PART- 3
(Control Office Equipment)
of
Technical Specification
of
Data Retrieval and Analytic System
for
Three Phase Electric Locomotives

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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 three phase Electric Locomotives. It creates a complete IT enabled ecosystem which provides a platform for remotely monitoring health and operational characteristics of three phase 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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3					

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1. **Introduction:**
   This document is part of set of documents specifying equipment and services for the deployment of DRAS system for three phase electric locomotive. Kindly see the list of referenced documents for locating other documents of the set.

2. **Scope & Objective:**
   This document details the specifications of equipments required for the interface of operations and maintenance staff involved in Electrical loco operations. Such systems shall be installed at Electrical/diesel loco sheds, power controller's office at the divisional control office, loco driver lobbies and zonal power controller's office, Production Units etc as per requirement.

3. **Abbreviations & Keywords used throughout the document:** Kindly refer to part 0 of the specification.

4. **Keywords:** Kindly refer to part 0 of the specification.

5. **Brief description of the system/equipment/components:**

   The different kinds of the points of control for operations and maintenance of Electrical locomotives require varying level of user's inputs. Different types of interface systems are required handling these requirements. These systems shall use the following different type of components:
   - **SADS (Situation Awareness Display System):** These systems shall consist of large LED backlit displays connected to an embedded PC. These shall be used for displaying the overview of locomotives on a GPS overlaid map.
   - **DAWS (Data Analysis Work Station):** DAWS shall consist of high end PC with two displays, KVM switch and data analysis and office software and network connected laser printers.
   - **Remote office communications and asset management equipment:** This equipment shall be mounted in 19" racks of suitable size. This equipment rack shall provide connectivity for DAWS and SADS and also provide data backup and remote management facility.
   - **Power conditioning equipment:** shall be provided for all mains powered equipment.
   - **Software** only clients working on existing PC and notebooks: These shall be provided as a download from website.
   - **Apps for use on PDA's and smart phones:** These shall be provided as a download from website for Android/IOS platform.
   - Modular furniture prewired and configured to mount computers and display screens.

6. General requirements

The following general conditions apply to all equipment that shall be supplied against this specification.

6.1. Quality of equipment / software

6.1.1. The equipment and mounting racks, tables and chairs shall follow OSHA guidelines for office working.

6.1.2. All equipment shall be from reputed manufacturers and shall be of good quality.

6.1.3. All software shall be developed with proper documentation and be thoroughly tested before deployment.

6.1.4. All computers workstations supplied shall have remote management features.

6.2. Requirement for service provider

The LMS system and its clients shall be developed, deployed and maintained IR and/or CRIS as per requirement mentioned in part-2 of this specification. Further the ORMS and CLW in consultation with propulsion manufacturers will assist IR/CRIS and LMS vendor in development of LMS and GUI and will also help in implementing the AI and ML model for predictive analysis.

6.3. Duration of contract

Since a considerable effort and experience are required for developing, testing and deployment, the duration of this contract shall be at least five years or more preferably tallying with the life of equipment and technological obsolescence. The duration of the contracts may be suitably modified by the agency initiating the contract and as such the correct duration may be mentioned in the tender documents.

6.4. End of life/termination of contract

The equipment / service provider shall handover the following at the time of:

- Source of all equipment and ordering specifications
- All software source code and configuration files
- Details of header files, libraries and compilers used for creation of software.
- Full rights to ownership of the code and details provided.
- The developer may retain rights to re-use the code, configuration and specifications for any other application or customer.

7. Functional Requirements:

The functional requirements of the system components and the hardware configuration are described for each component in the following paragraphs. The systems provided here shall abide by the guidelines contained in **ISO 9241** as applicable.

7.1. SADS

This display system shall display the locomotives equipped with DRAS on large display screens as icons on a map of India.

7.1.1. SADS equipment

The systems shall conform to the following broad specifications

- 60” or larger LED backlit TFT screen with HDMI interface
- Thin client or mini PC with compatible HDMI output
- Features for remote desktop support and remote management software.
- The PC system shall be connected to the internet access point and the keyboard and mouse input shall be shared with the DAWS through a KVM switch.

The system shall run suitable OS and shall have a SADS application. The SADS application shall be a web based application running within a browser or a client application that gets data from the internet

7.1.2. SADS Display

A sample picture is provided below for understanding the screen layout as applicable to the current application.

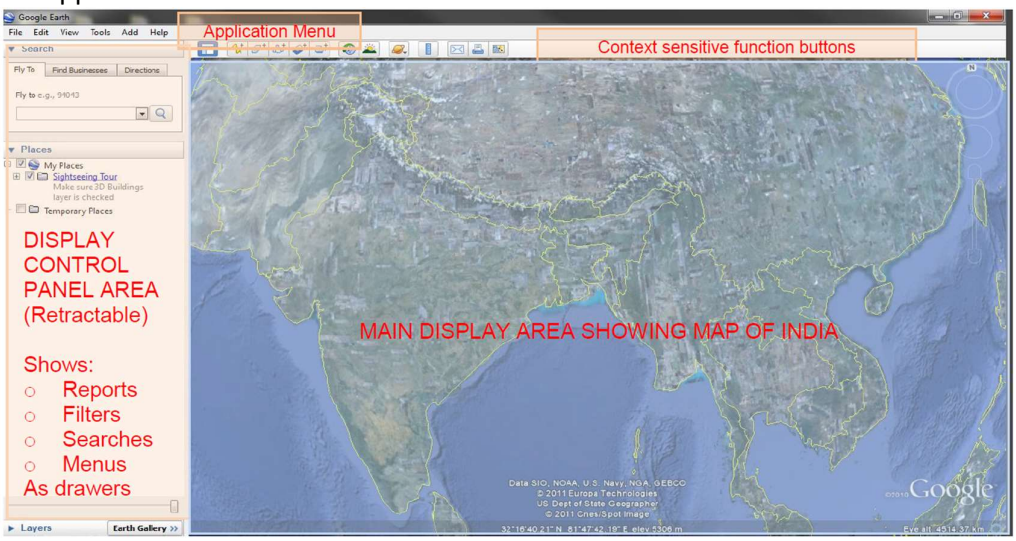

Figure 1: Layout of SADS display (based upon interface of Google Earth)

The basic underlying concept for display on the SADS shall be: "Overview first, zoom and filter, then details on demand." The application software user interface shall be built loosely on the design of 'Google Earth'.

7.1.3. Map display The following requirement shall be met by the SADS map display.

- The application shall use the large format display as the main display screen.
- The output on the large screen shall be a map of India with GPS mapping overlay.
- This map shall be of good resolution such that the display remains readable at different levels of zooming in/out. Use of Google Maps is suggested.
- The India map shall have dynamic auto zoom and pan feature which shall have the options of switching on or off.
- When the auto zoom and pan feature is selected as on, the display on the screen shall automatically zoom and pan in such a manner that all selected locomotives are displayed on the screen.
- When the auto zoom and pan feature is turned off, the user shall be able to zoom / pan the map manually using mouse and / or keyboard commands.

7.1.4. SADS User Interface

- The user interface shall be all graphical (GUI) and shall be designed to be similar to modern software user interface. The GUI for commonly used software like MS Office, AutoCAD and Google Earth etc., shall be studied to arrive at the best possible options for menu and options navigation.
- The UI shall use hyperlinks and ESC. FORWARD, BACK and HOME options for data navigation.
- Clicking on hyperlink shall open new window with additional data / hyperlinks.
- Pressing ESC shall reverse the last command.
- FORWARD / BACK shall mean one step forward / one step back similar to a web browser.
- If data or options are required to be entered, these shall be done by opening context sensitive forms by following hyperlinks.
- Right clicking from the mouse shall open a context sensitive menu at the cursor location.
- AutoCAD style pan and zoom feature for controlling the map extents shall be implemented.

7.1.5. Display of prebuilt reports

Options of prebuilt reports shall also be provided on the display control bar on the left of the screen. It should be possible to view, print and save all pre-built reports. The list and contents of pre-built reports shall be worked out jointly by the system manufacturer and CLW. These reports shall be displayed in a new window with options to view, print & save.

7.1.6. Locomotive Icons

Locomotives in communication with the central server shall be shown as icons at the GPS mapped location. These icons shall be able to display the direction of motion of the locomotive e.g ( ).The icons shall be coloured with different colours depending on the state of the locomotive. The following color scheme shall be followed for depiction of locomotives on the map. The color of the locomotive icon shall be determined by the locomotive condition

Locomotive Condition	Locomotive Icon	Description of locomotive condition
ALL OK		Locomotive running okay.
OVERDUE		Locomotive running overdue schedule
IDLE		Locomotive idling
DEAD		Locomotive in dead condition
ALERT		Locomotive having alerts
CRITICAL ALERT	(Blinking)	Locomotive having critical alerts

7.1.7. Locomotives with communication loss Locomotive equipped with DRAS but not responding shall be listed in pop up table. A link to this table shall be provided on the left hand side control panel of the main display in a subtle hyperlink and also as a popup menu obtained by right clicking the map. Clicking on the hyperlink shall open a web page displaying the uncommunicative locomotive numbers. Clicking on the locomotive number shall open additional windows with further details.

7.1.8. Display filters

It shall be possible to reduce clutter on the map display by reducing the number of displayed locomotives by applying criteria filters. This shall be possible using multiple filter options that shall be independent of each other. It shall be possible to apply filter criterion of different categories simultaneously. These filter categories and criteria are listed as below:

7.1.8.1. Category 1, Filter based on locomotive location

This shall have the following mutually exclusive criteria:

- No filter set: Show all locomotives.

- My Division: Show locomotives within the boundaries of My Division. The default division shall be entered in the configuration files of the application.
- My Railway: Show locomotives within the boundaries of My Railway. The default railway shall be entered in the configuration files of the application.
- Select Division: Show locomotives within the boundaries of selected division. The selection of division shall be made via a combo box.
- Select Railway: Show locomotives within the boundaries of selected railway. The selection of division shall be made via a combo box.
- Locomotives with specified radius of cursor location. Show locomotives within specified distance (radius) of the cursor.
- Default: It shall be possible to set one of the filter options as default. The locomotives shall be displayed as per this default option.

7.1.8.2. Category 2, Filter based on locomotive condition This shall have the following mutually exclusive criteria

- No filter set: Show all locomotives
- All OK: Show only locomotives that are running all right.
- OVERDUE: Show only locomotives that are running over due schedule.
- IDLE: Show locomotives that are idling.
- DEAD: Show locomotives that are dead.
- ALERT: Show locomotives with outstanding alerts.
- CRITICAL ALERT: Show locomotives with critical alerts.
- Default: It shall be possible to set one of the filter options as default. The locomotives shall be displayed as per this default option.

7.1.8.3. Category 3, Filter based on locomotive numbers, ownership, operational control

- No filter set: Show all locomotives
- My Locos: Show only the locomotives homed by the shed. The default shed shall be entered in the configuration files of the application.
- Select Shed: Show only the locomotives homed by a shed. The selection of shed shall be made via a combo box.
- My Railway: Show only the locomotives owned by the railway. The default railway shall be entered in the configuration files of the application.
- Select Railway: Show only the locomotives owned by the selected railway. The selection of railway shall be made via a combo box.
- Select loco number: Show the selected loco number. The loco number shall be entered in a text box.

- Select a set of listed locomotives: Show only the locomotives listed in a list. A new list of locomotives shall be entered if required. Lists shall be saved by name for reuse.
- Default: It shall be possible to set one of the filter options as default. The locomotives shall be displayed as per this default option.

7.1.8.4. **Clicking a locomotive icon on the map** Clicking on a locomotive icon shall open a pop up window showing the locomotive number, homing shed, owning railway and alerts if any. Option for further expansion shall be provided as hyperlinks which shall open other window containing data entry forms and parameter reports. Updating data on forms presented in this application shall update server and locomotive records. It shall be possible to display the list of locomotives displayed on the GPS map in a separate pop-up window on requirement. The following details shall be provided in this list. Option to export this list to a MS Excel file shall also be provided.

- Locomotive Number
- Locomotive condition attribute.
- Shed, Railway
- Last schedule done
- Next schedule due
- Faults recorded in last 1/7/15/30/45/90/180/270/360 days. (Time duration to be selectable in the window)
- The window shall have hyperlinks to retrieve the relevant FDP.
- Selection filters set for the list.

7.2. **DAWS** The DAWS system shall be a high end PC with the following minimum specifications:

- Quad core processor
- 16 GB RAM
- 1024 GB HDD/SDD
- Graphics controller for dual head display
- High resolution TFT displays with 24” diagonal screen size, two numbers.
- MS Windows 11, 64-bit professional operating system or latest.
- MS Office 365 or latest.
- Remote management software.
- Any other high end software required for shed control offices

Each DAWS shall be equipped with a A3 size, heavy duty, color laser printer with network interface. The SADS PC shall be configured for remote desktop connection with the DAWS system. The keyboard and mouse of DAWS shall be routed through a KVM switch to enable the same to be used on the SADS. The DAWS system shall be connected to the internet via

the communications rack and have full capabilities for communicating with the central server.

7.3. Pre-wired modular workstation

A single control office shall be equipped with two SADS and two DAWS systems. These systems shall be arranged and installed on a T-shaped modular workstation with integrated cable management systems. The following features shall be provided on the modular workstation:

- The workstation shall each be of 5'x5' making the total size to 10'x5' approximately.
- The SADS displays shall be installed such that the bottom edge of the display is at a height of 5' (approximate) from the floor. These shall be installed preferably along the longer edge of the T and facing the operators.
- The DAWS system shall be installed such that it is possible to be used sitting at the workstation.
- Four comfortable chairs shall be provided with each T shaped modular workstation, permitting operators to work efficiently without fatigue.
- All interconnecting wiring for LAN, power supply and telephones shall be done inside the cable management system and adequate ports shall be provided on the work surface. The minimum number of spare ports, per work area (after fitting all specified equipment) required are given below: (Note the requirement shall be double for a T-shaped workstation)
    - LAN RJ45 : 2 nos
    - Telephone, RJ11 :2 nos
    - Power supply, 5 amp sockets: 3 nos.
- All wires shall be brought out to interface boxes one for power supply and another for the communications cables. These boxes shall be designed to accept connections from the control room circuits.

Figure 2: Mockup of SADS + DAWS on the T-shaped workstation (for guidance only)

7.4. Communications Rack

All communications and remote management equipment shall be housed in a single 19" rack of adequate size.

This rack shall have the following equipment on board:

- WAN communications device
- WAN router
- Firewall / VPN devices
- Application performance measuring device
- NAT edge processor
- Network switch
- Network Attached Storage device of adequate capacity for data backups.
- Power supply distribution, conditioning and UPS system for the rack equipment. Further An Integrated Services Router for remote office can be considered for meeting the network requirements listed above.
- The communication rack shall provide internet access to all the systems installed at the respective control office.
- The communication rack shall provide internet access to all the systems installed at the respective control office.
- VOIP based handset for service during emergency/faulty/trouble shooting.

7.5. Power Conditioning Equipment

Adequate size UPS system capable of providing upto 6 hours backup shall be provided for power supply to the SADS and DAWS equipment.

7.6. PDA's and smartphones with apps

Smart phones running Android/IOS operating system shall be provided with Apps displaying data in manner similar to the SADS. These phones shall be provided as required for use by the railway officials. Only the equipment and required app shall be provided. The connectivity for voice and data shall not form a part of the scope of supply for this specification. Apps for Android/IOS platform shall also be provided for download from the central server for use by personnel. These shall be provided after due authentication.

7.7. Software clients

Software only clients shall be provided for downloads from the central server. These shall be provided after due authentication. These clients shall be used on existing PC's and notebooks.

7.8. Standard ordering combinations

The following table lists the general guide for standard ordering combinations for control office equipment.

Control Office equipment
SADS: 2 Nos DAWS: 2 Nos Modular T workstation: 1 Nos Communications Rack: 1 Nos Power conditioning Equipment: 1Nos Smart phones with SADS apps: 4 Nos. Apps for PDA's and smartphones: As required. Software clients: As required

8. Technical Requirements

Kindly see part 2 of the specification.

9. Applicable drawings

None

10. Safety Requirements The equipment / systems shall follow the following safety guidelines: All mains powered equipment shall be compliant to UL 60950 for electrical safety.

11. Environmental / climatic requirements All equipment (if any) supplied by the service provider, under the requirements mentioned in this document shall be suitable for use in non-air-conditioned office spaces.

12. Referred standards Kindly refer part 0 of the specification.

13. Maintenance and diagnostic aid: The service provider shall explicit document and requirements and function of the any special tools and diagnostic aids required. All such tools and aids shall be provided by the service provider.

14. Documents to be supplied by the equipment supplier The service provider shall initially provide documents containing concept overview of LMS and its clients. This document shall be approved and filed at CLW. The following documents shall be provided and updated as required by the service provider during the duration of the contract.

- All software developed shall be documented and provided in source code in soft copies.
- All configuration files shall be documented and provided in soft copy**.**

15. Accessories List of accessories required shall be specified by the service provider.

16. 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

17. Tests and verification: All equipment and software shall be tested for functional working before deployment. Performance tests shall be conducted using the third party APM tools. These tests and verification shall be conducted by CLW or by any other third party. A scheme for testing shall be jointly prepared by CLW and service provider for conducting the tests.

18. Types of tests

The following different types of tests shall be conducted at different stages verifying compliance of functional requirements and meeting the performance requirements

18.1. Proof of concept The proof of concept shall be tested at the initial stages to prove out the requirement as mentioned in the specification. This shall be done by demonstrating the setup with limited users and simulated data. The complete details of deployment shall be documented and same approved by CLW for further action.

18.2. Functional test This test shall be conducted after initial deployment of LMS servers. This test shall be conducted for checking the compliance to the functional requirements specified in the set of specifications and developed during the proof of concept tests.

18.3. Load test Server load test shall be conducted by enabling data transfer from locomotives already equipped with DRAS' ORMS and simulating additional loads of locomotives and clients on the local area network. The load test parameters shall be monitored using third part APM tools. The parameters to be tested shall be monitored as described in part-0 of this specification. These load tests shall be conducted as required for determining the connection with the server systems and ability to meet the performance specification.

18.4. Routine tests: The routine test shall be conducted whenever a new locomotive is to be added to the list of locomotives monitored by the DRAS' ORMS system. This test shall consist of functional check for all features for the particular locomotive to verify the system is working and operational.

18.5. Makers test certificate for outsourced item All items that are outsourced by the equipment manufacturer shall be indicated so. The type and extent of control that has been exercised shall be provided with proper documentation. The manufacturers (of the outsourced sub-assembly) test certificates shall be provided.

19. Painting labelling and marking: The equipment shall be appropriately painted for aesthetics and protection. The parts, connector ports, mounting points etc shall be clearly marked in a manner that these are easily readable and remain legible over the lifetime of the equipment. ID plate Name of Component, Make, Sl. No, Date of Manufacture, Ratings shall be provided on all assemblies/subassemblies.

20. Packing and delivery: The equipment consists of sensitive and fragile electronic systems. These should be packed with precautions required to prevent damage in transit. All requirements of IRS conditions for packaging and delivery shall be applicable.

21. Guarantee / Warrantee: Kindly refer part 0 of the specification.

22. Intellectual Property Rights Kindly refer part 0 of the specification**.**

23. Information to be supplied by supplier The equipment manufacturer must provide to CLW, the complete details of algorithms, design and drawings required for the purpose of evaluation of the design and its functionality. Operations and maintenance manuals, spare parts catalog shall be supplied to all users as required in both hard and soft (PDF) copies.

24. Information to be supplied by purchaser Required design details and layouts of room to house the equipment shall be provided by the purchaser.