PART- 0
(Overview)
of
Technical Specification
of
Data Retrieval and Analytic System
for
Three Phase Electric Locomotives

Specification No. CLW/C-D&D/ES/3/0554

Issued in: April 2024

Total no. of sheets-16

ISSUED BY:
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Brief Description

This is a part of a four-part specification numbered 0 to 3 describing the requirements for setting up systems for Data Retrieval and Analytics System (DRAS) for Three Phase Electric locomotives.

FOREWORD

DRAS Enables remote monitoring of Electrical Locomotives. It creates a complete IT enabled ecosystem which provides a platform for remotely monitoring health and operational characteristics of electric locomotives.

It also enables monitoring of performance of crew and helps in identifying lapses. This will enable focused counselling and training of such crew, who are prone to unsafe working.

DRAS also monitors condition of locomotive and makes preventive and predictive maintenance of locomotives more effective. DRAS monitors shutting down of locomotives when idle for a long time and generates management information to ensure this.

The complete specification for DRAS is split over four parts numbered from 0 to 3. Together these parts specify the requirements for setting up the complete system.

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STATUS OF REVISION

Sl.No.	Date of Revision	Clause No.	Page no.	Alteration	Reasons for Revision
1	April'24	All	All	Nil	First Issue
2					
3					

TABLE OF CONTENTS

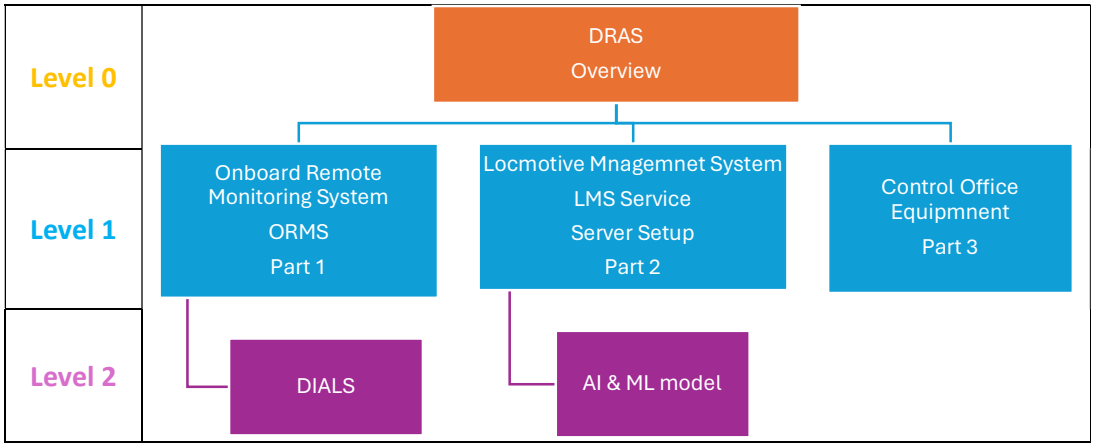
1. Introduction

This document is part of set of documents specifying equipment and services for the deployment of DRAS. Kindly see the list of referenced documents for locating other documents of the set.

Electric locomotives of IR are fitted with Microprocessor based control, which have fault diagnostic and locomotive health monitoring system. These systems capture the operational and performance data of locomotive continuously.

This document provides the overview of a set of specifications that aim to capture, relay, analyse and present this data to maintainers for improving maintenance by applying condition monitoring strategies.

The specifications of this set of equipment / service requirements are detailed in their respective specification. The relationships of the different specifications included in this set are as given in the diagram below:



2. Scope & Objective:

This document outlines the scope of requirements and the inter-relationships for setting up DRAS systems. The complete deployment of DRAS requires the following sub-systems:

- 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.

The implementation of DRAS will require equipment and services to be procured. The related specifications contain the technical details for the procurement and equipment and services. This specification gives a general guidelines for design, development, manufacturing, testing, supply, commissioning and field validating of Data Retrieval And Analytic System (DRAS) and the main objective of DRAS is to develop interface equipment for three phase electric locomotives (WAG-9, WAG-9H, WAP-7 and WAP-5 classes) for real time monitoring and data analytics of performance of key equipments provided on three-phase electric locomotives

3. Abbreviations & Keywords used throughout the document:

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

4. Keywords:

4.1. Onboard Remote Monitoring System (ORMS): ORMS includes Remote Monitoring Unit with GPRS/CDMA/3G/4G/LTE/5G connection and GPS. The purpose of ORMS System shall be for real time monitoring of loco parameters & transmission thereof and shall include necessary remote monitoring units, cables, interfaces, software

etc. Further it is recommended to use stable communication as per latest technologies available.

4.2. Data: Complete data frame consisting of loco parameters (process data on MVB), fault generated (event data/ Process Data/ Conditional data/ DDS) for MICAS/TCN based system, GPS data and self- generated data.

4.3. Display: The format in which the data is displayed on its website shall be mutually agreed by Indian Railways/CRIS and the contractor.

4.4. Server: There shall be server as under:

- Web application server of ORMS's web portal setup, operated and maintained by IR and/or CRIS.
- The other is optional web application vendor server at contractor specified location setup, operated and maintained by setup, operated and maintained by the contractor. The primary requirement of DRAS is that packet data from ORMS shall be directly transmitted to the web application server of IR. The ORMS device provided by vender shall have the required hardware and software in system to transmit the data to server of IR and/or CRIS. There may be optional provision to transmit ORMS data to Vendor server in parallel. Railway may also ask for integration of vendor server with IR server till web application server of IR and/or CRIS is not operational. The vender require to associate with IR and/or CRIS for finalization of technical details for development of web application server, website and backend application at IR and/or CRIS server.

4.5. Website: The website, hosted by Railways, where data pertaining to ORMS from all the locomotives can be made available. Loco number shall be the link to the server of respective vendors.

4.6. Communication: Protocol, software, hardware such as SIM cards are included in communication.

4.7. Parameter: Items related to the operation of major safety equipments of locomotives such as speed, node progressing, temperature of main transformer, BP pressure etc.

4.8. Real time data: Data of the parameters (as given in this specification), representing the health of the locomotive, shall be viewed in the web page on actual time basis during which a process or event occurs.

4.9. Background data: It is a snapshot of the status of various signals taken before and after fault occurrence as given in this specification.

4.10. Diagnostic data: Fault/error messages including background data, necessary for analyzing/ diagnosis of any type of fault that occurs in the locomotive.

4.11. Recorded data: It remains stored in the respective web application server for a minimum period of time (as specified in this specification) like a record and may be required as a supporting document during analyzing/ diagnosis a fault/ event.

4.12. Configurable data: Parameters of the locomotives which are manually pre-set by an authorized person with secured login and password protection for reliable and safe working of locomotives.

4.13. SADS: Situation Awareness Display System (SADS) is a network of PCs connected to multiple large-screen LCD monitors which displays real-time information.

4.14. Geo-fence: A geo-fence is a virtual perimeter for a real-world geographic area. This is developed using GPS sensing and referencing with a set of coordinates stored in a database that define the virtual fence.

4.15. Communication link: Locomotive on-board equipment shall be equipped with GPRS/GSM/EDGE/CDMA/LTE/3G/4G/5G based communication system for relaying of acquired data.

5. Brief description of the system/equipment/components

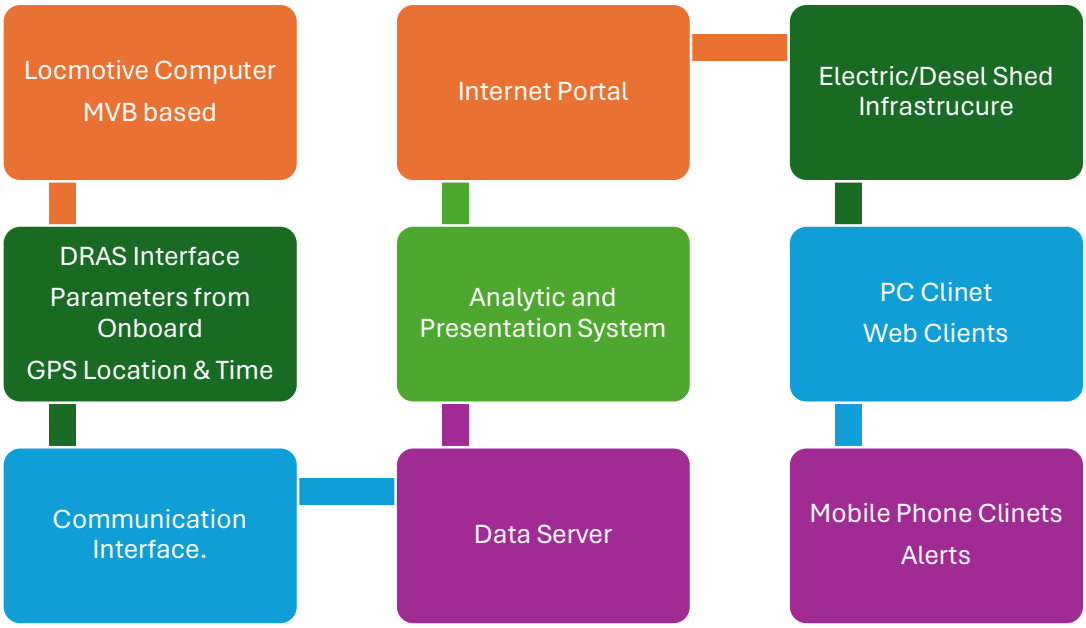
The overall aim of the project is to provide an intelligent, time saving infrastructure that provides capability to identify and grade locomotives in real-time for proper planning of maintenance and prevention of line failures.

The primary aim of the proposed system is to improve the utilization of locomotives by taking corrective measures at right occasion in case of online failures. The real-time monitoring facility in locomotives shall provide fast decision making at appropriate level, thereby, leading to an improvement in reliability of the locomotive. It shall create a complete IT enabled ecosystem which provides a platform for remotely monitoring health and operational characteristics of three-phase electric locomotives and will help in predictive maintenance. Basically, the data shall be collected from the locomotive computer, relayed to the remote server via communication link. The data shall be stored on the server, analysed as per pre-defined or user defined rules and presented via simple and easy to use web interfaces.

The complete DRAS system shall consists of locomotive on-board equipment, communication interface, data logging server, data analysis engine, data presentation application, user client (both PC and cellphone based). A 24x7 helpdesk at sheds, Divisions Headquarters and PUs is specified for providing assistance for maintenance of system and also for troubleshooting of the locomotives though Control Office Equipments (COE).

The data shall be collected from the locomotive computer, relayed to the remote server via communication link. The data shall be stored on the server, analyzed as per pre-defined or user defined rules and presented via simple and easy to use web interfaces.

The following figures provide the overview of the equipment and services that are required for implementation of DRAS:



6. General requirements

The equipment supplied against this specification shall meet the following general requirements.

- The equipment supplied shall be of good quality, rugged and reliable and capable to withstand environmental and use conditions. The individual components shall meet the lifecycle for that category of equipment.
- Wherever outsourced equipment is used care shall be taken to ensure that the equipment is sourced from reputed manufacturers.
- The supplier of equipment supplied under this specification shall ensure proper interfacing and connectivity between equipment / software.

7. Functional Requirements

The expected functional requirements of the system components are provided briefly as under.

7.1. Locomotive on board equipment: The onboard equipment shall interface to the locomotive Vehicle Computer in a manner such that all parameters acquired by the vehicle computer are available for further processing. This equipment shall have its own independent GPS system for getting the geographical location.

7.2. Communication system: Locomotive on-board equipment shall be equipped with communication link-based communication system for relaying of acquired data to the servers.

7.3. Data analysis and presentation systems: These shall be server-side applications running at the data centres and shall analyse the data as per predefined /user defined rules. This software shall also prepare the information generated for display on the internet portal.

7.4. Internet Portal: A secure internet portal shall form the user interface of the DRAS system. All users shall interact through the portal.

7.5. Client applications: PC and mobile applications shall form the applications for interaction for users. Additionally, data analysis and visualization application shall be provided on the PC for further analysis as required by the user.

7.6. Geo-fence development: The LMS provider shall be required to develop geo-fences for identification of locomotive location. These fences shall demarcate boundaries of railway zones and divisions.

7.7. 24x7 technical helpdesk: This helpdesk at Electric/Diesel shed shall provide support for running of the system. Control Office Equipment specified in the specification mention the requirements for working of help desk.

7.8. Training: Training of users shall be an inherent part of service to be delivered. The users shall be trained for use of different applications and software provide.

8. Overview of DRAS Dataflow

i. The data is generated in the Locomotive control computer.

ii. ORMS system shall be able to record long and short-term event recorder and fault data packs. Data is stored in the ORMS system data logger. ORMS shall have the required non-volatile memory for recording of 72 hours of short-term data with a sampling rate of 1 sample per second. Approximately 100 signals shall be required to store in initial stage. Final list shall be decided during the design finalization stage. Long term data to approximately 90 days with a sampling rate of 1 sample per 10 second shall be recorded. Approximately 100 signals shall be required to store in initial stage. Final list shall be decided during the design finalization stage. There shall be provision to download the above data in laptop and visualize it thought proper applications.

iii. The DRAS-ORMS equipment shall also acquire the data and add GPS location and RTC time and transmit the same wirelessly to the remote data-logging servers. The details are provided on this specification at relevant clause.

iv. Data shall be received and assembled at the data-logging servers

v. Data shall be stored in TDMS files and RDBMS.

vi. Data stored in the RDBMS shall be made available through http on web pages designed using the SADS concept.
vii. The information shall be viewed using clients running on PC / laptops and phones.
viii. The TDMS files shall be available for download using FTP.
ix. The downloading programme shall convert the data to TDMS file.
x. The TDMS file generated shall also be available for local data analysis if required

9. Technical Requirements

Detailed technical requirements for each component of the DRAS systems are provided in the relevant part of the specification.

10. Applicable drawings

Applicable drawings (if any) for each component of the DRAS systems are provided in the relevant part of the specification.

11. Safety Requirements All equipment provided under this specification shall meet the existing safety norms as applicable for the respective environment. The applicable norms are listed in the relevant part of the specification.

12. Environmental / climatic requirements All equipment provided under this specification shall meet the prescribed environmental requirements as prescribed in the relevant part of the specification

13. Referred standards

The following standards are referred by this specification. It is requested to kindly ensure operational understanding of all the referred standards.

- IEC 801-1,2,3,4,5,6 for Electromagnetic compatibility for Industrial Process measurement & control equipment
- EN-50155 Railway applications electronics equipment used on rolling stock
- IEC 61375 Train Communication Network
- IEC 60529 Degrees of Protection provided by Enclosures (IP Code)
- AAR S-9401 or IS equivalent for testing for affect of working environmental conditions
- EN-50121 EMC Emissions to external environments
- IEC-60077 Rules for equipment for onboard rail vehicles
- IEC 61373 Electric Railway Equipment-Rolling Stock-Shock & Vibrations Requirements
- CMMI-SVC for service provision
- IEC 60571 or IS equivalent for rail road electronics
- IS 2500 for sampling plans
- ISO 27001 for information security management systems

- ISO 9001 for Quality Management System
- ISO 9421 guidelines for user interface development
- NMEA 2000 (IEC61162-3) for sharing of GPS Data
- TIA-942 for server uptime
- UL 60950 for safety of mains powered equipment.

14. Maintenance and diagnostic aid As listed in the relevant part of the specification.

15. Documents to be supplied by the equipment supplier As listed in the relevant part of the specification.

16. Approval for Design:

16.1. Design Aspect: The design shall be developed based on the requirements given in this specification and sound engineering practices. The entire design of the system shall be supplied by the Contractor with required technical data and calculations to CLW for approval before commencing the manufacturing. This includes hardware and control logic and detail operation with functional description of the system which will be implemented.

16.2. Documentation: The Contractor shall submit the following information also for the design approval in printed form and digital format:.

i. Schematic Circuit.

ii. Functional description in detail with frame data which will captured and sent to server.

iii. System design concept including protection schemes (both electrical and mechanical).

iv. Detailed description of mounting, cables, connectors and connection diagrams of each system/ sub-system which are to be interfaced with locomotives.

v. Complete Bill of Material (BOM) including quantity, contractor details etc., of each component/ material.

vi. Modifications, if any, needed in the present existing locomotive to accommodate the offered system.

vii. Clause by clause compliance of this specification.

viii. Details of technical support and training offered.

ix. Detailed recommended list of spares with cost for 3 years' maintenance after warranty.

x. List of special tools, jigs and fixtures needed for assembly, testing, commissioning, maintenance and repair of the system.

xi. Mechanical drawings of complete system as well as major sub-assemblies, details of dimensions, mounting arrangement and weight etc. Details of mounting accessories shall also be provided. Protection against dust and water ingress shall be explicitly shown.

xii. Details of infrastructure, manufacturing, testing and service engineering activities in line with guidelines issued.

xiii. ISO certification.

16.3 Approval of design means the approval of general design features. Notwithstanding the approval, the supplier will be wholly responsible for the performance and reliability of the complete system.

17. Accessories As listed in the relevant part of the specification.

18. Training As listed in the relevant part of the specification. Further The supplier shall arrange for training of Indian Railway personnel in various loco sheds and training schools regarding maintenance & trouble shooting of the system supplied. The supplier will provide detailed technical write-up to all the trainees. The frequency and man-hours of training shall be mutually decided by IR and Contractor.

19. Tests and verification As listed in the relevant part of the specification.

20. Types of tests As listed in the relevant part of the specification.

21. Painting labelling and marking As listed in the relevant part of the specification.

22. Packing and delivery As listed in the relevant part of the specification.

23. Field Trials: After successful completion of prototype type test, the RMS shall be subjected to field service trials for minimum, defect free, 50,000 Km of service cumulative. 10 (ten) nos. of RMS unit of each supplier shall be subjected to field/ service trials. Venue of trial shall be mutually agreed between the purchaser and the supplier. Locomotives, provided for field trial, shall be preferably based at one loco shed for the ease of monitoring and after sales support.

24. Guarantee / Warrantee:

24.1. The contactor shall warrant that everything to be furnished under the contract shall be free from defects and faults in design, material, workmanship and manufacture, and shall be of the highest grade and consistent with the established and generally accepted standards for stores of the type ordered and

in-full conformity with the contract and samples, if any, and shall, if operable, operate properly according to the contract.

24.2. The warranty for the stores to be supplied under this contract shall be 72 months from delivery or 60 months from date of satisfactory commissioning and acceptance test of the stores, whichever is earlier.

24.3. The contract shall immediately on receipt of notice of defect depute his engineer to start action for rectification of defects under warranty.

24.4. In the eventuality of major design modifications during the currency of the warranty period the warranty for such components shall be extended for such period as is mutually agreed.

24.5. The period of warranty will be extendable in case of recurring problems attributable to defective material or manufacturing.

24.6. The supplier shall be responsible for carrying out all the modifications at his own cost on any part of the equipment during the period of warranty provided such modifications/ improvements are decided (jointly between contractor and purchaser) to be necessary for meeting the requirements of reliability, performance and safety etc., of the equipment.

25. Intellectual Property Rights

25.1. Undertaking by equipment manufacturer Undertaking is to be signed by Vendors on “INFRINGEMENT OF PATENT RIGHTS”. The undertaking can be as under "Indian **Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/matters lies with the manufacturer/ supplier. Details / design/documents given by them are not infringing any IPR and they are responsible in absolute and full measure instead of railways for any such violations. Data, specifications and other IP as generated out of interaction with railways shall not be unilaterally used without the consent of CLW and right of Railways on such IP is acceptable to them.**

25.2. Declaration of confidentiality of submitted documents by manufacturers While submitting a new proposal/design, manufacturer must classify their documents confidentiality declaration, such as **This document and its contents are the property of M/s XYZ (Name of the vendor) or its subsidiaries. This document contains confidential proprietary information. The reproduction, distribution, utilization or the communication of this any part thereof, without express authorization is strictly prohibited. Offenders will be held liable for the payment**

of damages. Indian Railways/CLW is granted right to use, copy and distribute this document for the use of inspection, operation, maintenance and repair etc.

26. Information to be supplied by supplier As listed in the relevant part of the specification.

27. Information to be supplied by purchaser As listed in the relevant part of the specification.

ANNEXURE 1: DRAS Performance Parameters

The following services shall be provided and monitored as part of this specification.

S. No.	Service	Performance Parameter	Desired Value	Remarks
1.	Communication service for data transfer from locomotives	Ability to send data at rate better than once every 1 second	Compliance better than 95%.	This requirement shall be adhered to by the ORMS provider. The measurements shall be done at server side by using software tools developed by ORMS provider or by use of 3rd party APM tools.
2.	Data centre	Uptime of internet site	As per TIA 942 Tier III	This requirement shall be adhered to by the LMS provider. The measurements shall be done at server side by using software tools developed by LMS provider or by use of 3rd party APM tools.
3.	Data centre	Time to login to the site	Less than 10 seconds for 95% of login requests.	
4.	Data centre	Guaranteed minimum data transfer rate from site to client.	128 kbps	
5.	Data centre	Time to respond to service request. (All types HTTP, FTP ODBC etc)	Less than 5 seconds for 95% of requests.	
6.	Operation of SADS and DAWS at control offices.	Equipment uptime including connectivity	Better than 95% of demand.	

7.	Operation of software only clients.	Software uptime.	Better than 95% of demand.	
8.	Technical Support	Queries sent by email, letter, SMS	For 95% of cases, within 24hrs and problem resolution in 72 hrs	Measured on the LMS implemented by the LMS service provider. Cases where response time is mutually agreed to be longer shall not be considered.
9.	Technical Support	Deputation of personnel	For 95% of cases, within 24hrs and problem resolution in 72 hrs	Measured on the LMS implemented by the LTMS service provider. Cases where response time is mutually agreed to be longer shall not be considered.