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		PROJECT		DESIGN, DEVELOPMENT, MANUFACTURE, SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF 25kV IGBT BASED THREE PHASE ELECTRICS (ON BOARD MOUNTED) FOR AC MEMU													
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	DOC. No. : TBSG/ICF/ACMEMU/02/ DRIVER DESK REV No. 01	PI No.

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SECTION – 1

SCOPE AND QUANTITIES

1.1 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Pre-Wired Driver's Desk and other accessories.

The equipment is required for the following project

Name of the customer : BHEL/INDIAN RAILWAYS

Name of the Project : DESIGN, DEVELOPMENT, MANUFACTURE, SUPPLY,
INSTALLATION, TESTING & COMMISSIONING OF 25kV
IGBT BASED THREE PHASE ELECTRICS (ON BOARD
MOUNTED) FOR AC MEMU.

The scope shall also include the followings:

- The supply of complete documentation for approval of design, relevant drawings and calculations to the satisfaction of purchaser and RDSO/ICF and support documentation associated with the operation and maintenance of the equipment supplied.
- The supplier shall submit list of equipment and facilities required for maintenance and overhaul of equipment offered.
- The design has to be approved by RDSO/ICF/IR.

1.2 BILL OF MATERIAL:

Sl. No.	Description	Qty. per Set (4 Coaches)	Remarks
1.	DRIVERS DESK & ACCESSORIES (Pre-wired & with Prefabricated FRP Panel/Console)	1 Set	Quantity for each set as mentioned in 1.A below.

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1.A) EACH DRIVERS DESK SET CONSISTING OF FOLLOWING QUANTITY:

Sl.no.	Item description	Qty. per set	Remarks
A. DRIVER DESK:			
1)	DRIVERS DESK (Pre-wired & with Prefabricated FRP Panel/Console)	1 No.	
2)	Control switches, indicators, buzzers	As per Clause 2.1.2.3	Item no. 2 to 8 to be supplied fitted on driver desk
3)	Terminal Boards & Diode TB	As per Clause 2.1.2.4	
4)	Connectors	As per Clause 2.1.2.5	
5)	Pressure Gauges	4 Nos.	
6)	Time Table clip	2 Nos.	
7)	Relay for failure indication of Headlight	As per Clause 2.1.2.6	
8)	Reading Light	2Nos.	
B. ACCESSORIES:			
9)	Horn - Pneumatic horn with controls - Electric hooter switch with magnet valve	2 Nos. 1 No.	Item no. 8 to 19 to be supplied in loose separately packed.
10)	Electric wiper blade assembly with wiper motor (Each set consists of a wiper blade with motor)	2 Set	
11)	Driver's Seat	1 No.	
12)	Guard Seat	1 No.	
13)	Sun visors	2 Sets	
14)	Cab Emergency light (LED based Cluster light)	1Nos.	
15)	Twin beam LED headlight	1 Set	
16)	LED based Marker cum tail Light	2 Sets	
17)	LED Flasher light with control unit	1No.	
18)	Step light	2Nos.	
19)	Signal bell	1 Nos.	
20)	Alarm bell	1 Nos.	
21)	Guard side Box	1 no.	Guard side Box
22)	Wash tank	1 Nos.	
Other Accessories Required For Mounting and Electrical Connections		As required	Bottom anchoring bracket to be welded to coach

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Note:

1. For more details of each item mentioned above, please refer detailed description in Section 2 of this specification.
2. Prototype driver desk shall be supplied fitted with components mentioned in this specification and finalized layout with ICF/Railways in pre-wired condition.
3. Suitable mounting and wiring correction as required in prototype at ICF shall be in scope of supplier/vendor. Based on the further feedback of prototype driver desk from ICF/User Railway, further supply of desks incorporating the feedbacks for series supply shall be made by supplier.

1.3 ELIGIBILITY CRITERIA

The Bidder should be a regular supplier to Indian Railway Projects and should have supplied the offered equipment for Indian Railways projects of 3 phase IGBT Based AC EMU/MEMU or 3 Phase IGBT based Locomotives or Metros operating in India.

1.4 CLAUSE BY CLUASE COMPLIANCE

Vendor to submit clause by clause compliance to complete technical specification along with the technical bid.

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SECTION – 2

STANDARD TECHNICAL SPECIFICATION

2.1 TECHNICAL SPECIFICATION OF DRIVER'S DESK AND ACCESSORIES

2.1.1 Introduction:

1. Bidder shall design the complete pre-fabricated driver's desk in line with the UIC 651 to the extent possible. The layout of the crew area and control system shall be ergonomically designed to allow crew to efficiently operate all controls for safe train operation either sitting or standing.
2. Cab shall include all the cab equipments e.g. instrument panel with back-lit instruments, gauges for pneumatic indications, control panels, driver's diagnostic display unit & driver's "log in" device, driver and guard seat etc., ergonomically designed driver' desk/console, pre-wired and terminated on a terminal board and multi-pin plugs/sockets for inter-equipment connections. Cab shall also include pneumatic horns, electric motor driven wind screen wipers (wiper should have wind screen washer & control as well) with redundancy & emergency manual control, sun-screens, marker with tail light, safety related equipments like bell code system and flasher light etc. This shall also include suitable 'bell code exchange' system between the cabs of the MEMU train.
3. All crew workstation/driving desk and cab area controls must be robust, of industrial quality and resist physical abuse and vandalism. Moulded FRP or better material suitable for such application must be used. Color scheme given in attached drawings is tentative. The color scheme of interior shall be frozen at the time of design approval.
4. The top of the driver's control workstation must accommodate documents such as timetable or similar books without interfering with the operation of the controls.
5. The positioning of crew interface controls must be such that they are within the range of vision, touch and audibility requirements whilst the crew is in his/her normal operating positions under all operation conditions.
6. Equipment such as air pipes, conduits, ducts, cabling, terminals and connectors shall be hidden from the view and shall not interfere with the crew operations. The doors of such enclosures shall preferably be sliding with proper locking arrangements with ease of handling.
7. Each functional position and/or range must be clearly marked by raised or engraved letters or an agreed alternative. The labeling used must be by agreement.
8. A circuit breaker listing shall be included on the inside of any door or hatch that covers circuit breakers. The circuit breaker listing shall relate the circuit breaker labeling to its function, and the equipment which it isolates.
9. Ergonomically designed driver's desk: Ergonomically designed driver's desk/console taking into account necessary traction controls, safety controls and passenger

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amenities items etc. shall be a part of the complete driver's and shunting cab. The design of the console shall also take into account the positioning of various pneumatic gauges, brake controller, AWS equipments and any other equipment installed in the cab. The complete console shall be supplied pre-wired and terminated on the terminal board and multi-pin plugs/sockets for inter equipment connections. The cables under supplier's scope shall be Electron Beam Cross linked cables and shall conform to latest RDSO specification. These cables shall be procured from RDSO approved sources. The Cables shall be suitably marked using Cable Markers for easy identification. Cables for terminal connections will have only crimped joints.

All the equipment viz. indication and instruments, panels, switches, ventilation control system, lighting, driver and guard seat, sunscreens and gauges etc. required to be installed in the cab, shall be supplied by the supplier except for AWS equipments which shall be supplied by Indian Railways. As such the supplier shall have the complete responsibility of ergonomic design of driver's cab and supply, commissioning and interfacing of the complete cab equipment.

10. The layout of the equipment on driver's desk shall be finalized during design approval stage to maintain uniformity with cab arrangement of a similar project of IR so that the cab layout remains same from driver's perspective to the extent possible. **Based on the approved layout, mockup of the complete driver's cab shall be made at ICF/User Railway to finalize the finer details and freeze the design.**
11. The driver's desk shall include cut out for all the cab equipments e.g. combined master-cum-brake controller, instrument panel with back-lit instruments, gauges for pneumatic indications, control panels, driver's diagnostic display unit & driver's "log in" device, driver and guard seat, driver's desk display etc. Driver's desk and shunting desk will also have provision for mounting of Ethernet switch.
12. Design of driver desk, other accessories and their arrangement and Make of all equipments has to be finalized in consultation with RDSO/ICF/IR. Any changes required to be done shall be carried out by supplier without any price repercussion on BHEL.
13. Part numbers of Control switches as per Annexure -1 of Driver desk and Shunting desk shall be approved by BHEL.
14. Legend of Driver's Desk and Shunting Desk described in Drawing and Annexure 1 shall be finalized before manufacturing.

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2.1.2 Driver's Desk:

1. The tentative layout of driver desk has been attached at Annexure-2. In case if RDSO/ICF/IR recommends some changes, the same has to be incorporated.
2. Driving desk should have anchoring and earthing location at appropriate position. All Electronics under the driver's desk shall be mounted in a mild steel structural frame with IP54 protection.
3. The driver desk switches and other components wiring to be carried out by the desk supplier with 1 sq. mm E-beam cable (except few cables of 2.5 sq.mm.) from any of the RDSO approved cable suppliers, as per wiring list provided by BHEL.
4. The items mentioned for driver desk in section 1.2 of BOM are under supplier's scope of supply and any miscellaneous hardware and electrical accessories items which are not covered in this specification, but are required for completion of work, also to be supplied by supplier without any financial application.
5. These equipment should be suitable for AC MEMU applications and shall be mounted in driver's cab for which bidder shall submit detailed datasheets, drawings, test reports etc. and other relevant design documents. Mounting shall be finalized after discussion with RDSO/ICF/IR. Name plates for all items mounted on driver desk shall be provided by the supplier on the desk itself.
6. Detailed type/routine test protocol of items must be submitted for approval of RDSO. If type test has already been done, then type test reports shall also be submitted. All drawings shall be required in Auto-CAD and 3D drawings format. Project specific Operating/ Maintenance manual needs to be submitted.
7. Brake Controller mounting should be such that, there should be a minimum gap of 70mm between Brake Controller Driver's handle and top of desk surface.
8. There should be sufficient gap between ICS key on RHS of Brake controller (inside Desk) and vertical member of desk frame to operate ICS handle without any difficulty.
9. In each driver desk, following items shall be mounted by supplier at ICF. These items are to be indicated in the drawings submitted by desk supplier. Drawings /dimension details of these items shall be furnished by BHEL.

Fixing of these items and arranging of suitable hardware for fixing in driver desk shall be in scope of supplier. These items shall be supplied by BHEL at ICF. The mounting arrangement for these items shall be provided in the driver desk by the supplier.

- a) Driver display unit (DDU)
- b) DDU Cooling fan
- c) Master controller
- d) PAPIS MMI PANEL
- e) PAPIS Manual Mode Operation unit for Head Code Indication
- f) PAPIS Main Controller Unit
- g) PAPIS GPS Antenna
- h) PAPIS Microphone
- i) Display unit for CCTV Indication

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- j) Speed recorder cum Indicator
- k) Master controller connector
- l) MR & BP Pressure sensor

2.1.2.1 Pneumatic horn

Two Pneumatic Horns shall be mounted outside each Driver's cab with 2 levers mounted in Driver's desk- one foot operated lever under the driver's desk and one hand operated lever on the right hand side of the driver's desk (Guard box). There shall be 2 driver's cab in a 08 coach train.

Pneumatic horns of M/s ELGI make High Tone Type S07027 or M/S.ESCORTS DRG NO. KB-199 or equivalent RDSO/ICF/IR approved make (proven for traction application) shall be supplied. The required levers and controls for actuation of horn shall be in scope of supplier.

Electric Hooter switch suitable for AC MEMU application shall be provided on Desk as mentioned in Driver desk drawing of EAO or equivalent RDSO/ICF/IR approved make (proven design for traction application). The suitable Magnet valve required for actuation of pneumatic horn shall also be in scope of supplier procured from RDSO/ICF/IR approved supplier of proven performance. Details shall be finalized during detail design stage.

2.1.2.2 Pressure Gauges

Following pressure gauges to be supplied by supplier for each driver cab. There will be two driver's cab in a 08 coach train.

- a) 4"Single Pressure Gauge (Self illuminated with LED, 110 V DC, Flush mounted) for Parking brake of M/s. Midland type MC/PG/EMU/18, M/s Escorts type 3KB 6301 or of M/s WSF type IB-6527/9 or equivalent RDSO/ICF/IR approved make (proven for traction application).
- b) 6"Single Pressure Gauge (Self illuminated with LED, 110 V DC, Flush mounted) for Brake Cylinder of M/s. Midland type MC/PG/EMU/16, M/s Escorts type 3EB 6300 or of M/s WSF type IB-6537/7 or equivalent RDSO/ICF/IR approved make (proven for traction application).
- c) 6"Duplex Pressure Gauge (Self illuminated with LED, 110 V DC, Flush mounted) for Main reservoir & Brake pipe reservoir of M/s. Midland type MC/PG/EMU/14, M/s Escorts type 3EB 6299 or of M/s WSF type B-78773/11 or equivalent RDSO/ICF/IR approved make (proven for traction application).
- d) 6"Single Pressure Gauge (Self illuminated with LED, 110 V DC, Flush mounted) for Brake Pipe of M/s. Midland type MC/PG/EMU/17, M/s Escorts type 3EB 6300 or of M/s WSF type IB-70754 or equivalent RDSO/ICF/IR approved make (proven for traction application).

2.1.2.3 Control switches and indicators

The control switches of M/s EAO make or equivalent RDSO/ICF/IR approved make (proven for traction application) shall be supplied. The quantity that has been given below is applicable for one driver desk.

The Switches and Indicators shall have the following features: -

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- a) The working voltage level of Switches shall be 110V DC, 110V AC or 24 V DC depending upon the application for which the switch is used. Exact voltage working level shall be decided with supplier during detailed design stage.
- b) The Switches shall be provided with Screw terminal.
- c) Terminal Cover shall be provided for covering of screw terminal.
- d) All switch elements shall be with snap-action with Hard-Silver contacts except Emergency Stop switches, which for safety reasons shall be with slow-make contacts.
- e) The Tentative Type Nos. of EAO make switches have been mentioned. Exact type number and other details shall be finalized in consultation with RDSO/ICF.
- f) All the switches shall be properly Marked (i.e. legend and name) which shall be similar to Driver Desk of existing MEMU. Exact details shall be finalized in consultation with RDSO/ICF.
- g) Selector Switches shall be with Anti Twisting Ring.
- h) Numbering scheme of auxiliary contacts should not vary between different sets of supplies. As such, only one make of items should be supplied throughout entire order quantity.
- i) List of Switches/indicators/push buttons/auxiliary contacts/etc. that are required on each Driver Desk is mentioned at Annexure-1.
- j) List of spare items that are to be supplied is provided at annexure-3. These are to be supplied as a set only one time along with first set of supply and delivery location of same shall be informed at later stage.

2.1.2.4 Terminal Boards Assembly:

Terminal Boards Assembly of M/s.Wago Make or equivalent RDSO/ICF/RCF/IR approved make shall be required. The Terminal Boards should be properly marked.

The Following Three Types of TB Assembly shall be required: -

i) Type A— 1 Set of 'Type A' TB Assembly shall consist of:

- a) 4 Conductor Through Terminal Blocks with Front Entry, 2.5 Sq mm (Grey Colour) – 200 Nos.
- b) End Plate – 10 Nos.
- c) Screwless End Stop – 20 Nos.
- d) Adjacent Jumper – 10 Nos.
- e) Suitable Din Rail – 2 No.

ii) Type B —1 Set of 'Type B' TB Assembly shall consist of:

- a) 4 Conductor Through Terminal Blocks with Front Entry, 2.5 Sq. mm (Grey Colour) – 150 Nos.
- b) End Plate – 6 Nos.
- c) Screwless End Stop – 12 Nos.
- d) Adjacent Jumper – 10 Nos.
- e) Suitable Din Rail – 2 No.

iii) Type C — 1 Set of 'Type C' TB Assembly shall consist of:

- a) 4 Conductor Through Terminal Blocks with Front Entry, 2.5 Sq.mm (Grey Colour) – 10 Nos.
- b) End Plate – 2 Nos.
- c) Screwless End Stop – 4 Nos.
- d) Suitable Din Rail – 1 No.

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iv) **Type D — 1 Set of 'Type D' Diode TB Assembly shall consist of:**

- a) 4 Conductor Through Terminal Blocks with Front Entry, 2.5 Sq mm (Grey Color) – 06 Nos
- b) End Plate – 2 Nos

v) **Type E – 1 Set of 'Type E' TB Assembly shall consist of:**

- a) Terminal Blocks with cover type Weidmueller WFF 35/AH or similar suitable for 35 Sq mm (110V DC) – 06 Nos
- b) Suitable Din Rail – 1 No.

2.1.2.5 Connectors

The supplier shall also supply **7 Nos of 46- pin Connectors** of Harting make or equivalent (proven for traction application) for each Driving Desk. Both male and female Connectors shall be in scope of supply of vendor. Part no. of has to be approved by BHEL before supply. BOM for Each 46 pin Harting connector set is as following.

Sl.No.	Part No.	Description of the item	Quantity
1.	09320463001	Male Insert - 46 Male Insert /16A/500V/6Kv/3	1 No
2.	09320463101	Female Insert - 46 Female Insert /16A/500V/6Kv/3	1 No
3.	19400240414	Hood - 24B HPR hood Top Entry M50	1 No
4.	09400240311	Basepanel - 24B HPR Basepanel	1 No
5.	09140009908	Guide Pin - Coding	2 Nos
6.	09140009909	Guide Bush - Coding	2 Nos
7.	19000005086	Cable Gland - Cable Clamp range between 32-38mm	1 No

The supplier shall also supply **1 no. of MR/BP connectors** of Harting make or equivalent (proven for traction application) **for each Driving Desk**. Both male and female Connectors shall be in scope of supply of vendor. Part no. of has to be approved by BHEL before supply. BOM for Each **MR/BP connector** is as following.

Sl.no.	Harting part no.	Description of the item	Qty.
1.	09 20 003 0301	HOUSING BULKHEAD MOUNTING	2
2.	09 12 012 3004	Insert Han 12/0 Male 1,5mm ²	2
3.	09 15 000 6123	Han D M Crimp Contact Au AWG 20	20
4.	09 15 000 6121	Han D M Crimp Contact Au AWG 20	4
5.	09 12 012 3104	Insert Han Q 12/0 Female 1,5mm ²	2
6.	09 15 000 6223	Han D F Crimp Contact Au AWG 20	20
7.	19 00 000 5084	CABLE CLAMP M20, 10-14mm, BRASS, IP 68	2
8.	09 20 000 9918	Screw M3x6 with Nylite f. Han 3A housinG	2
9.	19 20 003 1443	Han 3A grey metal hood	2

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2.1.2.6 Current Monitoring Relay for Headlight

According to the current drawn by the main headlight, the suitable current relay to be supplied, mounted and wired by the driver desk supplier. 1 number of current relay for main headlight is required to be supplied with each driver desk. **Driver desk supplier needs to supply 01 no. of CM-SRS.12S or equivalent (proven for traction application) with each driver desk.** These relays should be DIN rail mounted in driver desk.

2.1.2.7 Diagram, Book holder, Time table holder & Bottle holder

Suitable provision to keep time table, diagram, logbook & bottle shall be provided in driver desk and details shall be finalized with ICF/RDSO/Railway.

2.1.2.8 Battery Voltmeter

Battery Voltmeter of range 0-150V DC of analog type (Self illuminated with LED) suitable for AC MEMU application (proven for traction application) shall be procure from RDSO/ICF/IR approved supplier of proven performance.

2.1.2.9 Reading light with switch

Supplier have to provide Reading light with switch on the driver desk. The tentative location of reading light is shown in the drawing. Reading light shall be procured from approved RDSO/ICF/CLW/IR sources.

2.1.3 Accessories

2.1.3.1 Electric wiper with motor

Electric motor driven wind screen wipers (wiper should have wind screen washer & control as well) with redundancy & emergency manual control suitable to operate with **110V DC of M/s Lucas TVS make (type ECM66) or equivalent RDSO/ICF/IR approved make** (proven for traction application). Wiper arm and blade assembly shall be as per RDSO spec no. C-K306 (latest rev.) and electrically operated wind screen wiper system shall be as per ICF specification no. ICF/ELEC/122 (latest revision). The wiper should be already Type tested and type test report should be approved by RDSO. The 110V DC Electric wiper should have been installed and running satisfactorily in 3-phase ACEMU/MEMU/Loco etc.

- Following items of 110V DC Electric wiper should have been already type tested and RDSO approved as per standard below:
 - Wiper motor as per clause 4.2 (IS :7827) latest,
 - Arm & Blades as per Clause of RDSO C-K306 latest,
 - Washer Pump as per Clause of IS 14141:1994 latest.
- In addition, these sub-equipment of wiper will be routine tested as per above standards during routine testing inspection for each supplies.
- The wash tank should be made of fire retardant material and should be in MS/SS cage.
- Other components of wiper should also be as far as possible made of fire retardant material as wiper is mounted in driver's cab.
- Terminal connector (male & female parts) to be supplied with wiper to make electrical connections.

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2.1.3.2 Signal bell and Alarm Bell

Signal bell and Alarm Bell for AC MEMU application (proven for traction application) shall be procure from RDSO/ICF/IR approved supplier of proven performance.

2.1.3.3 Driver's seat

The Driver's seat of M/s MSL make or equivalent RDSO/ICF/IR approved make (proven for traction application) shall be supplied, using Fire-retardant silicone foam conforming to RDSO specification no. RDSO/2013/CG-13.

2.1.3.4 Guard's seat

The Guard's seat of M/s MSL make or equivalent RDSO/ICF/IR approved make (proven for traction application) shall be supplied, using Fire-retardant silicone foam conforming to RDSO specification no. RDSO/2013/CG-13.

2.1.3.5 Sun visors/Sun screen

The sunscreen of M/s Aarem Enterprises or equivalent RDSO/ICF/IR approved make (proven for traction application) shall be supplied. 1 Set of Sunscreen for each driver desk should be suitable for 2 lookout glasses.

2.1.3.6 Lights:

2.1.3.6.1 Cab Emergency light (LED based cluster light)

Driver's cab emergency light working on 110V DC of RDSO/ICF/IR approved make (proven for traction application) shall be supplied.

2.1.3.6.2 LED based Twin beam LED headlight

LED based Twin Beam Headlight as per RDSO Specification No. RDSO/2017/EL/SPEC/0134 (Rev-1) or latest shall be procured from RDSO/ICF/CLW/IR supplier (proven for traction application).

2.1.3.6.3 LED based Marker cum tail light

LED based Marker cum tail light shall be of RDSO/IR/ICF/CLW approved make only (proven for traction application). Each set shall be comprising of 2 Nos. marker cum tail light, one Selector Module. Marker cum tail light shall conform to RDSO Specification No. ELRS/SPEC/PR/0022(Rev-1, Oct 2004) or latest. of RDSO/IR/ICF/CLW approved supplier

2.1.3.6.4 LED Flasher light:

LED Flasher Light along control unit as per RDSO Specification No. ELRS/SPEC/LFL/0017 (Rev-1, Sep 2004) or latest shall be supplied from M/s Altos/M/s Matsushi or equivalent RDSO/ICF/CLW/IR approved Supplier (proven for traction application).

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2.1.3.6.5 Step light

Step light shall be procured from approved RDSO/ICF/CLW/IR. Details shall be finalized after discussions with RDSO/ICF/IR (proven for traction application).

2.1.3.7 Guard side Box

Guard Side Box shall be as per drawing no MEMU_DMC_GuardBox Rev.00. Guard side box will have water tank for wiper and lever for Pneumatic Horn for Guard. Supplier has to supply a FRP cover to connect pneumatic connection and water pipes between driver desk and Guard Side Box as per drawing.

In addition to the above mentioned technical requirements, driver's desk and accessories and the entire wiring and bundling shall conform to relevant IECs/other applicable standards.

2.4 EQUIPMENT TESTING:

- 4) **Valid Type test report** is to be submitted for all the accessories/equipment along with the offer, if the equipment is already type tested. In case, ultimate customer insists to repeat the type tests of any particular accessory/equipment due to any reason, the type test shall be conducted again by the supplier, for which test procedure shall also be submitted by the respective supplier for approval before conducting the type test. In case ultimate customer desires to witness the type tests, the supplier shall have no objection. The supplier is required to quote for the type test charges if any, separately in commercial offer. These charges will be loaded in the equipment price at the time of final evaluation.
- 5) Supplier to submit Routine test certificates and inspection certificate of equipment as per QAP along with equipment.
- 6) Type and routine test will also confirm to clause 3.11 of section 3 of technical specification.

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2.2 DESIGN REQUIREMENTS TO BE PROVIDED BY SUPPLIER:

• Write-up/ description of each equipment	to be provided by supplier
• Circuit diagram/connection & wiring diagram/equipment drawing with mounting details/ center of Gravity details / other relevant drawings	to be provided by supplier
• Datasheets of the equipments	to be provided by supplier
• Type test protocol & procedure/ Type test reports	Supplier to submit the complete reports of type test already conducted on the proposed/offered equipment. In case type test is required to be done, supplier to submit the detailed test procedures for approval. Supplier to submit Routine test certificates and inspection certificate of equipment as per QAP along with equipment..
• Complete Bill of Material for proven design	to be provided by supplier
• Performance statement	to be provided by supplier in the attached format.
• Performance certificate	to be provided by supplier in the attached format
• Approval letter (conforming to the latest RDSO/CLW/ICF spec as applicable)	to be provided by supplier
• Project specific AUTO CAD drawing- 2D and 3D model	to be provided by supplier after order placement
• Project Specific Drawings in A3 size (hard copy)	To be provided by supplier
• Technical Manual	To be provided by supplier
• Installation, Operational and Maintenance Manual	To be provided by supplier

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SECTION-3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3 GENERAL

This section stipulates the General Technical Requirements under the contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections and are not exclusive.

However, in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 INSTRUCTION TO BIDDERS

The bidders shall submit the technical requirements, data and information as per the technical specification, provided in Section-2.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc. fully in conformity with the technical specification. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously.

3.2 GENERAL DESIGN REQUIREMENTS

- i) The traction equipment shall be suitable for operation with 25 KV AC, 50 Hz supplied by overhead contact wires. In case of MEMUs, the control equipment shall be suitable to permit multiple operation up to 24 coach formation of 04 basic units here each basic unit shall comprise of 01 (Driving Motor coach), 03 associated trailer coaches.
- ii) The equipment design shall incorporate all essential features necessary to yield high traffic use, low maintenance requirements, easy maintainability, high reliability in operation and high efficiency with low Specific Energy Consumption (SEC).
- iii) The stock fitted with the supplied equipment shall meet the operating/service conditions and performance requirements as specified in section 3.3 Ambient conditions/operating conditions of this specification respectively and shall be suitable for varying loading conditions.

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- iv) The entire equipment shall be designed to ensure satisfactory and safe operation under the running conditions specified in section 3.3 Ambient conditions/operating conditions and especially under sudden variations of load and electric pressure as may arise under working conditions due to faulty operation and short circuits. The design shall also facilitate erection, inspection, maintenance and replacement of the various units comprising the equipment.
- v) All working parts of the control and auxiliary circuit specifically electronics and PCBs, shall be suitably covered in cubicles with essential interlocks/keys to keep them free from moisture and dust. As a minimum, equipment shall be sealed to the standard below:
 - a. Under frame mounted equipment (except traction motor) IP65.
 - b. Equipments mounted inside the car body IP54.

The protection level (IP level) shall be furnished by the supplier during design approval.
- vi) All the electrical equipment's shall comply with the latest edition of IEC specifications unless otherwise specified. The temperature rise shall be measured according to the procedure stipulated by IEC and shall comply with the limits specified and the ambient conditions defined in this specification. Specified temperature rise of equipment shall be calculated after taking into account at least 25 % choking of air filters and radiator fins etc.
- vii) All equipment's shall be adequately earthed, insulated, screened or enclosed. They shall be provided with essential interlocks and keys as may be adequate to ensure the protection of the equipment and the safety of those concerned with its operation and maintenance.
- viii) If applicable, supplier shall study the currently available lubricants/cooling oils in India and employ these as far as possible. Full lubrication scheme and schedule for the equipment shall be submitted. Wherever the imported lubricants or cooling oil are used, Supplier shall study and furnish details of equivalent Indian lubricants/oil.
- ix) The equipment shall be designed keeping in view that the EMUs/MEMUs operates with doors and windows wide open.
- x) The design shall also facilitate easy erection by means of suitable tools & equipment, inspection, maintenance and replacement of the various units comprising the equipment.

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xi) Supplier shall submit 3D models of propulsion & other equipment, cooling system, driver desk, cab layout and roof/under frame/HT compartment layouts populated with equipment etc.

xii) The design of the equipment shall be based on sound, proven and reliable engineering practices. The equipment used in different sub systems shall be of proven technology and design. The supplier shall submit the supportive document for each of the assembly/sub-assembly for its proven performance under the environmental conditions prevalent in India.

xiii) The supplier shall design the mounting arrangements suitable for coaches to be manufactured by IR. The accessories for mounting the equipment shall be in the scope of supply. The hardware for mounting, safety links for underslung equipment, the termination hardware also will be in the scope of supply all equipment.

xiv) SOFTWARE (IF APPLICABLE)

- a. Software shall be written in a structured manner and fully documented during all stages of its design and development. This shall meet the requirements of EN 50126-2: Dependability for Guided Transport Systems - Part 2: Safety, EN 50128: Railway Applications: Software for Railway Control and Protection Systems, and EN 50129: Safety related Electronic Railway Control and Protection Systems. Any deviation from this requirement will need approval of RDSO in design stage.
- b. Logic of the Software of various sub-systems shall be approved by RDSO in consultation with user railways at the design approval stage. The supplier shall submit the values of parameters, list of fault messages, their environmental data sets, hierarchy of fault display, fault categorization, trouble shooting of each fault, etc. for approval of RDSO. Changes in parameters shall be demonstrated with their effect on results.
- c. The supplier shall submit software logic diagrams with detail explanation along with complete software packages to be loaded in train management system before the commissioning of the prototype rake. Parametric changes shall be possible in the software in order to meet future requirements, such as change in acceleration and deceleration, bogie and coach suspension, train configurations, OHE voltage and frequency, etc. While listing out the values of various parameters, the contractor must provide a range within which any change can be made without jeopardizing the functionality of the system.

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- d. Software shall be fine-tuned through simulations & real life working conditions based on the extensive trials, associating user railways before putting the rake into commercial services. As it requires, instrumentation and expertise of Software Design Professional, software expert (s) of supplier shall be based at the work place along with the commissioning engineers so that all the software related issues are resolved before putting the rake into commercial service.
 - e. Quality and efficacy of Trouble shooting manual, software tools and software documentation shall be validated during extensive field trials. Final version of these documents shall include the changes required based on the trials and experience of operating railways. This shall be approved by RDSO.
 - f. All the changes, thereafter, in software shall be approved by RDSO in consultation with user railways before actual implementation and the supplier must give software release which shall include brief description of the problem, logics, explanations, parametric changes etc. to the satisfaction of Railways.
 - g. Software documentation shall be provided to give the full understanding of the software function and operation. Documentation shall be complete, clear and concise, and include all modifications up to final acceptance. Documentation shall include software block diagram showing signal flow, logic, and hardware interfaces. A top level flow diagram and description of detailed operation shall be provided.
- xv) Notwithstanding the contents of this specification, the supplier shall ensure that the equipment supplied by them is complete in all respect so as to enable the desired operation of the MEMU fitted with their equipment.
- xvi) The specification has been prepared for the general guidance of the Supplier. Deviation from this specification may be proposed if it intends to improve the performance, utility and efficiency of the MEMU as a whole or part thereof. All such deviations shall be accompanied with complete technical details and justification for the proposed deviation.

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3.3 AMBIENT CONDITIONS / OPERATING CONDITIONS

MEMUs are currently running in NR, NER, ER, ECR, SECR, SCR, SWR, SR and NCR etc. These EMUs/MEMUs are operating at 25 kV AC OHE voltage fed through pantograph and vacuum circuit breaker mounted on the roof of the motor coach. The incoming power supply is fed to the primary of the main transformer and stepped down to a lower voltage, converted into AC voltage through IGBT based Converter and inverters and fed to four (04) parallel connected 3 phase traction motors. For AC MEMU, the configuration of the coaches shall be of either 8/12/16/20/24. Indicative train formation for 8 and 12 cars is as shown below:

8 car Formation:

DMC-TC-TC-TC-TC-TC-TC-DMC

12 Car Formation:

DMC-TC-TC-TC-TC-TC-TC-DMC-TC-TC-TC-DMC

DMC: Driving Motor Coach

TC: Trailer Coach

The equipment shall be designed to work satisfactorily under following environmental conditions: -

Relative Humidity	Up to 98% saturation during rainy season which may be as long as five (5) months.
Ambient temp.	i) Max. 50° C ii) Min. -5°C
Average annual ambient temperature	35°C.
Maximum temperature inside HT compartment of motor coach	Max. 55° C.

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Stationary rake temperature	The temperature of stationary rake may go as high as 70-75 °C. The equipment shall not be adversely affected in any way due to exposure to such high temperatures. Supplier shall furnish the precautions taken in equipment/ component selection in order to conform to this requirement.
Altitude	At any altitude between 0 and 1200 m above mean sea level.
Rainfall	Very heavy and continuous (up to 2500mm during rainy season) All underslung equipment shall be designed suitably to ensure its normal working even in adverse conditions as above. The equipment shall be so designed to run at 8 Km/h through water up to 203 mm above rail level, allowance to be made in addition for increase in the height of water level due to wave effect. In case of flood level increasing more than 203mm, the MEMU shall be made dead. There are certain sections of the track that get flooded with water to standing depth of 400mm. The traction gear and other under slung equipment must be completely water proof to this height above rail level. During the peak flood condition water may reach up to floor level. The equipment shall not get damaged due to such flooding and it should be possible to rejuvenate the equipment with minor attention without any adverse effect on their performance.
Atmosphere during hot weather	Extremely dusty, humid and salty. The MEMU shall be working primarily in coastal area and thus shall be continuously exposed to highly corrosive, salty atmosphere along with industrial pollutants. Special care shall be taken to ensure no damage to equipment due to deposition of atmospheric salts and industrial pollutants. Supplier shall enclose details of specific measures adopted to ensure the satisfactory working of equipment against the deposition of salts & industrial pollution.

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Vibrations	The vibration levels at some intermittent points on the track may be higher than those specified by the relevant IEC publication (IEC 61373). The suspension system and the mounting arrangements shall be so designed that the equipment's performance is not adversely affected due to such high vibrations and shocks.
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3.4 STANDARDS

The equipment covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

The equipment to be furnished under this specification shall conform to latest issue (with all amendments) of specified standards.

In addition to meeting the specific requirement called for in Sections 2 of the Technical Specification, the equipment shall also conform to the general requirement of the applicable standards, which shall form an integral part of the specification. The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other. When the specific requirements stipulated in the specifications exceed or differ from those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards, which ensure equivalent or better performance than that specified in the standards referred, shall also be accepted. The bidder shall submit copies of such standards.

3.5 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc. for the equipment.

3.6 ENGINEERING DATA

3.6.1 DRAWINGS

The contactor shall necessarily submit all the drawings/ documents unless anything is waived. The contactor shall submit 6 (six) sets of drawings/ design documents/ data/

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test reports as may be required for the approval of the purchaser. All drawings submitted by the Manufacturer including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Manufacturer shall be clearly marked with the name of the Customer and Project, the unit designation, the specifications title, the specification number, date of revision (if any), duly signed by the concerned technical person. If standard catalogue pages are submitted, the applicable items shall be indicated therein and should be made project specific. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Manufacturer shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Manufacturer's risk. The Manufacturer may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Manufacturer's drawing or work by the Purchaser shall not relieve the manufacturer of any of his responsibilities and liabilities under the Contract.

All engineering data submitted by the Manufacturer after final process including review and approval shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Owner in Writing.

The title block of drawings shall contain the following information incorporated in all contract drawings

1. Customer : BHEL /Indian Railways
2. Project: DESIGN, DEVELOPMENT, MANUFACTURE, SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF 25kV IGBT BASED THREE PHASE ELECTRICS (ON BOARD MOUNTED) FOR AC MEMUs.
3. Contract No./LOA No. : P.O no. 08/18/1848/2617/F dated 22/11/2018
4. Main Contractor : Bharat Heavy Electricals Limited
5. BHEL Order No. & Date :

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3.6.1.1 SIZE OF DRAWINGS

The drawings of the following parts shall be to the sizes indicated below

- I. Equipment details – full size or half size
- II. Motor Assemblies – 1:5
- III. General Assemblies- 1:10

The dimensions, weight, capacity, etc. shall be in SI units. All drawings shall be submitted on CDs along with complete setup with software for reading and taking prints through desk top PC and suitable printer. In case the format is not compatible with AUTOCAD necessary customized hardware and software shall be submitted.

3.6.1.2 METHOD OF FILING OF DRAWINGS

To facilitate filing of drawings, it is essential that each drawing submitted for approval is marked so that it can be identified. The supplier is, therefore, required to ensure that all prints are marked legibly at the right hand bottom corner. The following information is required in respect of each drawing:

- I. Supplier's drawing number.
- II. Supplier's name and date of submission.
- III. Contract no. given by the purchaser.
- IV. Description of drawings.
- V. Relevant Specifications

3.6.2 PHOTOGRAPHS

While the equipment is under manufacture, photographs shall be taken of the various assemblies and sub-assemblies in various stages of production. Photographs on digital media and videos shall also be furnished.

3.6.3 BINDING

Each set of tracings together with a set of photographs shall be suitably bound within a cover of superior quality durable materials with the title block printed on the outside of the cover.

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3.7 MARKING OF EQUIPMENT & RATING PLATE

All main assemblies of the equipment shall bear serial number for identification and initials of the purchaser. Where the sub-assemblies/components of the main assemblies are not inter-changeable, the sub-assemblies shall also be marked with the serial nos. of the main assembly of which they form a part.

All equipment/cubicles shall contain rating plates of anodized aluminium with embossed letters. The rating plate will give detailed rating specification and identification of equipment. The details of rating plate of each of the equipment shall be as approved by RDSO.

3.8 INFRINGEMENT OF PATENT RIGHTS

BHEL and Indian Railway shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, components used in design, development and manufacturing of propulsion system & other equipment and any other factor which may be a cause such dispute. The responsibility to settle any issue lies with the manufacturer.

3.9 DOCUMENT SUBMISSIONS

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Purchaser would be discussed and finalized at the time of award. The following schedule shall be followed generally for approval:

Sl.no.	No. of copies	Schedule
i)	Initial Submission Drawings, Data sheets, Type test Reports	At the time of submission of offer.
ii)	Furnishing of distribution copies of drawings in bound volume	2 Weeks from the date of award. 3 copies for Railways plus 3 copies for BHEL.
iii)	Furnishing of distribution copies of type test reports in bound volumes	Hard copy to be submitted 1 Week from the date of type test and total 3 copies for Railways plus 3 copies for BHEL to be given. Soft copy to be submitted immediately after the completion of the test by email.
iv)	Furnishing of distribution copies of Routine test reports	Hard copy to be submitted 1 Week from the date of routine test and 3 copies for Railways plus 3 copies for

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		BHEL to be given. Soft copy to be submitted immediately after the completion of the test by email.
v)	CD/pen drive containing all documents including Installation, Operation & Maintenance manuals.	2 Weeks from the date of award. 3 sets of hard copy and soft copy in editable format i.e. MS word/ MS excel.

3.10 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Manufacturer's Works or at his Sub-manufacturer's premises or at the Purchaser's site or at any other place of Work, are in accordance with the specifications, the Manufacturer shall adopt a suitable quality assurance program to control such activities at all points, as necessary. Such program shall be outlined by the Manufacturer and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance program of the manufacturer shall generally cover the following:

- a) Manufacturer's organization structure for the management and implementation of the proposed quality assurance program;
- b) Documentation control system;
- c) Qualification data of bidder's key personnel;
- d) The procedure for purchases of materials, parts components and selection of sub-Manufacturer's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
- f) Control of non-conforming items and system for corrective actions;
- g) Inspection and test procedure both for manufacture and field activities;
- h) Control of calibration and testing of measuring instruments and field activities;
- i) System for indication and appraisal of inspection status;
- j) System for quality audits;
- k) System for authorizing release of manufactured product to the Purchaser
- l) System for maintenance of records;
- m) System for handling storage and delivery; and
- n) A quality plan detailing out the specific quality control measures and Procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

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The Purchaser or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Manufacturer/'his vendor's quality management and control activities.

3.10.1 QUALITY ASSURANCE DOCUMENTS

The Manufacturer shall be required to submit the following all the Quality Assurance Documents as stipulated in the quality plan at the time of purchaser's inspection of equipment/ material.

3.11 TYPE AND ROUTINE TESTING & INSPECTION

- 1) The individual equipment, systems and sub systems shall be type and routine tested in accordance with the relevant RDSO/IEC/BS/DIN/JIS/IS or equivalent Specification inclusive of the mandatory and optional tests along with the special tests as specified.
- 2) All type tests shall be carried out at the Supplier's cost where ever performed in presence of and to the satisfaction of BHEL/RDSO/Indian Railways (IR)/ Third Party, who reserves the right to witness any or all of the tests.
- 3) Wherever any equipment, system, sub system is not specifically covered by an international recognized specification or test procedure, the tests which are acceptable to both to Supplier and to the IR's representative shall be devised.
- 4) Without prejudice to any provisions of the contract, the purchaser reserves the right to witness any or all of the type tests and to require submission of any or all test specification and reports.
- 5) The price of conducting all tests and additional type tests is deemed to be included in Bid price. In case any bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.
- 6) The Purchaser, his duly authorized representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractors premises or Works and shall have the power, at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Manufacturer shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Manufacturer's own premises or works. Inspection

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may be made at any stage of manufacture, dispatch or at site as the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

- 7) In all cases where the Contract provides for tests whether at the premises or at the works of the Manufacturer or of any Sub-Contractor, the Manufacturer except where otherwise specified, shall provide free of charge items such as labor, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser Inspector or to his authorized representative to accomplish testing.
- 8) The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Manufacturer in respect of the agreed quality assurance program forming a part of the Contract.
- 9) The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site.
- 10) During the prototype tests/trials or services, if any problems arise or feedback information is obtained, which warrants a re-check of the design/manufacture/quality of the equipment and components, action will be taken as may be necessary by the Supplier to carry out the required investigations and to incorporate the improvements considered most appropriate to reach compliance with the specification without any extra costs to the Purchaser.
- 11) The prototype rakes fitted with the supplied equipment, shall be subjected to pre-revenue service trials. Service trials are intended to prove the satisfactory running performance of the supplied MEMU equipment and evaluate their reliability in service, ease of maintenance and operations. The performance of the equipment shall be assessed based on the experience gained during the service trials. Necessary modification as required and also as desired by the RDSO/Indian Railway shall be implemented in the series production without any extra costs to the Purchaser.
- 12) Before carrying out any modification, as found necessary on the basis of tests and trials, the drawings and execution plan shall be got approved from the RDSO.

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3.12 MATERIALS AND WORKMANSHIP

Equipment materials and components shall be new, of high grade and good quality and be to the latest engineering practice. The material and workmanship throughout shall be in accordance with the purpose for which they are intended. Each component shall be designed to be consistent with its duty.

All the information concerning materials or components to be used in manufacturing, machinery, equipment, materials and components supplied, installed or used shall be submitted for approval. Without such approval the supplier shall run risk of subsequent rejection. The cost as well as time delay associated with such rejection shall be borne by the supplier.

3.13 PACKING AND STORAGE

All the equipment's shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. On request of the purchaser, the manufacturer shall also submit packing details/ associated drawing for any equipment/ material at a later date, in case the need arises.

While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The manufacturer shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the manufacturer. Purchaser takes no responsibility of the availability of the wagons.

All coated surfaces shall be protected against abrasions, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device.

Supplier shall ensure that equipment shall be properly packed, blocked, padded, coated and protected so that it is not damaged due to possible mishandling. Storage requirements shall be clearly defined by the supplier. Packing shall be such that if required, long time storage at site should not deteriorate the performance of the equipment.

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3.14 FIRE PREVENTION

- i) The equipment's shall be designed to minimize the risk of any fire.
- ii) Materials used in the manufacture of equipment's shall be selected to reduce the heat load, rate of heat release, propensity to ignite, rate of flame spread, smoke emission and toxicity of combustion gases.
- iii) The Supplier shall comply with specification NF F 16-101: (Railway Rolling Stock Fire behavior "Choice of Material"), NF F 16-102: (Railway Rolling Stock Fire behavior "Material choosing, application for electric system" category A2), BS 6853 – 1999 Category II or DIN 5510, EN 45545(for rolling stoke design) CET.HL-2 or any other equivalent/superior international standard for fire safety plan in respect of their equipment. Whichever standard is selected for meeting the fire safety, the standard shall be declared and a copy shall be furnished to BHEL/RDSO.

3.15 MAINTENANCE MANUAL, SPARE PARTS CATALOGUE & MATERIAL SPECIFICATION

The detailed maintenance and service manual (including the trouble shooting directory shall be prepared for the various equipment's and 3 sets of hard copies & soft copy of the same shall be supplied free of charge.

Detailed spare parts catalogue listing all components manufactured or purchased by the supplier along with their rating, source & schematic position etc. (40 copies) each shall also be supplied free of charge.

The documentation shall be provided on compact discs & floppies (5 no's) along with relevant software and complete arrangements to read them or edit them in future to take prints in color.

3.16 MAINTAINABILITY

Supplier shall submit the basic maintenance schedules of the proposed equipment. Minimum interval between two maintenance schedules for the equipment supplied under the specification in the depot shall be 90 days except for the pantograph strips and 3 years for major works in workshop/major depot.

It may be noted that the periodicity of the present maintenance schedules are as under: -

I 'A'	45 days
I 'C'	180 days
POH	18 months

	TECHNICAL SPECIFICATION FOR DRIVER's DESK, SHUNTING DESK AND ACCESSORIES	PROJECT- ICF/MEMU Project
	DOC. No. : TBSG/ICF/ACMEMU/02/ DRIVER DESK REV No. 01	PI No.

The maintenance programme prepared by supplier shall have the following objectives ascertaining the above periodicity of maintenance schedules:

- a) Enhancement of EMU/MEMU availability
- b) Minimization of maintenance costs
- c) Minimization of coach downtime /MTTS (meantime to restore serviceability).

3.16.1 Based on the proposed maintenance schedules the supplier will submit average downtime on account of scheduled maintenance for the equipment to be supplied excluding the time required for transfer of rake to and from the maintenance depot. Ineffective on this account should not exceed Two percent. Supplier should also submit an estimate for the downtime for unscheduled maintenance in respect of equipment to be supplied. The supplier shall assess and submit the figure for 'total percentage Ineffective', in terms of percentage of rakes expected to be ineffective/unserviceable due to schedule and unscheduled repairs/maintenance of equipment supplied (excluding the time taken for transfer of the rakes to and from maintenance depot) against the total number of rakes fitted with the equipment under his scope of supply. This ineffective figure shall not exceed FOUR percent in any week (Monday-Sunday) calculated on 24 hourly basis. If during the test and service trial period of prototype rakes, it is experienced that downtime due to unscheduled repairs/scheduled maintenance of the equipment supplied is excessive, supplier shall be required to take suitable remedial measures to bring the ineffective figure within the limit submitted during the design approval stage without any cost."

3.16.2 Modular design principles shall be employed. Requirements for adjustments after module interchange shall be avoided except as required in the specification. All systems, components and structural areas serviced as part of inspection or periodic preventive maintenance shall be readily accessible for service and inspection.

3.17 RELIABILITY

In addition to meeting the performance requirements, the equipment, shall incorporate high standards of reliability to ensure that operating cost and operation performance is optimized.

	TECHNICAL SPECIFICATION FOR DRIVER's DESK, SHUNTING DESK AND ACCESSORIES	PROJECT- ICF/MEMU Project
	DOC. No. : TBSG/ICF/ACMEMU/02/ DRIVER DESK REV No. 01	PI No.

ANNEXURE-1

DMC DRIVER DESK CONTROL SWITCHES

(Page 1- 4)

DMC DRIVER DESK CONTROL SWITCHES

Sl. No	Description of switch	Details of switch	Make & Type	Color	No. of contacts required	Part Numbers	LEGEND
Driver's Side (Panel 1)							
1.	CAB LIGHT	Selector switch Maintain, 2 Position, short lever	EAO 704.411.018		2NO	704.411.018 + 704.900.3 + 704.954.0 + 704.964.5	CAB LIGHT OFF ON
2.	CAB FAN	Selector switch Maintain, 2 Position, short lever	EAO 704.411.018		2NO	704.411.018 + 704.900.3 + 704.954.0 + 704.964.5	CAB FAN OFF ON
3.	CAB EMERGENCY LIGHT	Selector switch Maintain, 2 Position, short lever	EAO 704.411.018		2NO	704.411.018 + 704.900.3 + 704.954.0 + 704.964.5	CAB EMG. LIGHT OFF ON
4.	General Fault	LED indicator	EAO 704.006.218	RED		704.006.218 + 10-2512.1142	General Fault
5.	STEP LIGHT	Selector switch Maintain, 2 Position, short lever	EAO 704.411.018		2NO	704.411.018 + 704.900.3 + 704.954.0 + 704.964.5	STEP LIGHT OFF ON
6.	LAMP TEST	PB switch (Blue-Momentary) illuminated	EAO 704.012.618	BLUE	2NO	704.032.518 + 704.900.3 + 10-2512.1145 704.964.5	LAMP TEST
7.	AUDIO VISUAL	Push Button (Momentary), illuminated	EAO 704.032.418	YELLOW	2NO	704.032.418 + 704.900.3 + 10-2512.1144 704.964.5	AUDIO VISUAL
8.	FLASHER LIGHT	Push Button (Maintain), illuminated	EAO, 704.062.418	YELLOW	4NO for double pole switch	704.062.418 + 704.900.3 + 704.900.3 + 10-2512.1144 704.964.5	FLASHER LIGHT
9.	PARKING BRAKE RELEASE	Push Button (Momentary), illuminated	EAO 704.032.518	GREEN	2NO	704.032.518 + 704.900.3 + 10-2512.1145 704.964.5	PARKING BRAKE REL
10.	PARKING BRAKE APPLY	Push Button (Momentary), illuminated	EAO 704.032.618	BLUE	2NO	704.032.618 + 704.900.3 + 10-2512.1146 704.964.5	PARKING BRAKE APL
11.	Spare	LED indicator	EAO 704.006.418	YELLOW		704.006.418 + 10-2512.1144	
12.	HEAD LIGHT FAILURE	LED indicator	EAO 704.006.418	YELLOW		704.006.418 + 10-2512.1144	HEADLIGHT FAILURE
13.	HEAD LIGHT (OFF/BRIGHT/DIM)	Selector switch, Maintain, 3 position, long lever	EAO, 704.403.018		2NO+ 2NC+ 1NO+1NC	704.403.018 + 704.900.3 + 704.900.4 + 704.900.5 + 704.965.3 704.965.4 704.954.0 + 704.964.5	HEAD LIGHT OFF BR DIM
14.	WIPER ON/OFF (SELECTOR SWITCH)	Selector switch Maintain, 2 Position, short lever	EAO 704.411.018		2 NO	704.411.018 704.900.3 + 704.954.0 + 704.964.5	Wiper ON/OFF
15.	DRIVER WIPER SPEED SELECTOR	Selector switch, Maintain, 3 position, long	EAO 704.403.018		2NC+ 1NO+1NC	704.403.018 + 704.900.4 + 704.900.5 +	Driver Wiper SPEED OFF LOW

Sl. No	Description of switch	Details of switch	Make & Type	Color	No. of contacts required	Part Numbers	LEGEND
	SWITCH (OFF/LOW/HIGH)	lever				704.965.3 704.954.0 + 704.964.5	HIGH
16.	GUARD WIPER SPEED SELECTOR SWITCH (OFF/LOW/HIGH)	Selector switch, Maintain, 3 position, long lever	EAO 704.403.018		2NC+ 1NO+1NC	704.403.018 + 704.900.4 + 704.900.5 + 704.965.3 704.954.0 + 704.964.5	Guard Wiper SPEED OFF LOW HIGH
17.	WASHER PUMP ON/OFF	PB switch (Blue-Momentary) illuminated	EAO 704.032.618	Blue	2NO	704.032.618 + 704.900.3 + 10-2512.1146 704.964.5	WASH PUMP ON/OFF
18.	Spare						Blind plug
19.	SIGNAL BELL	Push Button (Momentary), illuminated	EAO 704.032.418	YELLOW	2 NO	704.032.418 + 704.900.3 + 10-2512.1144 704.964.5	SIGNAL BELL
20.	EMY BELL	Push Button (Momentary), illuminated	EAO 704.032.218	RED	4 NO	704.032.218 + 704.900.3 + 704.900.3 + 10-2512.1142 704.964.5	EMY BELL
21.	Spare						Blind plug
22.	TRAIN OFF	PB Switch (Red-Momentary) illuminated	EAO 704.032.218	RED	1NO+NC	704.032.218 + 704.900.3 + 704.900.3 + 10-2512.1142 704.964.5	TRAIN OFF
23.	Spare						Blind plug
24.	TRAIN REVERSE	Push Button (Momentary), illuminated	EAO 704.032.218	RED	2NO	704.032.218 + 704.900.3 + 704.900.3 + 10-2512.1142 704.964.5	TRAIN REVERSE
DRIVER'S SIDE (PANEL 4)							
25.	EMERGENCY OFF	Emergency PB (RED-Maintain) with yellow cover	EAO, 704.064.2	RED	2 NOS OF 1NO+1NC slow making contacts	704.064.2 + 704.910.5 + 704.910.5 + +704.963.6 + 704.927.8 10-2512.1142 704.964.5	EMERGENCY OFF
26.	PANTO UP/DOWN	Selector switch, 3 position, Momentary, Long lever	EAO 704.095.018		6 NO	704.095.018 + 704.900.3 + 704.900.3 + 704.900.3 + 704.965.3 704.965.4 704.954.0 + 704.964.5	PANTO UP DOWN
27.	VCB/MC ON/OFF	Selector switch, 3 position, Momentary, long lever	EAO 704.095.018		6 NO	704.095.018 + 704.900.3 + 704.900.3 + 704.900.3 + 704.965.3 704.965.4 704.954.0 + 704.964.5	MC ON OFF
28.	FAULT RESET	Push Button (Momentary), illuminated	EAO 704.032.418	Yellow	2NO	704.032.418 + 704.900.3 + 10-2512.1144 704.964.5	FAULT RESET

Sl. No	Description of switch	Details of switch	Make & Type	Color	No. of contacts required	Part Numbers	LEGEND
29.	EMERGENCY OFF	LED Indicator	EAO 704.006.218	RED		704.006.218 + 10-2512.1142	EMY OFF
30.	NEUTRAL SECTION	Push Button (Momentary), illuminated	EAO 704.032.418	YELLOW	2NO	704.032.418 + 704.900.3 + 10-2512.1144 704.964.5	NEUTRAL SECTION
31.	CRUISE CONTROL	Push Button (Momentary), illuminated	EAO 704.032.418	YELLOW	2NO	704.032.418 + 10-2512.1144 704.900.3+ 704.964.5	CRUISE CONTROL
32.	HORN SWITCH	Mushroom head pushbutton	EAO 704.070.4	YELLOW		704.070.4 704.900.3	
Driver's Side (Panel 2)							
33.	EMERGENCY BRAKE	LED Indicator	EAO 704.006.218	RED		704.006.218 + 10-2512.1142	EMR BRAKE
34.	MIN. ONE PANTO UP	LED Indicator	EAO 704.006.618	BLUE		704.006.618 + 10-2512.1146	MIN. 1 PANTO UP
35.	MINIMUM ONE VCB/MC ON	LED Indicator	EAO 704.006.618	BLUE		704.006.618 + 10-2512.1146	MIN 1 MC ON
36.	TCN FAILURE	LED Indicator	EAO 704.006.218	RED		704.006.218 + 10-2512.1142	TCN FAILURE
37.	NOT ALL PANTOUP	LED Indicator	EAO 704.006.418	YELLOW		704.006.418 + 10-2512.1144	NOT ALL PANTO UP
38.	NOT ALL VCB /MC ON	LED Indicator	EAO 704.006.418	YELLOW		704.006.418 + 10-2512.1144	NOT ALL MC ON
39.	MINIMUM ONE BRAKE APPLIED	LED Indicator	EAO 704.006.218	RED		704.006.218 + 10-2512.1142	MIN 1BRAKE APPLIED
40.	MINIMUM ONE AIR SUSPENSION FAILED	LED Indicator	EAO 704.006.418	YELLOW		704.006.418 + 10-2512.1144	MIN 1 AS FAILED
41.	RDM ACTIVE	LED Indicator	EAO 704.006.618	BLUE		704.006.618 + 10-2512.1146	RDM.
42.	OHE Available	LED Indicator	EAO 704.006.218	RED		704.006.218 + 10-2512.1142	OHE Available
Guard's Side (Panel 3)							
43.	STEP LIGHT	Selector switch Maintain, 2 Position, short lever	EAO 704.411.018		2NO	704.411.018 + 704.900.3 + 704.954.0 + 704.964.5	STEP LIGHT OFF ON
44.	CAB LIGHT	Selector switch Maintain, 2 Position, short lever	EAO 704.411.018		2NO	704.411.018 + 704.900.3 + 704.954.0 + 704.964.5	CAB LIGHT OFF ON
45.	CAB EMERGENCY LIGHT	Selector switch Maintain, 2 Position, short lever	EAO 704.411.018		2NO	704.411.018 + 704.900.3 + 704.954.0 + 704.964.5	CAB EMG. LIGHT OFF ON
46.	CAB FAN	Selector switch Maintain, 2 Position, short lever	EAO 704.411.018		2NO	704.411.018 + 704.900.3 + 704.954.0 + 704.964.5	CAB FAN OFF ON
47.	TAIL LIGHTS (ON/OFF)	Push Button (Maintain), illuminated	EAO 704.032.418	YELLOW	4NO for double pole switch	704.032.418 + 10-2512.1144 704.900.3+ 704.964.5	TAIL LIGHT (ON/OFF)

Sl. No	Description of switch	Details of switch	Make & Type	Color	No. of contacts required	Part Numbers	LEGEND
48.	MARKER LIGHT	Push Button (Maintain), illuminated	EAO 704.032.418	YELLOW	2NO	704.062.418 + 704.900.3 + 10-2512.1144 704.964.5	BLINKER LIGHT
49.	100% LIGHTS ON	Push Button (Momentary), illuminated	EAO 704.032.618	BLUE	2NO	704.032.618 + 704.900.3 + 10-2512.1146 704.964.5	100% LIGHTS ON/OFF
50.	50% LIGHTS	Push Button (Momentary), illuminated	EAO 704.032.618	BLUE	2NO	704.032.618 + 704.900.3 + 10-2512.1146 704.964.5	50% LIGHTS ON/OFF
51.	FAN ON/OFF	Push Button (Momentary), illuminated	EAO 704.032.618	BLUE	2NO	704.032.618 + 704.900.3 + 10-2512.1146 704.964.5	PASSENGER FAN ON
52.	EMR LIGHT OFF	Push Button (Momentary), illuminated	EAO 704.032.218	RED	2NO	704.006.218 + 10-2512.1142 704.964.5 704.900.3 + 704.006.218 +	EMR LIGHT OFF
53.	PANEL & GAUGE LIGHTS SWITCH	Selector switch Maintain, 2 Position, short lever	EAO 704.411.018		2NO	704.411.018 + 704.900.3 + 704.954.0 + 704.964.5	PANEL & GAUGE LIGHT OFF ON
54.	FLASHER (ON/OFF)	Push Button (Maintain), illuminated	EAO, 704.062.418	YELLOW	4NO for double pole switch	704.062.418 + 704.900.3 + 704.900.3 + 10-2512.1144 704.964.5	FLASHER LIGHT
55.	SIGNAL BELL	Push Button (Momentary), illuminated	EAO 704.032.418	YELLOW	2NO	704.032.418 + 704.900.3+ 10-2512.1144 704.964.5	SIGNAL BELL
56.	EMY BELL	Push Button (Momentary), illuminated	EAO 704.032.218	RED	4 NO	704.032.218 + 704.900.3 + 704.900.3+ 10-2512.1142 704.964.5	EMY BELL
57.	SPARE		EAO 704.964.8				BLIND PLUG
58.	LAMP TEST	PB switch (BLUE-Momentary) illuminated	EAO 704.032.618	BLUE	2NO	704.032.618 + 704.900.3 + 10-2512.1146 704.964.5	LAMP TEST
59.	SPARE		EAO 704.964.8				BLIND PLUG
60.	Test Battery Voltage	PB switch (BLUE-Momentary) illuminated	EAO 704.032.618	BLUE	2NO	704.032.618 + 704.900.3 + 10-2512.1146 704.964.5	
SEPARATE SWITCH ON DRIVER'S DESK							
61.	BUZZER AV	Buzzer				14-810.910	BUZZER AUDIO VISUAL
62.	BUZZER (FAULT)	Buzzer				14-810.910	BUZZER FAULT
63.	Reading light with switch	Reading light with switch					
64.	Battery Voltmeter						

	TECHNICAL SPECIFICATION FOR DRIVER's DESK, SHUNTING DESK AND ACCESSORIES	PROJECT- ICF/MEMU Project
	DOC. No. : TBSG/ICF/ACMEMU/02/ DRIVER DESK REV No. 01	PI No.

ANNEXURE-2

DRIVER DESK LAYOUT

Page 1- 5

REV.	DATE	ALTD.	CHD.	APPD.
03	07.8.19	Ish	Pratful	AKY
Drawing updated with ICF comment dated 03.08.2019				

Note:

1. All front doors of driver's desk shall be push to latch type lock
2. All Hinges and locks are of M/s Southco/ M/s Emka / M/s Dirake
3. Base Frame top side to be screwed to Driver desk
& bottom to be welded to cab floor frame.
4. Weight 400 $\pm$ 20 Kgs
5. Color Scheme :
 - A. All fabricated parts & FRP top cover : Painting RAL9018–PAPYRUS White
 - B. All door & Detachable panels :Powder coating–Oxford Blue RAL5003

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COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.

DRG. NO.

1

2

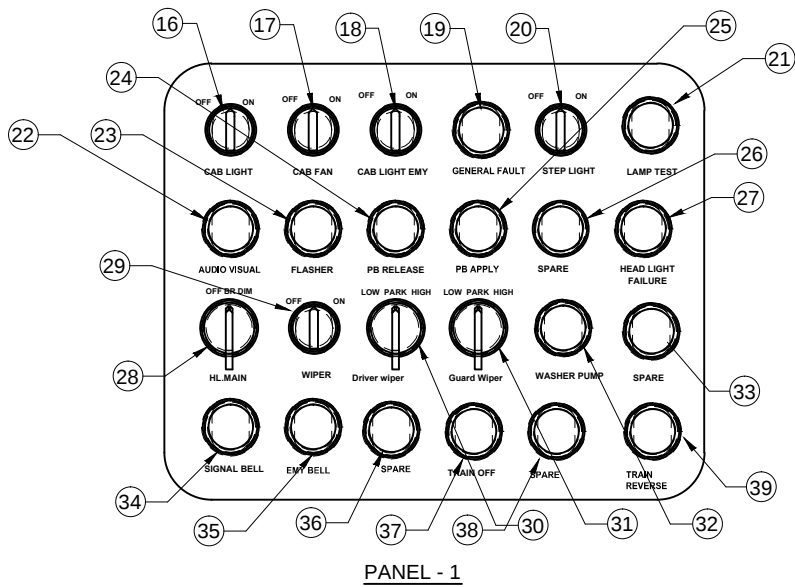
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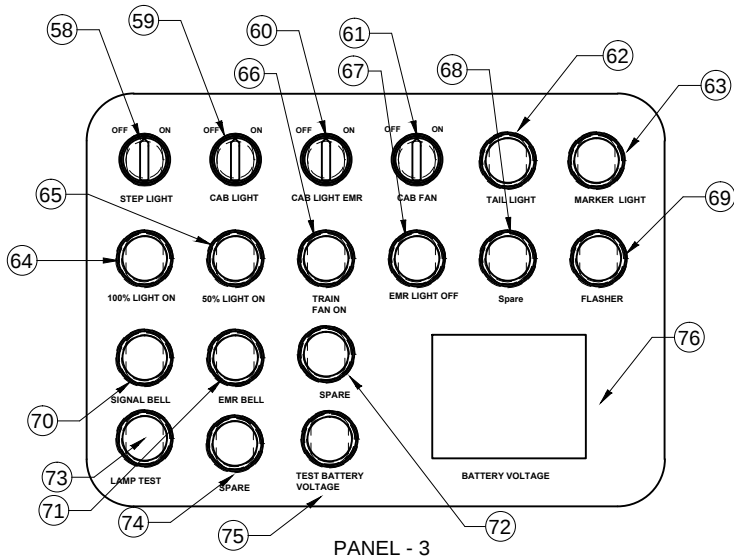
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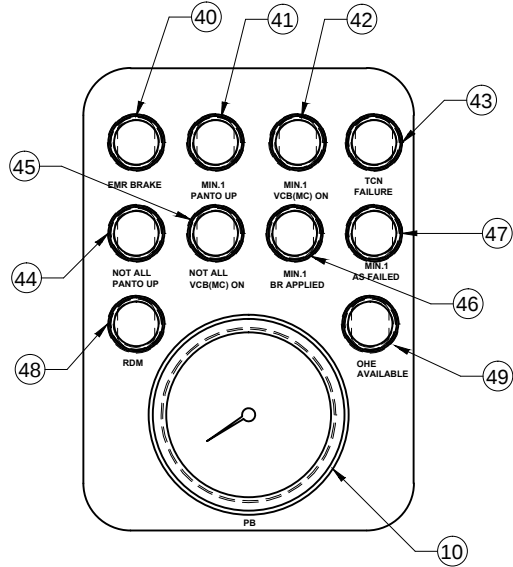
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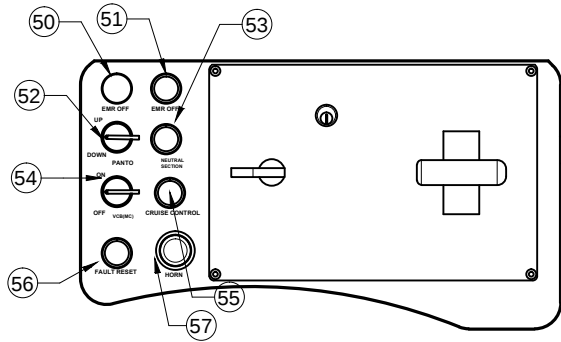
PANEL - 1



PANEL - 3



PANEL - 2



PANEL - 4

REV.	DATE	ALTD.	CHD.	APPD.
03	07.8.19	Ish	Prafful	AKY

Drawing revised as per ICF comments
Dated 03.08.2019

REV.	DATE	ALTD.	CHD.	APPD.
02	18.7.19	Ish	Prafful	AKY

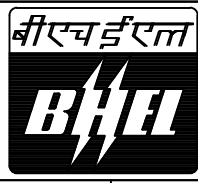
Quantity of switch and location
Revised, top FRP provided
as per ICF requirement

REV.	DATE	ALTD.	CHD.	APPD.
01	26.3.19	Ish	Prafful	AKY

Quantity of switch and location
Revised

	NAME	SIGN.	DATE
DRAWN	ISH		14.02.19
CHECKED	Prafful Lakra		14.02.19
APPROVED	Arun Yadav		14.02.19

DISTRIBUTION OF PRINTS			



DEPT.	CODE
TBSG	018

NAME OF CUSTOMER/ INTEGRAL COACH FACTORY CHENNAI/INDIAN RAILWAYS
PROJECT 3-PHASE IGBT PROPULSION EQUIPMENTS FOR 25 KV AC MEMUs.
Contract No. ICF PO-08/18/1848/2617/F DATE 22.11.2018

BHARAT HEAVY ELECTRICALS LIMITED
TRANSPORTATION BUSINESS & SYSTEMS GROUP
TITLE Driver's Desk Layout

Scale-1:1

SHEET No. 2of2

SIZE	W.O. No.	DRG. No.	REV.
A3	-----	MEMU_DMC_DriverDesk	03

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COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO.

1

2

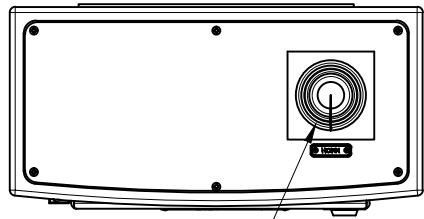
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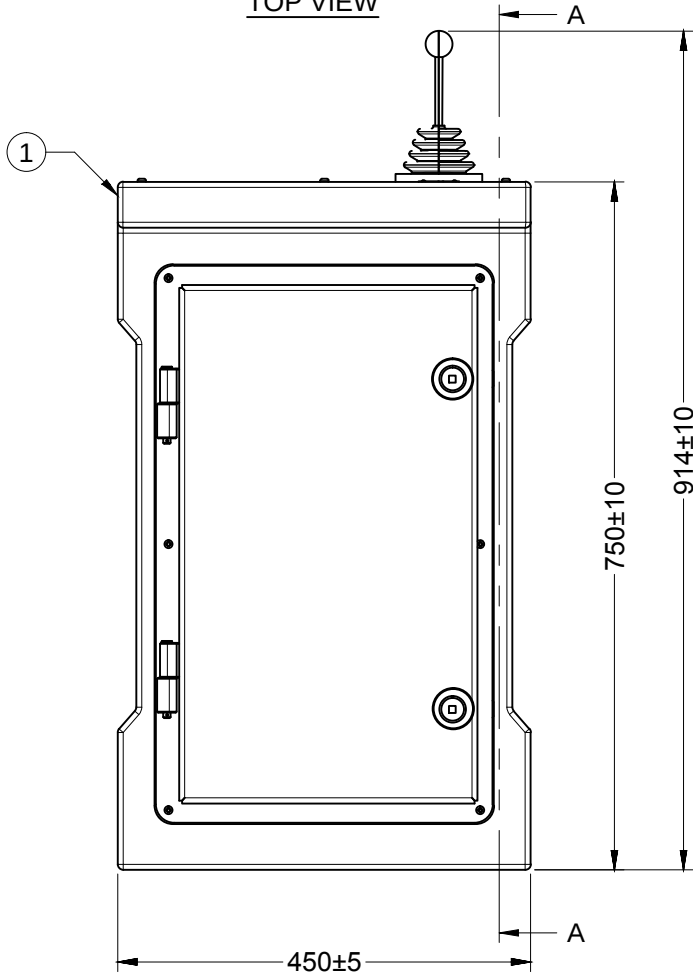
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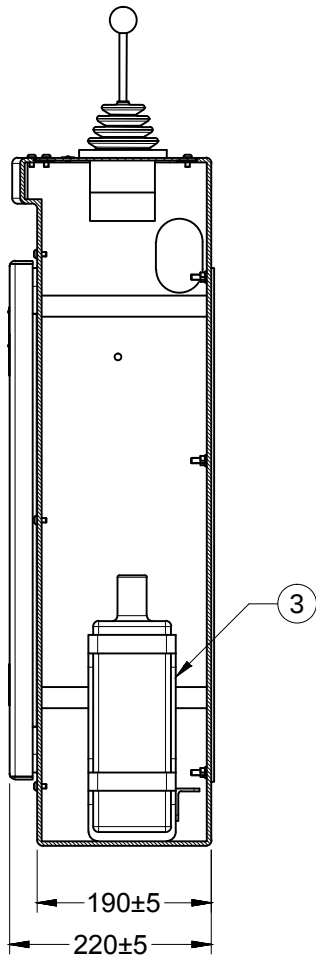
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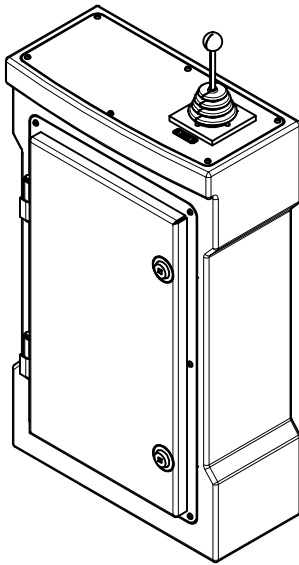
TOP VIEW



FRONT VIEW



SECTION A-A



3D VIEW

S.NO	DESCRIPTION	QTY
1	FRP GUARD SIDE BOX	1
2	LEVER - MECHANICAL HORN	1
3	5L PLASTIC WASH TANK ASSEMBLY	1

NOTES :

1. MAIN BODY - FRP, FABRICATED PARTS - M.S SHEET
2. FINISH : FRP BODY - PU PAINT (RAL 9018) - PAPYRUS WHITE
M.S SHEET - POWDER COATING: OXFORD BLUE IS 5 (105)
OR RAL 5003 AS PER SD 3892 & SD 3895

NAME OF CUSTOMER/ PROJECT Contract No. INTEGRAL COACH FACTORY CHENNAI/INDIAN RAILWAYS
3-PHASE IGBT PROPULSION EQUIPMENTS FOR 25 KV AC MEMUs.
ICF PO-08/18/1848/2617/F DATE 22.11.2018

REV.	DATE	ALTD.	CHD.	APPD.	REV.	DATE	ALTD.	CHD.	APPD.		NAME	SIGN.	DATE
										DRAWN	ISH		18.07.19
										CHECKED	Prafful Lakra		18.07.19
										APPROVED	Arun Yadav		18.07.19
										DISTRIBUTION OF PRINTS			



DEPT. CODE
TBSG 018

BHARAT HEAVY ELECTRICALS LIMITED		Scale - 1:1	
TRANSPORTATION BUSINESS & SYSTEMS GROUP		SHEET No. 10f1	
TITLE DMC Guard Box Layout		REV. 00	
Ref. Drg. No.: xxx		DRG. No. MEMU_DMC_GuardBox	
SIZE A3		W.O. No. -----	

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COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO.

1

2

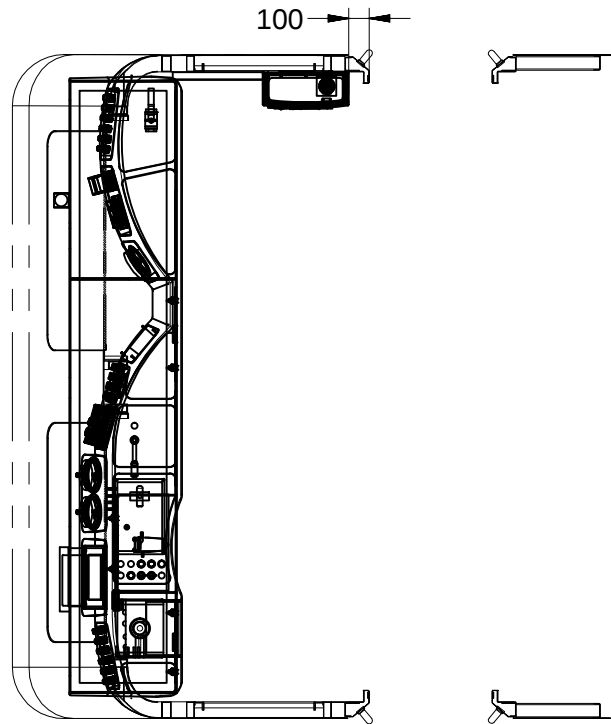
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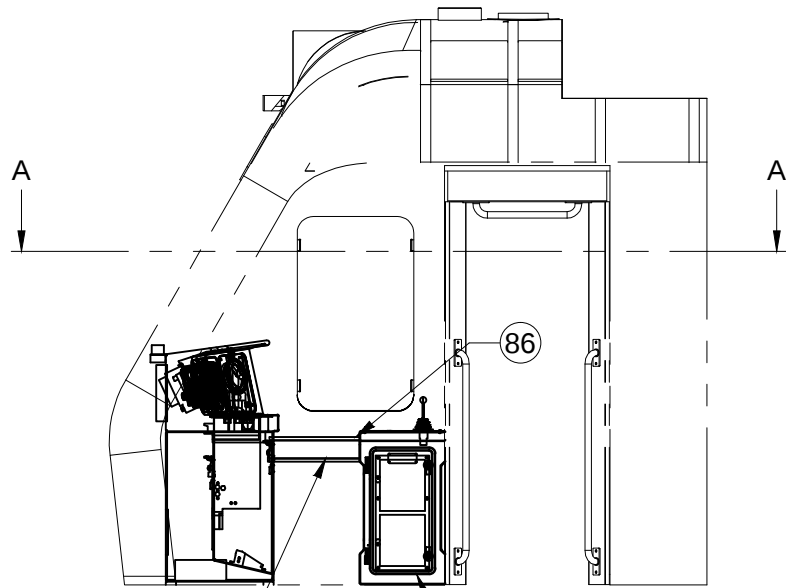
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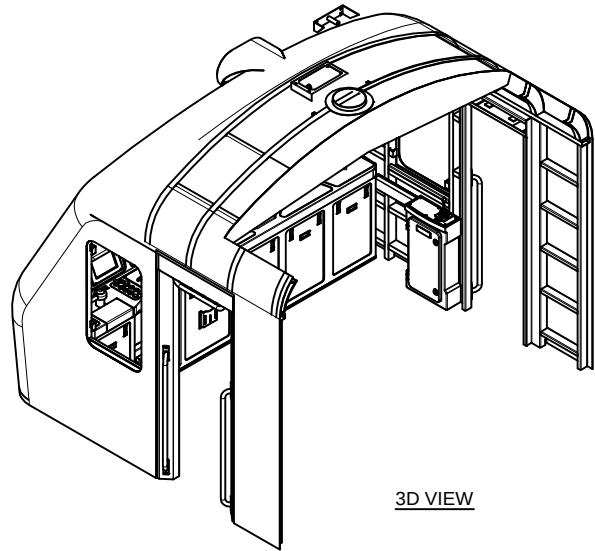


SECTION A-A

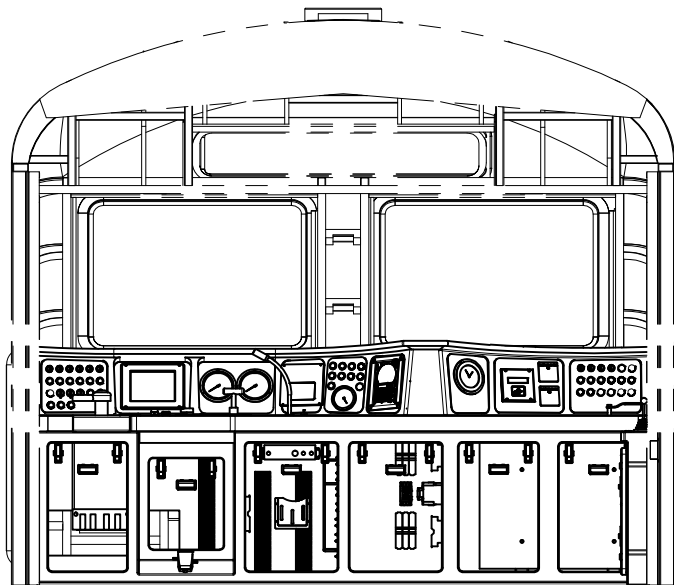


HOSE COVER

GUARD SIDE BOX



3D VIEW



NAME OF CUSTOMER/
PROJECT
Contract No.

INTEGRAL COACH FACTORY CHENNAI/INDIAN RAILWAYS
3-PHASE IGBT PROPULSION EQUIPMENTS FOR 25 KV AC MEMUs.
ICF PO-08/18/1848/2617/F DATE 22.11.2018

REV.	DATE	ALTD.	CHD.	APPD.	REV.	DATE	ALTD.	CHD.	APPD.	NAME	SIGN.	DATE
										DRAWN	ISH	12.08.19
										CHECKED	Prafful Lakra	12.08.19
										APPROVED	Arun Yadav	12.08.19
										DISTRIBUTION OF PRINTS		
										DEPT.	CODE	
										TBSG	018	



BHARAT HEAVY ELECTRICALS LIMITED TRANSPORTATION BUSINESS & SYSTEMS GROUP			Scale -1:1
TITLE Driver's Desk Layout-Inlet connection			SHEET No. 1 of 1
Ref. Drg. No.: xxx			
SIZE A3	W.O. No. -----	DRG. No. MEMU_DMC_DD_GB_Connection	REV. 00

	TECHNICAL SPECIFICATION FOR DRIVER's DESK, SHUNTING DESK AND ACCESSORIES	PROJECT- ICF/MEMU Project
	DOC. No. : TBSG/ICF/ACMEMU/02/ DRIVER DESK REV No. 01	PI No.

ANNEXURE-3

SPARE SWITCHES & CONTACT BLOCKS

(Page 1)

Annexure-3

SPARE SWITCHES & CONTACT BLOCKS

S. No.	DESCRIPTION	Part no.	Quantity
1	2NO	704.900.3	20
2	1NC+1NO	704.900.5	10
3	2NC	704.900.4	10
4	Terminal cover	704.964.5	5
5	Anti-twist ring	704.954.0	8
6	Terminal marking	704.965.3	3
7	Terminal marking	704.965.4	3
8	Selector switch actuator illuminable, 3 positions, short lever,	704.403.018	3
9	Pushbutton actuator, yellow	704.012.418	3
10	Pushbutton actuator, blue	704.012.618	3
11	Illuminated pushbutton actuator, yellow	704.062.418	3
12	Selector switch actuator illuminable, 3 positions, long lever,	704.095.018	3
13	Illuminated pushbutton actuator, yellow	704.032.418	2
14	Pushbutton actuator, red	704.012.218	2
15	Illuminated pushbutton actuator, red, momentary	704.032.218	2
16	Illuminated pushbutton actuator, blue	704.032.618	2
17	Illuminated pushbutton actuator, red, maintain	704.062.218	2
18	Mushroom-head pushbutton actuator, yellow	704.070.4	2
19	Selector switch actuator 2 positions, short lever, maintain	704.411.018	2
20	Push Button (Momentary), illuminated green	704.032.518	2
21	Indicator Yellow	704.006.418	6
22	LED Yellow	10-2512.1144	15
23	Indicator BLUE	704.006.618	6
24	LED Blue	10-2512.1146	15
25	Indicator Red	704.006.218	4
26	LED Red	10-2512.1142	12
27	Indicator green	704.006.518	1
28	LED Green	10-2512.1145	2
29	Buzzer	14-810.910	2
30	Emergency PB (RED-Maintain)	704.064.2	1

PERFORMANCE CERTIFICATE

Name of firm:

TO WHOMSOEVER IT MAY CONCERN

Sub : Confirmation letter for service performance

Dear Sir,

We hereby confirm that We have manufactured _____ number of sets of(Name of Equipment with Model No.) for 3 Phase IGBT based EMUs/MEMUs/Metros/LOCOs.

We further confirm that number of sets of(Name of Equipment with Model No.) for 3 Phase IGBT based EMUs/ MEMUs/Metros/Locos are in satisfactory operation for railway rolling stock application.

Proforma for performance statement confirming above is also attached.

Yours faithfully

For (Name of Firm)

**IGBT BASED 3 PHASE DRIVE AC MEMU
PROFORMA FOR PERFORMANCE STATEMENT**

Name of the Equipment
Name of the Firm

S. No.	Order placed by (full address of Purchaser)	Order No. and Date	Description of Quantity of ordered equipment	Details of System for which equipment was supplied at Sr. No. 4 above to be given as follows			Value of Order	Date of Completion of Delivery		Remarks indicating Reasons for late Delivery, if any	Qty. Satisfactory Service on 3 Phase IGBT based EMU's/MEMUs/Locos/Metros
				Supply System	Unit Formation	Speed Potential		As per Contract	Actual		
(1)	(2)	(3)	(4)	(5)			(6)	(7)	(8)	(9)	(10)