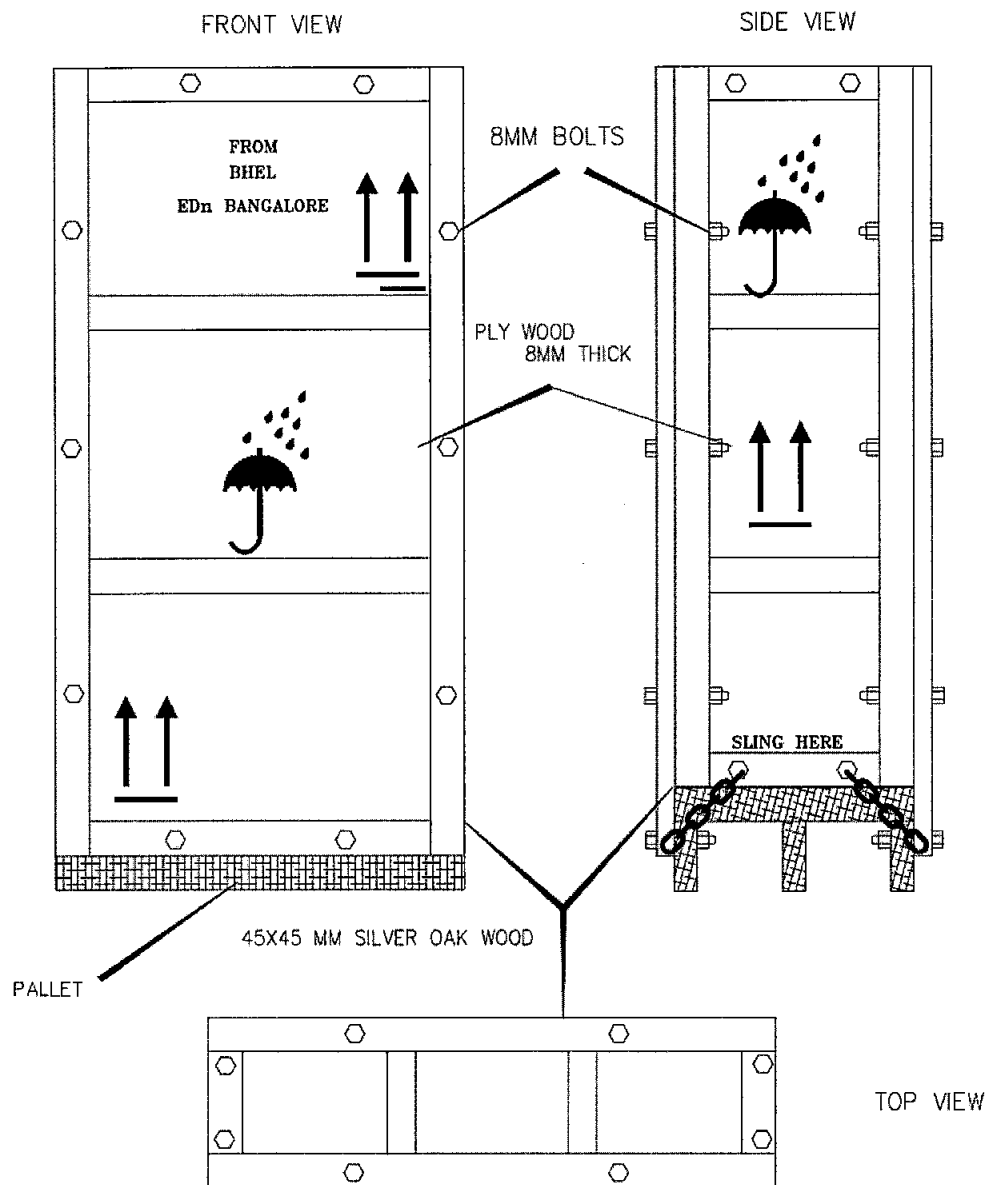


FIG-4



A4 - 14

PLANT STANDARD

ED 049 00 92

REV NO 05

Page 17 of 26

LAP JOINTS

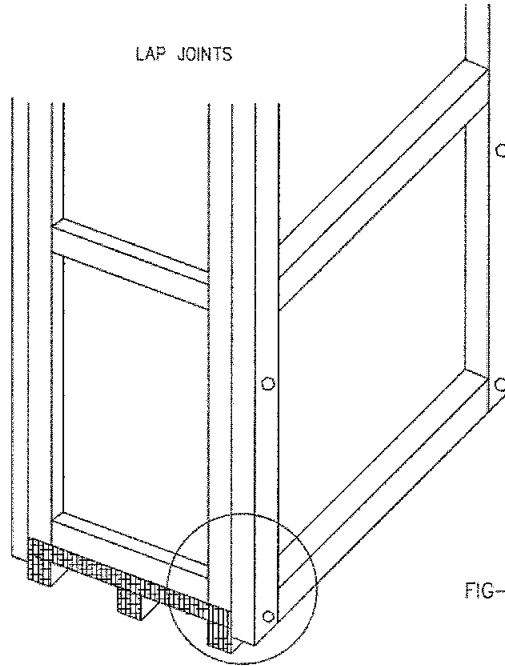
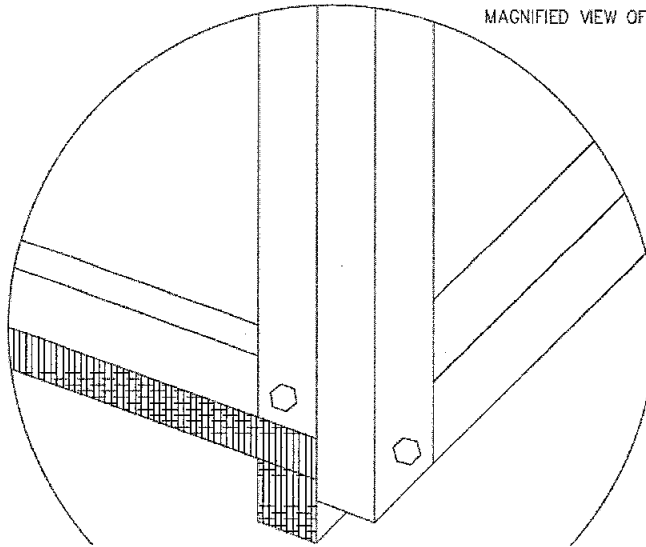


FIG-5

MAGNIFIED VIEW OF THE LAP JOINT





A4 - 14

PLANT STANDARD

ED 049 00 92

REV NO 05

Page 18 of 26

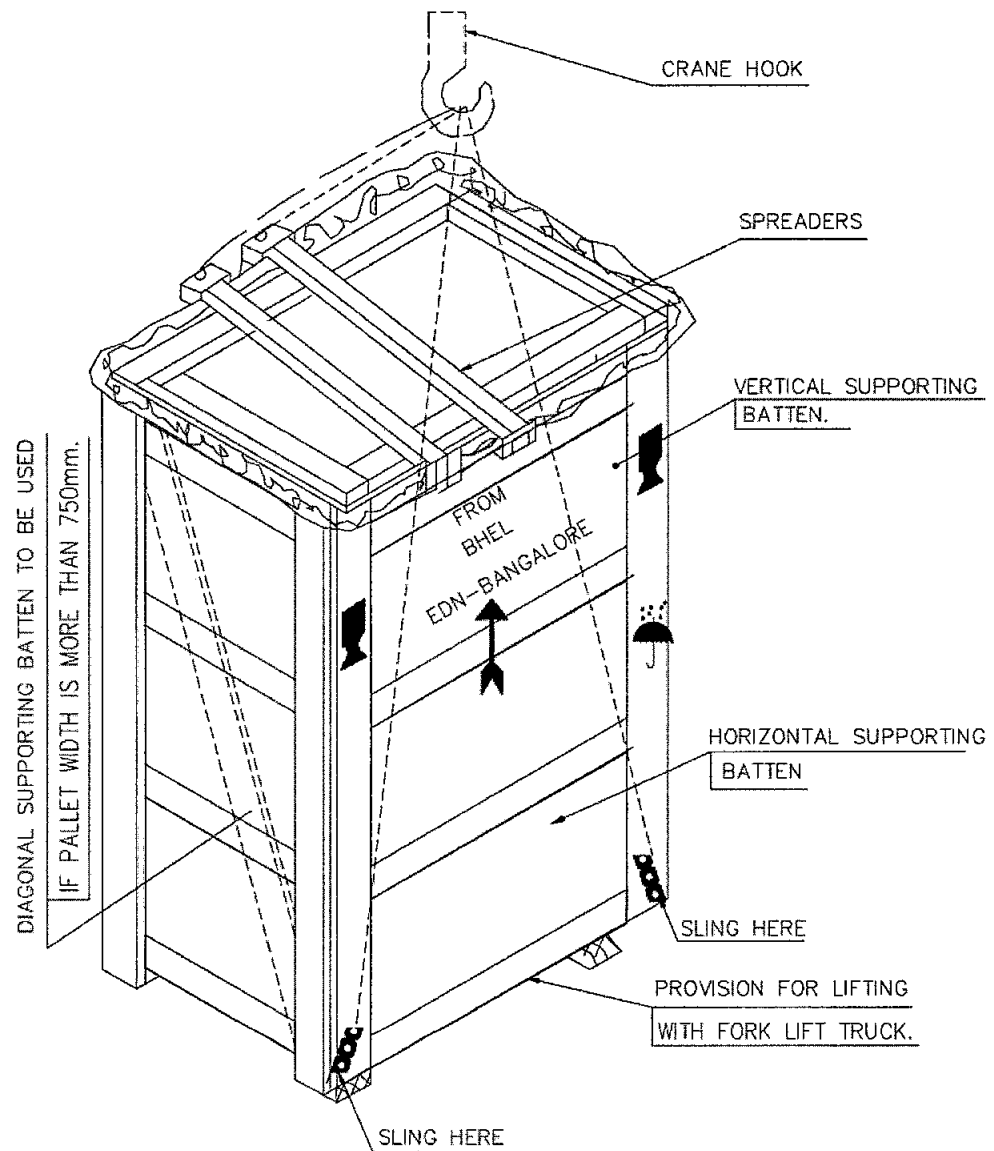


FIG-6 : LIFTING OF PACKED CASE



A4 - 14

PLANT STANDARD

ED 049 00 92

REV NO 05

Page 20 of 26

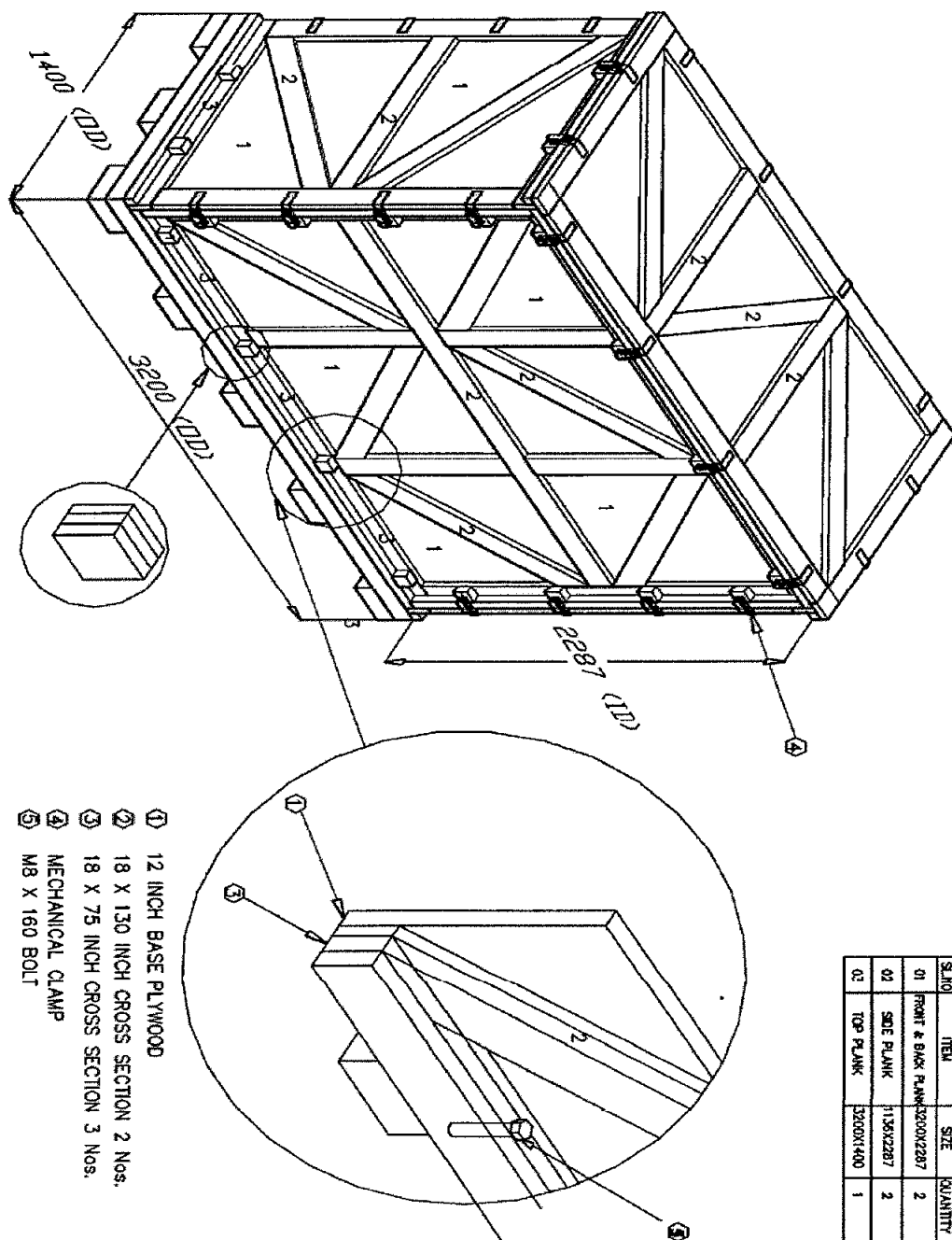


Fig - 8 : CLW Railway Panel Packing with Plywood & Plywood Support Battens



A4 - 14

PLANT STANDARD

ED 049 00 92

REV NO 05

Page 21 of 26

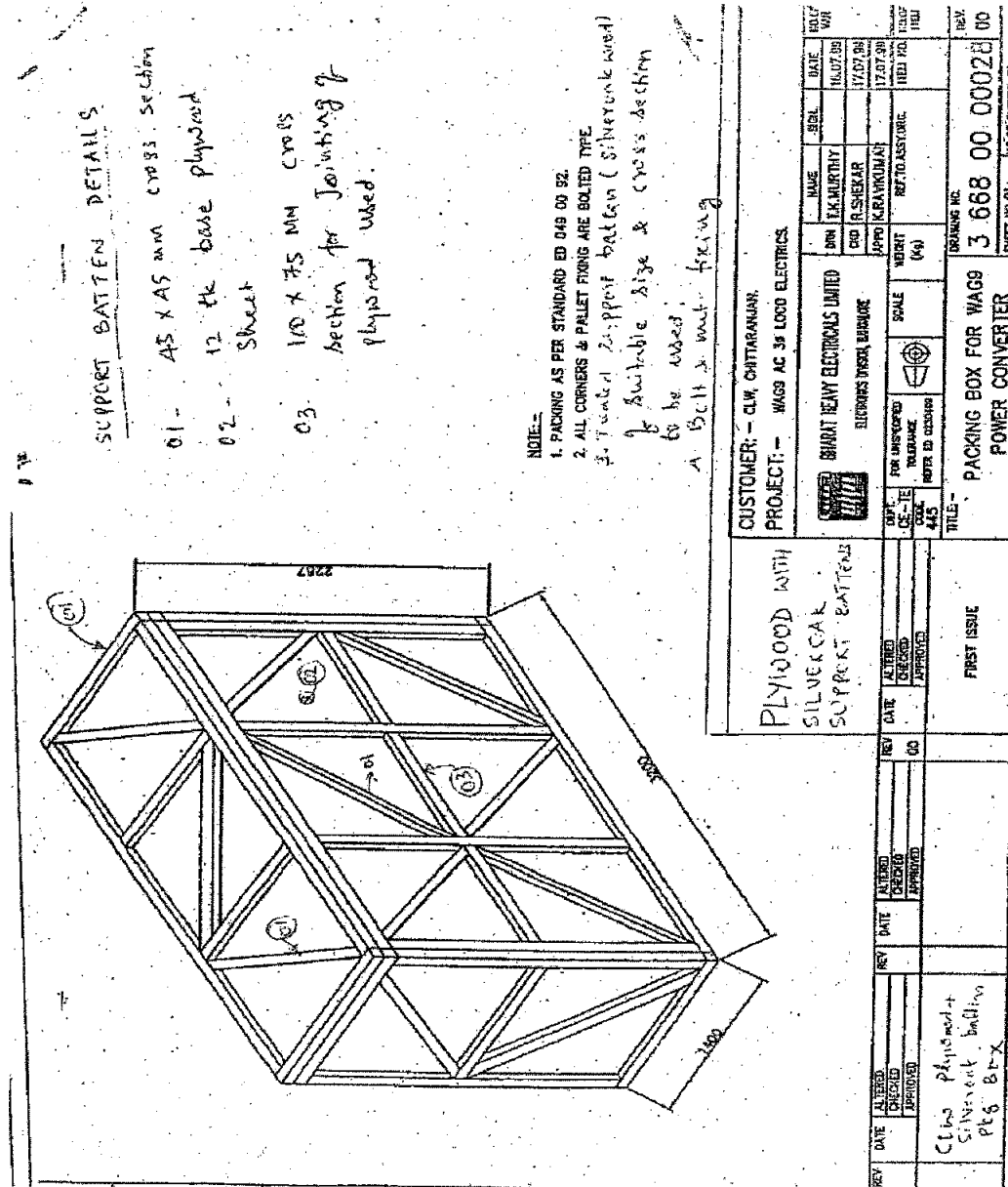


Fig - 9 : CLW Railways Panel Packing with Plywood & Silver Oak Battens



A4 - 14

PLANT STANDARD

ED 049 00 92

REV NO 05

Page 22 of 26

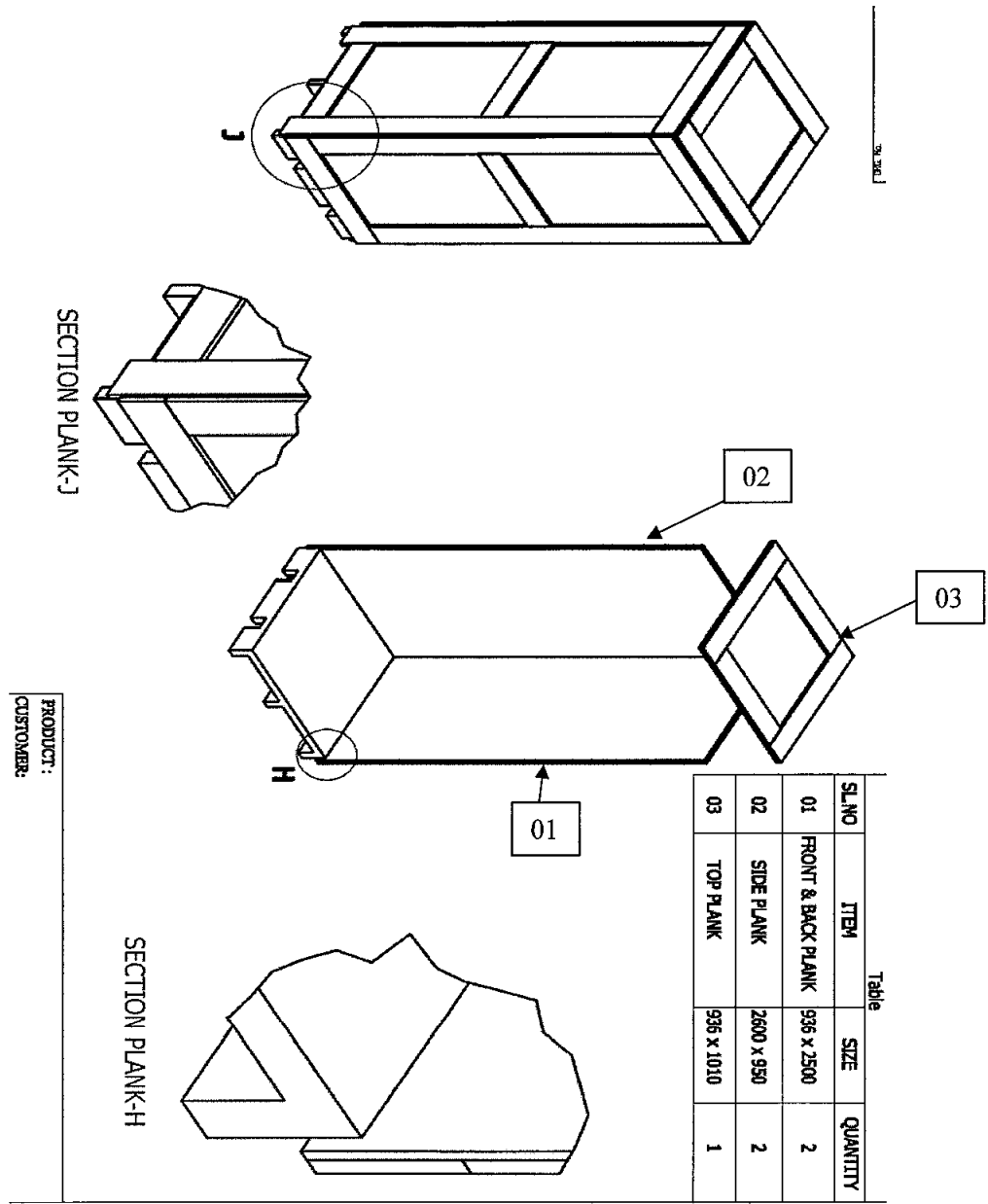


Fig-10 : Plywood Packing for Single Suit Panel.



A4 - 14

PLANT STANDARD

ED 049 00 92

REV NO 05

Page 23 of 26

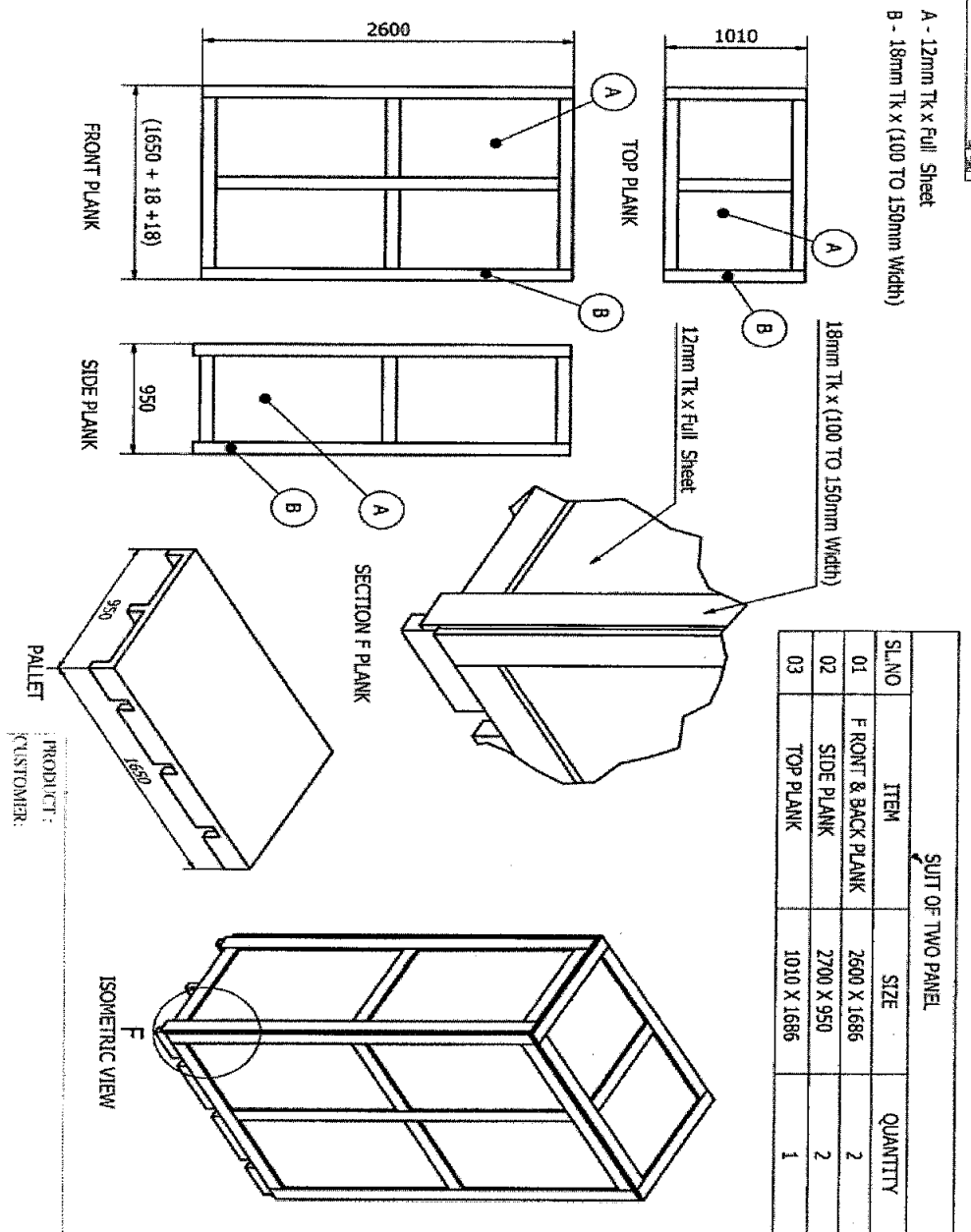


Fig - 11 : Plywood Packing for 2suit panel.

 A4 - 14	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 25 of 26
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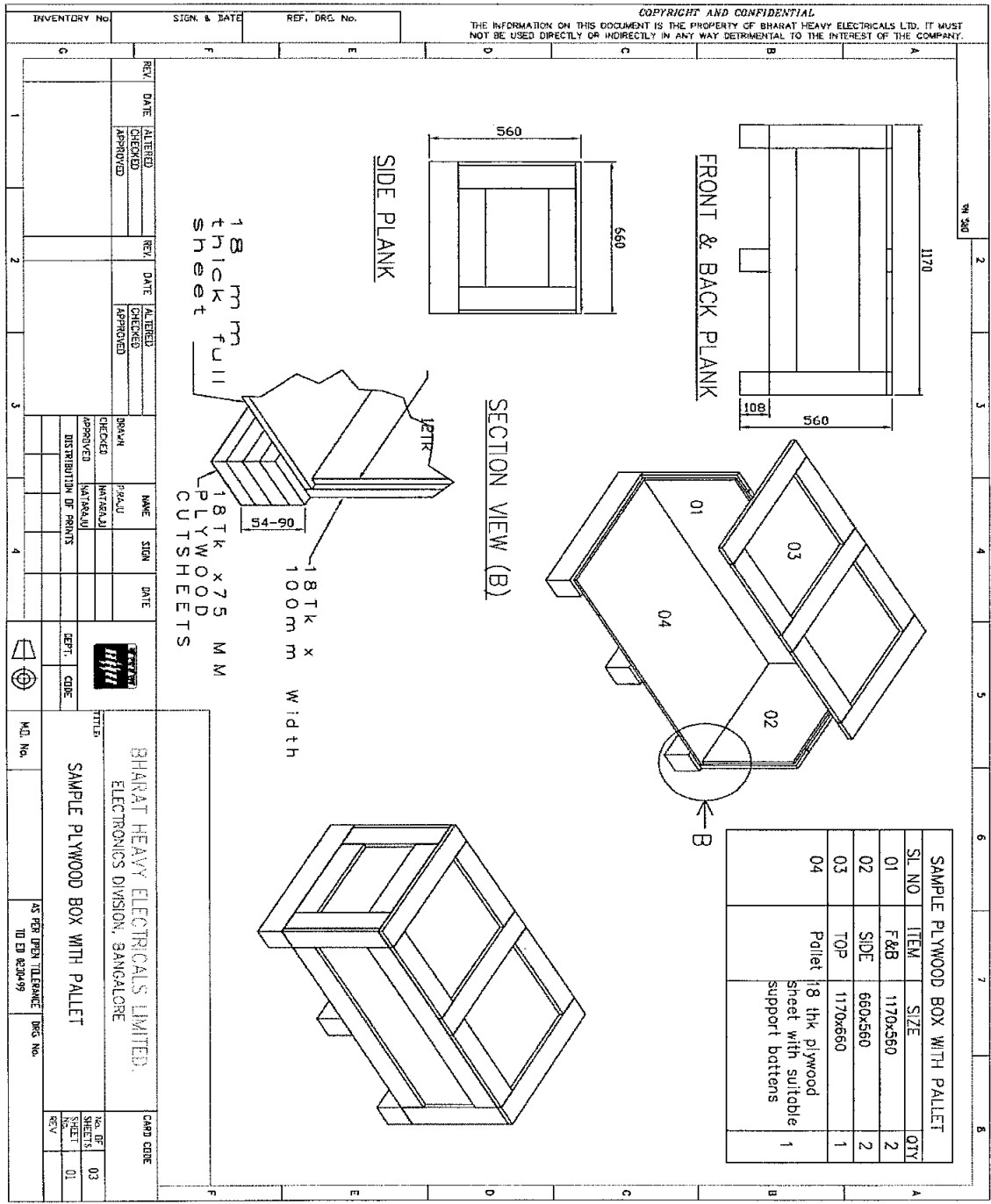


Fig – 13 : Plywood small case with Pallet

	PLANT STANDARD	ED 049 00 92 REV NO 05 Page 26 of 26
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Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

Fig: 14

