GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

SCHEDULE OF TECHNICAL REQUIREMENTS (STR)
FOR
MANUFACTURING, TESTING & SUPPLYING
DATA RETRIEVAL AND ANALYTICS SYSTEM
FOR
THREE PHASE ELECTRIC LOCOMOTIVES

As per

Specification No. CLW/C-D&D/ES/3/0554, Part 0 & Part 1
(Issued On: April, 2024)

ISSUED FROM

CENTRE FOR DESIGN & DEVELOPMENT
CHITTARANJAN LOCOMOTIVE WORKS
CHITTARANJAN, WEST BENGAL

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DETAILS OF REVISIONS

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1	—	All	0	First Issue

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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 Data Retrieval and Analytic System for Three Phase Electric Locomotives as per specification no. CLW/C-D&D/ES/3/0554, Part 0 and Part 1 (Issued on: April, 2024) or latest. The perspective prospective vendors shall satisfy themselves having complied with all the points mentioned in this STR to get into the project of developing Data Retrieval and Analytic System (DRAS).

2. Abbreviations used throughout this document :

STR	:	Schedule of Technical Requirements
ORMS	:	Onboard Remote Monitoring System
GPS	:	Global Positioning System
GPRS	:	General Packet Radio Service
DDS	:	Diagnostic Data Set
VCU	:	Vehicle Control Unit
MVB	:	Multifunction Vehicle Bus
GSM	:	Global System for Mobile Communications (5G or Latest)
SIM	:	Subscriber Identity Module
TCP/IP	:	Transmission Control Protocol/ Internet Protocol
TCN	:	Train Communication Network
FIFO	:	First In First Out
IR	:	Indian Railways
AI	:	Artificial Intelligence
ML	:	Machine Learning
FTP	:	File transfer Protocol
ITS	:	Issue Tracking systems
LMS	:	Locomotive Management System
RTC	:	Real Time Clock
SADS	:	Situation Awareness Display System
TDMS	:	Technical data Management Streaming and file format creation
APM	:	Application Performance Management (Measurement)
DIALS	:	Digital Into Analog LCD based System

3. General :

3.1. Indian Railways (herein after called as 'IR') has planned to run all Three Phase Electric Locomotives with DRAS and the technology is to be developed as per CLW Specification No. CLW/C-D&D/ES/3/0554, Part-0 & Part-1 or latest. In this Electric locomotives of IR which are fitted with Microprocessor based control and having fault diagnostic features which will monitor the health of the system. These systems capture the operational and performance data of locomotive continuously and sent the same to server for better analysis and planning. The complete scope of the work of spec no. CLW/C-D&D/ES/3/0554 comprises of the following subsystems:

- Onboard Locomotive Remote Monitoring System (ORMS) consisting of the on-board equipment.
- Locomotive Management System (LMS) consisting of data centre, internet portal and 24x7 Technical Helpdesk.
- Control Office Equipment (COE) Facilities for access at Electric/Diesel Shed's for Three Phase Electric loco and generation of reports.

- Server Setup and necessary implementation of AI and ML model for predictive and preventive maintenance.

However, this STR will be focusing only on Onboard Remote Monitoring System and server which is optional but needs to be setup at vendor premises.

3.2. The Schedule of Technical Requirements (STR) is issued to serve as a 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.

3.3. The main vendor/ manufacturer (herein after called as 'Contractor') should have currently valid ISO: 9001 - 2008 or latest 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- 2008 or latest certificate is accredited by an accreditation body that is a part of the International Accreditation Forum (IAF) under the Multilateral Recognition Arrangement (MLA).

3.4. 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.

3.5. The contractor should have technically qualified personnel in the field of design, manufacturing & testing of Data Retrieval and Analytic System (DRAS).

3.6. The contractor should have its own testing laboratory, otherwise services of a NABL accredited laboratory can be availed. The detailing of NABL accredited laboratory is required to be furnished.

4. Quality Assurance Plan :

The contractor should have their Quality Assurance Plan containing the following as a minimum:-

4.1. Organizational chart clearly introducing the quality control set-up.

4.2. Qualification log sheet of the key personnel, maintaining the quality control set up.

4.3. Process flow chart / Description of manufacturing Process :-

a. Process Flow Chart indicating process of manufacturing for an individual product, with quality control points.

i) Process flow chart shall indicate all the operation involving manufacturing & testing of product from raw materials to finished product, including inspection and dispatch.

ii) There should be separate flow chart for each individual item.

b. Brief description of different manufacturing process mentioned in flow chart :-

i) Details of the manufacturing & testing process specially mentioned in the specification.

Sl. No.	Clause no. of Specification	Requirement of manufacturing/testing process as per specification	Details of the process being carried out/ follows

ii) Brief details of the other manufacturing process, not mentioned in the specification.

Sl. No.	Name of the manufacturing process	Brief description

4.4. Brief description of ancillaries & additional units (if any):

i) Whether all the facilities are available at a single location (or) multiple location.

ii) In case of multiple location give details in following formats :

Sl. No.	Name of the unit	Address	Whether unit is covered under factory license	Whether unit is ISO certified	Details of manufacturing process accomplished in the unit

4.5. The contractor should have a well defined process evolution regarding selection of its sub-vendors/ suppliers as a part of their quality management system which shall be well documented incorporating the following points as a minimum :

- Name of the item for which sub-vendor is approved by the contractor.
- Sub-vendor should be ISO: 9001 - 2008 or latest certified.
- Sub-vendor should submit the quality manual to the contractor.
- Sub-vendor should have all the requisite infrastructure of manufacturing and testing facilities, preferably under one roof. The contractor shall approve the QAP of the sub-vendor after proper verification justifying to the well defined process evolution.
- Periodical inspection schedule for sub-vendor needs to be followed strictly by the contractor for maintaining the quality of the product.

4.6. Inspection & Testing Plan for bought out material:

a. Incoming raw materials/parts/sub-assemblies

Sl. No.	Incoming Material/ part/ assembly	Sample Size	Frequency of inspection	Parameters for inspection	Mode of inspection/ equipment used	Acceptance limits/ criteria/ specified Value	Inspected value/ result	Remarks	Traceable register no.

b. In process inspection (of the product)

Sl. No.	Name of the process	Sample Size	Frequency of inspection	Parameters for inspection	Mode of inspection/ equipment used	Acceptance limits/ criteria/ specified Value	Inspected value/ result	Remarks	Traceable register no.

c. Final internal inspection of the product by the contractor

Sl. No.	Name of the test/ process	Sample Size	Frequency of inspection	Parameters for inspection	Mode of inspection/ equipment used	Acceptance limits/ criteria/ specified Value	Inspected value/ result	Remarks	Traceable register no.

d. In the test format, gauges should be mentioned for each operation, if used.

e. Flowchart presenting detailed system control.

4.7. Calibration scheme and status of calibration for test equipments:

Case-I : In-house calibration facility is available with the contractor.

A. Details of the master calibrator

Sl. No.	Model	Make	Range	Frequency of calibration	Name of the calibration agency	Date of calibration	Calibration certificate no.	Validity

B. Personnel trained for in-house calibration

Sl. No.	Name	Qualification	Experience

C. Calibration plan for measuring instrument

Sl. No.	Equipment name	Range	Accuracy	Frequency of calibration	In-house/ Outsourced	Date of calibration

Case-II : In-house calibration facility is not available with the contractor.

Sl. No.	Equipment name	Range	Accuracy	Frequency of calibration	In-house/ Outsourced	Name of calibration agency	Date of calibration

4.8. Customer complaint :

The contractor should have foolproof system of monitoring the customer complaints including warranty obligations with facility of traceability by the product identification no.

Warranty failures/ In-service failures reported from customers should be maintained in the format like below:

Sl. No.	Date of receipt of complaint	Letter no.	Complaint received from	Classification of failure	Brief details of	Whether any person deputed for collecting field sample	Date of joint inspection	Failure analysis &cause of failure	Date of compliance in case of warranty	C & P action taken
				Warranty failure/ In-service failure/ Call for joint inspection / Consignee end rejection / General complaints						

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The contractor shall maintain a complaint register in the above format and the summary required to be given during renewal of the contract.

5. Assistance to be provided by IR :

5.1. IR will give latest relevant specification, Design/ Drawings etc to the contractors as per the agreed terms and conditions.

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 DRAS for 3-phase electric locomotives based on the technical documents passed on to him 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 CLW. Notwithstanding approval from IR, the contractor will be wholly and completely responsible for the satisfactory performance of the equipment developed.

6.4. The contractor shall arrange for free of cost training of IR personnel in installation and commissioning, operation, maintenance and troubleshooting of the system supplied. Contractor shall also provided detailed technical write-up to all the trainees.

6.5. The contractor shall supply sufficient copies of user manuals in hardcopy as well as soft copy. This shall include system description and operating, maintenance, calibration and troubleshooting instructions. List of spares with part number with technical specification shall also be included.

6.6. Representative of IR shall be free to visit the works of contractor or his vendors during the stage of development and later during manufacturing to assess/check the manufacturing process, quality assurance etc. The contractor shall ensure that Railway representatives are given access to all information during their visits.

7. Tests and Trials :

7.1. The equipment shall be tested in accordance with the relevant IEC, IS, IRS, BS etc., as stated in the specification to the satisfaction of IR. The contractor shall arrange to conduct all such tests at his own responsibility and cost.

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 equipment will also be evaluated during operation under actual load conditions. 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.

7.4. During the period of prototype tests/ trials, if any problems are thrown up or feedback information is obtained, which warrants a re-check on the design/ manufacture/ quality of the equipment and components, action shall be taken as may be necessary by the contractor to carry out the required investigations and to incorporate the improvements considered most appropriate to reach compliance with the relevant specification without any extra costs to IR. Such improvements shall be carried out on all units of the equipment developed and will be evaluated for their validity for a further period of time as decide by IR in each case. Modifications mutually agreed to comply with the specification will be incorporated by the contractor at his own cost in all the prototype units as well as in all new units manufactured thereafter.

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 rating/capacity of these M&P should be adequate to perform the desired functions satisfactorily and quantity of these M&P should be available for smooth operation. 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.

8.4. Meticulous record of QAP shall be as per **Annexure-III**.

ANNEXURE-I

Manufacturing Facilities:-

The following minimum facilities are considered essential for manufacturing unit at the contractor's premises or at the approved sub-vendor's premises. The availability of facility either at the contractor's premises or at sub-vendor's premises shall depend on activity being done on that place.

Sl. No.	Details Of Machines
1	**DRAS equipments and it's enclosure assembly facility**
1.1	Drilling Machine (Vertical, Surface & Hand) with jig upto 25 mm drilling DIA
1.2	Hand Grinder, Tool Grinder, Angular Grinder
1.3	Welding Machine with current upto 300 Amp
1.4	CNC Milling machine (400 mm) for PCB face plate fabrication
1.5	Material handling trolley for 250 Kg
1.6	Digital Weighing Machine upto 0.5 ton
1.7	Anodizing/Plating/Powder coating
1.8	Torque wrench upto 300 Nm
2	**PCB Assembly facility**
2.1	Oven for PCB baking with range upto 100 degree C
2.2	ESD Protection as per IS:10087-1981 (Work Station including concern persons should have proper ESD band Protection)
2.3	Automatic/light beam guide component insertion machine or pick & place machine for SMD based PCBs
2.4	PCB wave solder machine for PTH, SMD and BGA technologies or Robotic soldering
2.5	Machinery for assembling Press fit connectors
2.6	Crimping tool for FRC and control power supply wires
2.7	PCB Conformal coating facility
2.8	Environmental chamber for Production Stage ESS for PCBs and DRAS equipment with range upto 85 degree C
2.9	Ultrasonic Cleaner
2.10	Temperature controlled de solder pump with range upto 450 degree C
2.11	Hot air gun and Illuminated Magnifier
2.12	Dust free environment facility
2.13	Component lead forming machines/ fixture for assembly of PCBs
2.14	In-circuit testing machine for checking the correctness of component inserted in PCBs and/or Automated optical inspection machine.

Below mentioned facilities are considered to be essential and should be available at contractor's premises.

3	**PCB and DRAS functional test facility**
3.1	Test bench for PCB and DRAS equipments for functional testing equivalent to locomotive operation.
3.2	DC Power Supply (Variable from 65 V to 145V,4A)
3.3	Testing Jigs for testing of assembled PCBs along with measuring instruments for different parameters
3.4	Burn-in test chamber (Minimum: minus 25° centigrade & plus 85° centigrade) for PCB

Sl. No.	Digital Embedded system tools
4	**Debugging equipments and software (essential at contractor premises)**
4.1	DRAS application software in application of the processor PCBs.
4.2	Flash programmer for DSP/FPGA/CPLD
4.3	Programmer for controller programming
4.4	Licensed software for circuit, PCB, layout and mechanical design tool
4.5	Embedded software development IDE
4.6	MVB programming tools
4.7	Graphical Display programming tools for UI
4.8	GSM module programmer
4.9	IC programmer
4.10	GPS data acquisition tool for programming
5	**Display system programming / data logging**
5.1	USB/PS2 Pen drive
5.2	USB/PS2 Keyboard
5.3	Ethernet and Serial Cables
5.4	Server with UI for displaying signals
6	**IEC-61375 TCN interface/Simulator (essential at contractor premises)**
6.1	MVB Diagnostic tool which can support TCN/MICAS based communication system (custom design)
6.2	Interface between MVB and Host PC (custom design)
6.3	DRAS control simulator for testing and verification for transfer of data to server for replicating different functionalities of Locomotives as executed by VCU-I & II.
6.4	Exclusive R&D facility, apart from Normal manufacturing setup.

Note :

- Firm should clearly mention about the details of outsourcing agency for respective activity, if any.

ANNEXURE – II

Measuring/Testing Equipments :-

The following minimum facilities for measuring/testing equipments are considered essential for manufacturing and the equipments should be available at contractor's premises. The rating of these equipments should be adequate enough to perform the desired function satisfactorily and also sufficient numbers of these equipments should be available to ensure smooth operation.

Sl. No.	Details of Equipment/Gauges.
1.	Digital Oscilloscope with Multi Probe (Storage type) with range upto 200 Mhz
2.	Digital Multi-meter with range 10 mV to 200 V
3.	Megger 500V and 1000V for Insulation testing
4.	Surge Tester with range upto 2KV.
5.	Laser Thermometer with range upto 200 degree C
6.	• Vernier Caliper • micrometer • Scale • Dial Gauge • Filler Gauge • Soldering Iron with Thermo control • Other measuring instruments for physical verification.
7.	Gauge to measure PCB conformal coating thickness upto 10 µm
8.	Different size of crimping tools (Power & Signal cables of 5 sq.mm maximum)
9.	Heat sink gun with range upto 200 degree centigrade
10.	Dielectric Tester upto 2KV
11.	Digital LCR meter
12.	Electronic leak detector
13.	Infrared Thermometer upto 200 degree C
14.	Baud Rate Checker
15.	GSM module programmer tool s showing signal strength also
16.	GPS acquisition tool
17.	Over/Under Voltage and Reverse Polarity test facility upto 150V DC

Below mentioned testing facilities should be available at contactor's premises or outsourced from NABL accredited laboratory:

20.	**Test to be conducted as per IEC 60571:2012 and IEC 61373:2010** ➢ Cooling test facility ➢ Dry and Damp heat test facility ➢ Vibration and Shock test facility ➢ Salt Mist test facility ➢ Water tightness test setup ➢ Transient Burst susceptibility, ESD and Radio Interference test facility

Note : All the measuring instruments shall confirm to relevant IS/IEC standards with up to date calibration.

ANNEXURE –III

Quality Assurance Plan :-

1. Organization

The contractor shall submit the organizational chart, along with qualification and experience of the key persons (in management) involved in Quality Assurance Programme. It will also be a perquisite for a contractor to submit QAP for getting approval for supply of Data Retrieval and Analytic System for Three Phase electric Locomotive.

2. Documentation

The contractor shall maintain all necessary documents and data that will help him to have consistency in producing quality product.

3. Purchase of raw material

Raw material/equipments shall be procured only from well-proven sources (having requisite ISO certificate), conforming to relevant standards and critical components shall be procured from ISO: 9001 - 2008 or latest certified vendors only.

4. Quality Control-Process

Screening of critical electronic components/devices shall be carried out as a part of in-process quality control.

5. Inspection and Testing

i) Bill of Material (BOM): A complete Bill of Material indicating all input material items, required for manufacturing of the product, alongwith specification and their sources of supplies as approved by the contractor in accordance with clause no. 7.4.1 of ISO:9001- 2008 or latest should be furnished. Test results of incoming raw materials with reference to test certificate issued by the supplier and the results of internal tests carried out by the contractor for verification may be submitted as part of QAP.

ii) Receiving Material: The contractor shall ensure that incoming material is not used for processing until it has been inspected or otherwise verified by contractor's QC as conforming to specified requirements. Verification shall be in accordance with quality plan or laid down documented procedures.

iii) In process inspection and testing: Inspect, test and identify product as required by the quality plan or documented procedures evolved on the basis of above mentioned specification and other relevant specifications/standards.

iv) The contractor shall carryout all final tests and inspections in accordance with the quality plan or documented procedures evolved on the basis of mentioned specification and specified standard to complete the evidence of conformances of the finished product.

v) The consistency type testing shall also be carried out on the product as per the specification.

6. Testing / Measuring Instruments

i) The instruments and equipments, used for testing and inspection, shall be of the required accuracy and with properly calibrated.

ii) All required facilities for routine testing shall be available at the contractor's premises. In the event of non-availability of shock & vibration test and environmental test or any other type test facility at the works of the contractor, the tests may be conducted at any NABL accredited laboratory and the relevant test results shall be submitted to IR for verification.

iii) The accuracy & capacity of the testing & measuring equipments shall be adequate to meet the requirements of the specification. The testing & measuring equipments shall be duly calibrated at regular intervals from the NABL accredited lab & the valid calibration certificate shall be produced during the stage of development and later during regular manufacturing of the product on demand by the IR inspecting authority.

iv) Cleaning facilities.

7. R&D Organization

The contractor shall specify the organizational structure of their R&D wing along with qualification of the personnel. The contractor should have at-least one Engineering Graduate design engineer with experience of more than 5 years in the relevant field and at least three or more Diploma Engineers with experience of more than 5 years in the relevant field.

8. Laboratory Test House

The contractor shall have a well-equipped Laboratory/Test House to carry out various tests on the raw material, stage inspection and inspection of the finished product.

9. Quality Audit

To ensure quality of the material supplied by the firms, regular checks/Quality audit shall be made on their quality assurance programme including machinery & plant, man-power, sources of raw material and the firm's own internal quality checks by Indian Railway inspection authority on demand, or on need basis based on adverse field performance report. The firms compliance of STR, Specification, Bill of material and QAP shall be verified during this quality audit Further the quality audit report shall consist of certain documents like valid factory license, latest electricity/water bill, Valid ISO and MSME certificate, latest ITR reports and certificate of incorporation under the companies act etc. Representatives of IR shall be free to visit the works of the contractor or his sub-vendors during the stage of development and later during manufacturing to conduct surprise check on manufacturing process and quality control along with any of the tests to ensure quality of the product and its conformance to the indicated specification. The contractor or his sub-vendor shall ensure that Railway representatives are given access to all information during their visits. Further the Quality Audit Plan shall be as per CLW format which can be downloaded from the below mentioned link

https://ireps.gov.in/ireps/upload/vendorApproval/vrinstdoc/21_04/CLWQAPFormat.pdf

10. Handling/ Storage/ Delivery

The contractor shall have proper facilities for handling and storage of raw material and finished product. The contractor shall control packing presentation and marking process so as to ensure conformity to the railway requirement.