



सत्यमेव जयते

**SCHEDULE OF TECHNICAL REQUIREMENTS (STR)**  
**OF**  
**MANUFACTURING, TESTING & SUPPLYING**  
**FUNCTIONALLY EQUIVALENT CARD**  
**FOR**  
**GTO BASED THREE PHASE ELECTRIC LOCOMOTIVES WITH MICAS S2**  
**CONTROL SYSTEM**

XX, XXXX

<b>Approved by</b>	
<b>PEDSE</b>	<b>Signature</b>

**Issued by**

**Electrical Directorate**  
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**Manak Nagar, Lucknow-226011**

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DETAILS OF REVISIONS

Sl.No.	Date of Revision	Page No.	Revision	Reason for Revision
1	----	All	0	First Issue
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FINAL DRAFT

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## 1. **Preface :**

Schedule of Technical Requirements (STR) is a stipulated document which describes the requirements to be met by the vendors who are interested in manufacturing, testing and supplying the functionally equivalent PCB cards of GTO based 3-phase electric locomotives. The perspective vendors have to comply all the points mentioned in this STR to get into the project of developing functionally equivalent PCB cards.

## 2. **Abbreviations used throughout this document :**

ToT	:	Transfer of Technology
IR	:	Indian Railway
GTO	:	Gate Turn of Thyristor
STR	:	Schedule of Technical Requirements
TCN	:	Train Communication Network
VCU	:	Vehicle Control Unit
SR	:	Traction Converter
BUR	:	Auxiliary Converter
MVB	:	Multi-function Vehicle Bus
QAP	:	Quality Assurance Program/ Plan
M&P	:	Machinery & Plant
PCB	:	Printed Circuit Board
CNC	:	Computerized Numerical Control
ESD	:	Electro-Static Discharge
SMD	:	Surface Mount Device
PTH	:	Pin Through Hole
BGA	:	Ball Grid Array
FRC	:	Flat Ribbon Cable
ESS	:	Environmental Stress Screening
IPL	:	Intermec Printer Language
RTOS	:	Real-Time Operating System
CPLD	:	Complex Programmable Logic Device
FPGA	:	Field Programmable Gate Array
TI DSP	:	Texas Instruments Digital Signal Processor

## 3. **General :**

- 3.1. Presently, Indian Railways manufacture four classes of 3-phase drive locomotives viz. WAG9H, WAP5 and WAP7, based on the transfer of technology (ToT) from ABB Switzerland (now Bombardier Transportation). Under the ToT, IR received the technology to manufacture 3-Phase locomotives with GTO based traction and auxiliary converter and MICAS based VCU. CLW has already switched over to manufacturing of 3-Phase locomotive with IGBT based traction converter and auxiliary converter. At present about 700 locomotives are running with GTO based traction and auxiliary converters which should be maintained in proper way so that with the time their reliability is maintained to the best extent possible.
- 3.2. Owing to the old technology, developed in 1980s, the PCB cards of the GTO based locomotives have high failure rates. In order to contain the failure rates, it is observed that it is mandatory to develop the functionally equivalent PCB cards of the existing PCB cards being used in GTO based 3-phase electric locomotives.
- 3.3. This Schedule of Technical Requirements (STR) is to serve as an essential guideline to the manufacturers/vendors. The firms should satisfy themselves about having complied with the technical requirements of the Specification and other infrastructure. The Technical Requirements are meant to serve as guideline only and are not exhaustive.

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- 3.4. The main vendor/manufacturer (herein after called as 'Contractor') should have currently valid ISO: 9001 - ~~2008~~-2015 certification for his works address, covering the items for which he seeks registration with IR. It shall be ensured that the certifying body which issues the ISO: 9001 certificate is accredited by an accreditation body that is a part of the International Accreditation Forum (IAF) under the Multilateral Recognition Arrangement (MLA).
- 3.5. All the machines and measuring instruments/gauges should be properly calibrated. The latest calibration certificate may be required to be shown during validation of the contractor.
- 3.6. The contractor should have technically qualified personnel in the field of design, manufacturing & testing of PCB cards.
- 3.7. The contractor should have its own testing laboratory, otherwise services of a Government approved Test Laboratory can be availed. The detailing of the Government approved Test Laboratory is required to be furnished.

#### **4. Quality Assurance Plan :**

- 4.1 Firm shall submit QAP as per latest RDSO ISO document no. QM-RF-8.1-3 which is available on RDSO website link [http://www.rdsso.indianrailways.gov.in/view\\_section.jsp?lang=0&id=0,5,268,5443,5445,5477](http://www.rdsso.indianrailways.gov.in/view_section.jsp?lang=0&id=0,5,268,5443,5445,5477).
- 4.2 Outsourcing of some minor activities by vendor shall be properly mentioned in QAP and got to be verified during assessment of the firm.

#### **5. Assistance to be provided by IR :**

- 5.1. IR will give relevant available specification, design/drawings etc.
- 5.2. IR, to the extent possible, will assist the contractor during testing of components, sub-assemblies and the equipment by way of deputing suitable Railway personnel to witness such tests.
- 5.3. IR will assist the contractor in timely completion of prototype testing and field trials of the equipment developed.

#### **6. Responsibilities of the contractor :**

- 6.1. A time bound programme shall be made for the development of prototype.
- 6.2. The contractor shall be responsible for complete development of the above stated functionally equivalent PCB cards for 3-phase electric locomotives based on the technical documents passed on by IR. The design shall be developed based on the requirements given in the relevant specification.
- 6.3. The contractor shall be responsible for converting drawings into a version suitable for use in his factory. Nevertheless, before implementation of such converted drawings for manufacture, the contractor shall obtain approval (means the approval of general design features) from IR. Notwithstanding approval from IR, the contractor shall be wholly and completely responsible for the satisfactory performance of the equipment developed.

#### **7. Tests and Trials :**

- 7.1. The equipment shall be tested in accordance with the relevant test protocol as detailed in the ABB ToT documents to the satisfaction of IR. The contractor shall arrange to conduct all such tests at his own responsibility and cost.

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- 7.2. IR, at their discretion, will witness some or all of the tests as stated in above clause. The contractor shall provide all reasonable facilities to the inspecting officer for testing/ inspection at any stage.
- 7.3. The developed item shall also be evaluated during operation in locomotive. These will be termed 'Field Trials'. Apart from checking on repeatability of the operational performance under actual working conditions of a locomotive, these trials will also be used to access the maintainability, accessibility, reliability and such other aspects, which have been mentioned in the relevant specification.

### **8. Minimum Facilities/ Requirements :**

The information shall be furnished as per details required according to the following Annexure:

- 8.1. M&P required shall be as per **Annexure-I**. It however does not specify the capacity and quantity of various items of equipment/components. M&P may vary according to the manufacturing capacity of the individual contractor. The contractor should also have the good facility for storing the raw materials and finished product so as to maintain them in a healthy condition.
- 8.2. Measuring/Checking Instruments/Gauges: List of facilities required for measuring/ checking the instruments/ gauges in the contractor's premises shall be as per **Annexure-II**. The accuracy and capacity of the measuring equipment shall be adequate to meet the requirements. Records of calibration of all measuring instruments shall be maintained and made available, on demand.
- 8.3. Meticulous record of each batch of repair done during warranty investigation to trace out causes of failure etc shall be properly documented and required to be submit during renewal of the contract.

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**ANNEXURE-I****Manufacturing M&P Facilities:-**

The following minimum facilities are considered essential for manufacturing unit at the contractor's premises or at the approved sub-vendor's premises.

<b>Sl. No.</b>	<b>Details Of Machines</b>
1	Hand Drilling Machine with jig
2	Hand Grinder
3	CNC Milling machine (400 mm) for PCB face plate fabrication#
4	Digital Weighing Machine
5	ESD Protection ( Work Station including concern persons should have proper ESD band Protection)
6	Automatic pick & place machine for SMD based PCBs #
7	PCB wave solder machine for PTH, SMD and BGA technologies.#
8	Machinery for assembling Press fit connectors#
9	Crimping tool for FRC and control power supply wires#
10	PCB Conformal coating facility#
11	Environmental chamber for Production Stage ESS for PCBs and VCU rack#
12	Burn - In Test Chamber ( suitable for minus 25°C to plus 70°C) for PCBs.#
13	Test bench for PCB and VCU functional testing.
14	DC Power Supply (Variable from 70 V to 145 V, 4A )
15	PCB design software tools like PROTEL (Altium Designer), PADS (Power PCB), ORCAD, Allegro etc.

**Item marked as (#) may be outsourced to sub-vendor**

<b>Sl. No.</b>	<b>Digital Embedded system tools</b>
1	<i>Debugging equipments and software</i>
1.1	<ul style="list-style-type: none"> <li>Flash programmer for programming the controllers/processors used in the development.</li> <li>Software Development Platform for Rolling Stock application suitable for the processor/controller used.</li> </ul>
1.2	<del>CPLD and FPGA</del> <u>CPLD/FPGA</u> programming software <u>like "Impact" etc</u>
1.3	IDE for Firmware Development <u>like "Xilinx ISE Design suite", "AVR Studio" etc</u>
1.4	In circuit Emulator for debugging/programming of processor/controller boards. <u>Like "AMTEL ICE", "Xilinx platform cable USB II" etc</u>
1.5	CPLD/FPGA Programmer. <u>Like "Xilinx platform cable USB II" etc</u>

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**ANNEXURE – II****Measuring Instruments/Gauges and Debugging Equipments:-**

Sl. No.	Details of Equipment/Gauges.
1	Digital Oscilloscope with Probe (Storage type).
2	Digital Multi-meter (Adequate number of meters should be available.)
3	Megger 1000 V.
4	Surge Tester. #
5	<ul style="list-style-type: none"> <li>• Vernier Caliper</li> <li>• micrometer</li> <li>• Scale</li> <li>• Soldering and De-soldering station</li> </ul>
6	Gauge to measure PCB conformal coating thickness. #
7	Different size of crimping tools (Power & Signal cables)
8	Heat <u>sh</u> rink gun
9	PC based Video Microscope System for inspection of soldering quality.
10	Magnifying glass for physical verification of PCB
11	<u>IC Tester</u> <del>IC Tester</del> #

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