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रेल मंत्रालय

**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**

आप्टिमाइज्ड लोको प्रचालन हेतु निर्देशन के लिए विशिष्टि

Specification of Guidance for Optimized Loco Driving(GOLD) for
Microprocessor based Locomotive Control System with REMMLOT fitted
locomotives

DRAFT

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Specification of Guidance for Optimized Loco Driving(GOLD) for Microprocessor based Locomotive Control System with REMMLOT fitted locomotives

1 Objective:

The objective of this specification is to lay down the functional and hardware requirements of an in-cab advice system that helps Loco Pilots of both freight & coaching trains to save fuel and stay on time i.e. keep to the sectional running times as per the intended schedule. This advice system shall work in co-ordination with existing REMMLOT(Remote Monitoring and Management of Locomotives and Trains) as per Spec No. MP-0-0402-04 Rev. 05 and Microprocessor Based Control System (MBCS) as per Spec No. MP.0.2400.26 Rev0.06 in Diesel Electric Locomotives

REMMLOT facilitates GPS data and communication channel for GOLD system with central Server and Microprocessor control system facilitates real time speed, notch, power and locomotive characteristic inputs to GOLD system to provide a variety of advantages over stand alone system.

2 System description

2.1 Brief Description of the System:

GOLD shall be an in-cab advice system that shall help Loco Pilots of both freight & coaching trains to save fuel and stay on time i.e. keep to the sectional running times as per the intended schedule. GOLD shall use optimization techniques to determine speed profiles that minimize fuel consumption subject to completing the journey within the specified time. On-Board GOLD System consists of On board display and interface system (ODIS) and On board processing unit (OBPU) The ODIS hardware shall be as specified in TFT Display (DIALS Spec No MP.0.04.00.10 (Rev. 01) in addition to existing TFT for DIALS application), which is interfaced to REMMLOT and the OBPU shall compute a set of optimal speed profile for the current journey. The recommended speed profile shall be displayed on the screen in the cab of the locomotive along with additional advice about track topography and train location that will assist the Loco Pilot to follow an energy-efficient speed profile and stay on time. The system shall determine current location and real time clock from an on-board GPS unit of REMMLOT and also current speed from the odometer data of the microprocessor based control system, thus deriving necessary data even in case of tunnels and signal unavailability. From this data, it shall continually update the displayed advice during the journey, thereby ensuring that the advice is always optimized for the remaining journey based on actual progress of the train from the recommended speed profile. Thus the in-cab display shall always provide an optimal speed profile from the current position to the next target location. This technology shall ensure that best driving practice becomes the norm and hence consistently reduces fuel costs.

2.2 Aim of GOLD:

The aim of GOLD shall not be to override Loco Pilots, but to provide them with information that will help them drive more efficiently. GOLD may not take into account signals or train-handling requirements. When it is not appropriate to follow the ideal speed profile because of track conditions, restrictive speed signals or unexpected speed restrictions, the Loco Pilot shall simply ignore the advice until it is appropriate to follow the displayed speed profile.

2.3 Energy Savings:

Energy savings shall result from optimization based the system's ability to anticipate the upcoming topography i.e. increasing/decreasing gradients, horizontal curves and speed limits while using the known performance characteristics of the train such as tractive effort, weight, length, rolling resistance etc to calculate and communicate the optimal driving profiles for any given journey.

2.4 Loco Pilot:

At the beginning of a trip, the Loco Pilot shall specify information that is used to calculate ideal speed profiles, including:

- The number and types of locomotives
- The type of train (used to determine which speed restrictions apply)
- The number of and type of wagons / coaches.
- The mass of the train
- The maximum permissible speed of the train
- The route and Fuel balance at the start and end of journey and any additions in between for diesel locos.
- Depending on co-ordination with existing setup at Indian Railways, Time tables and caution order data shall alternatively be captured automatically on the server.

2.5 Data input:

The above information may be configured from the soft key based keypad interface on the ODIS. Alternatively, this information may be automatically downloaded from a central server. Temporary speed restrictions shall be automatically downloaded to the ODIS from a central server via REMMLOT.

2.5.1 The system shall be capable of computing and displaying several optimal profiles, each of these optimal profiles shall have a different arrival time. The fastest profile shall have the earliest arrival time, but shall use the most energy to complete the journey. Each of the subsequent profiles shall use less energy than its predecessor, but shall take more time. Destinations are key locations along a journey where the train has a specified arrival time.

2.5.2 Destinations can be key junctions, crew change locations, or terminals. Each time the Loco Pilot selects a new destination, GOLD system shall have the facility to automatically adjust the optimal driving strategy to ensure that the train arrives at its destination at the required time with minimum use of energy by computing optimal driving profiles from the current location to the destination.

2.6 Speed Profiles:

GOLD speed profiles shall save fuel by optimizing the speed to be followed for the remainder of the journey for the available time.

2.7 Display:

During a journey, Loco Pilots shall glance at the display to check the progress of the journey, and to

see what control changes may be approaching. Automatically for every journey, GOLD shall upload a journey log to a central server via REMMLOT. The figure below shows a typical advice graph that shall be required from a GOLD log for a specific journey. This is an indicative display screen and shall be finalized after discussion. However, all successful tenderers shall have to design a common screen so as to facilitate easy understanding by the locomotive drivers.

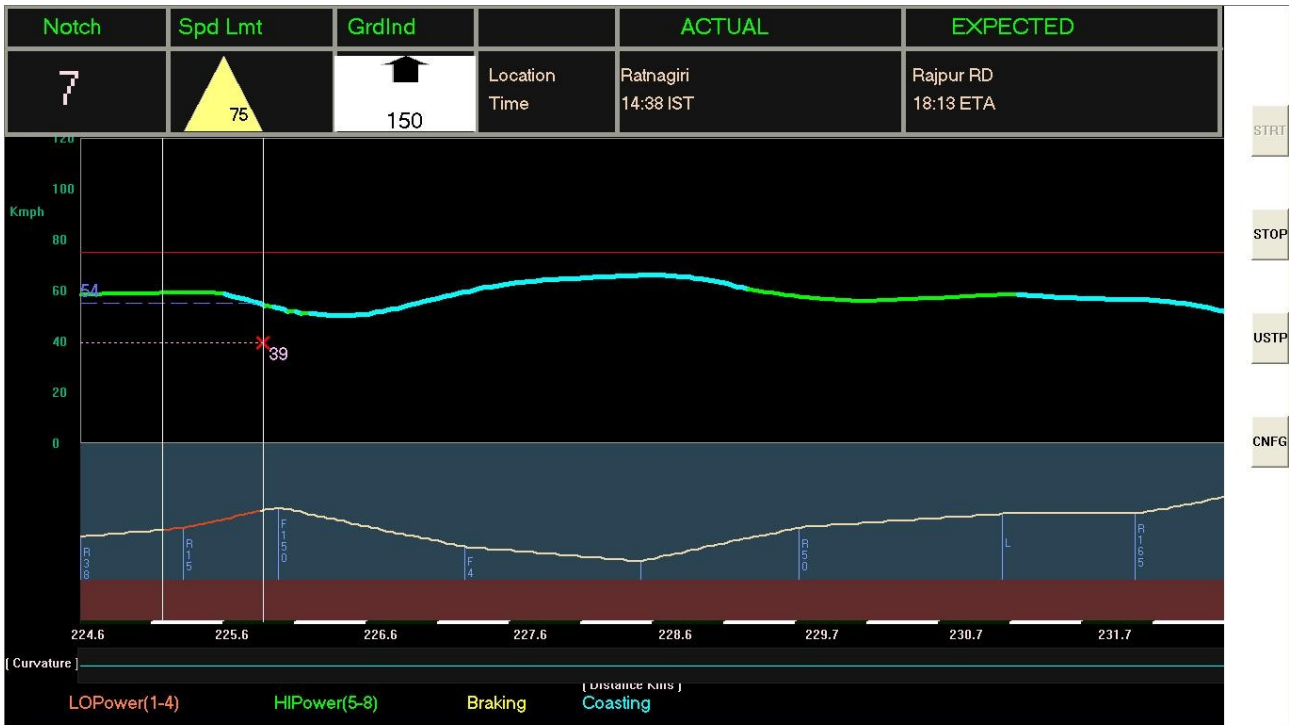


Figure 1 – GOLD Main Display (Indicative)

The main GOLD display as shown on the screen at Figure 1 above shall be divided into three areas.

- 2.7.1 Route Information: The bottom part of the display shall show track elevation, curvature and track-side features such as level crossings, signals and hectometer posts, for 6 km in front of the cab and 2 km behind the cab. The up-gradient and down-gradient values are indicated next to vertical lines below the track elevation graph. The location of the train shall be indicated by an orange line superimposed on the elevation profile. The vertical white lines shall indicate the front and rear of the train. Loco Pilots shall find the route information useful because it shall show the location of the front and rear of the train relative to hills, curves and speed restrictions, and because it shall provide confirmation of the train's location. The GPS data from REMMLOT shall be used to sync the hectometer posts to the data displayed.
- 2.7.2 Ideal Speed Profile: The part of the display immediately above the route information shall show the ideal speed profile calculated by GOLD. The height of the thick line shall indicate the ideal speed. The color of the line shall indicate how much power is required to follow the ideal speed profile: Colours for motoring(Lo power and High power), braking, coasting etc. are displayed at the bottom. The thin red line above the ideal speed profile shall indicate the track speed limit, including any temporary speed restrictions. The red 'X' followed with current speed line shall indicate the current speed(in kmph) of the train, as measured by the on-board odometer. The current recommended speed by the ideal profile is indicated in kmph by a blue line projected on the speed axis. Whenever possible, the Loco Pilot shall drive such that the 'X' coincides with the ideal speed profile.
- 2.7.3 Top strip of the display shall show the current notch of the driver, current speed limit in kmph, current gradient, actual location at the present time and next station with ETA for the next station. The loco pilot shall have a feature to select different optimal speed profiles based on the available time.

2.8 ON BOARD SYSTEM ARCHITECTURE

2.8.1 The GOLD System:

The GOLD unit shall comprise of two (per each driver desk) On-board display and interface systems(ODIS), which consists of Display one per driver desk, User interface and processing capabilities to handle communication from and to REMMLOT, and an On-board processing unit(OBPU) for computing the optimal speed profiles. The ODIS's hardware shall be as per the DIALS Spec No MP.0.04.00.10 (Rev. 01) and shall be interfaced to REMMLOT through RS485 interface. The OBPU and ODIS's shall be interfaced with RS485.

It shall draw power from the loco auxiliary power supply at 72 volts. The parameters required for optimal profile and improving the systems effectiveness are taken from with the Microprocessor Control system of the locomotive via REMMLOT. The on board REMMLOT shall be used for GPS, CDMA and GSM communications channels for GOLD data port access. The system shall be modular, providing a fully upgradeable system.

The tenderers shall make themselves acquainted with the locomotives on which the system is intended to be fitted. They shall submit the outline drawings of the offered equipments that shall be evaluated by Railway for suitability of fitment on the locomotive. Alterations if any shall have to be carried out by the shortlisted bidders. The successful tenderer shall provide detailed description of proposed solution covering the architectural details and component-based design

2.9 GOLD SYSTEM SCHEMATIC (CONCEPTUAL)

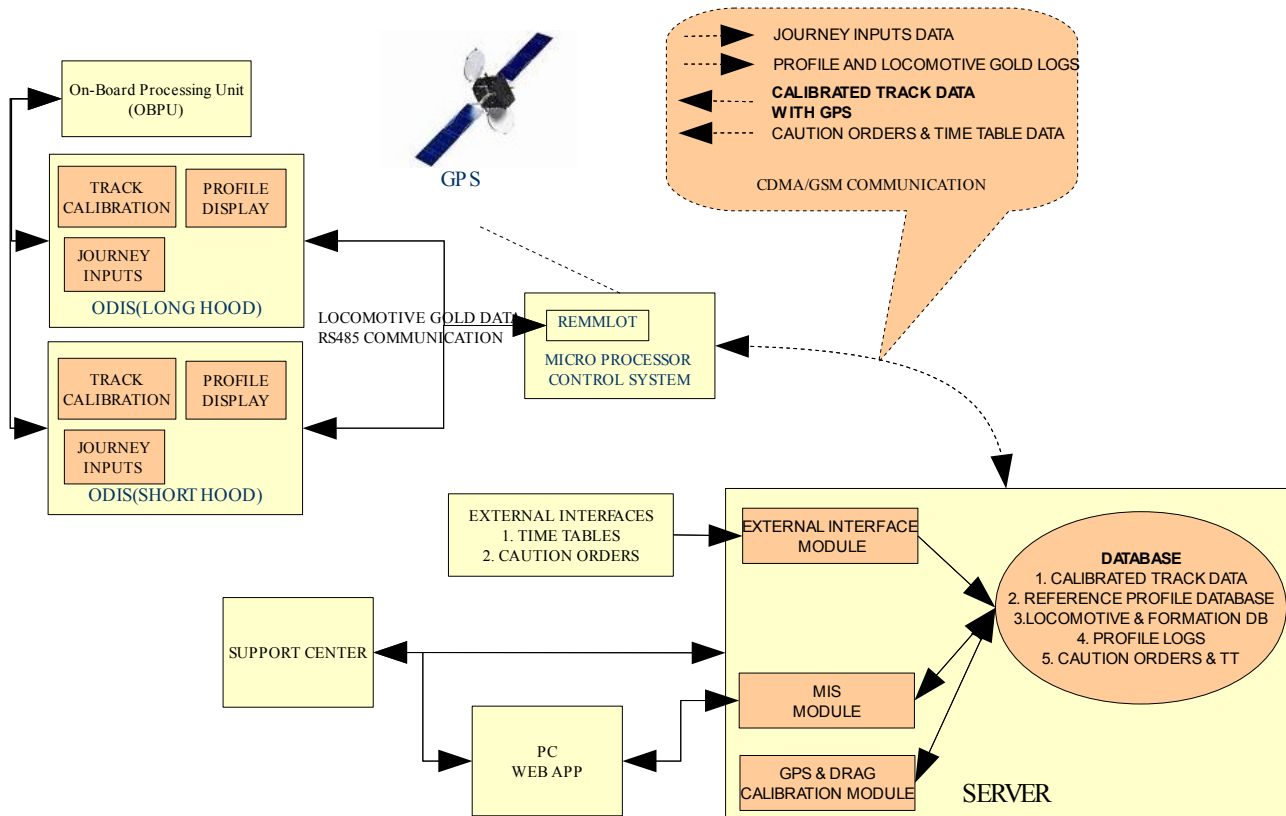


Figure 2: GOLD System Implementation Model

3 Scope of supply:

The system shall be supplied as a single unit per locomotive, comprising of software modules and hardware equipment. The hardware equipment shall be two ODIS as per DIALS Spec No MP.0.04.00.10 (Rev. 01), one at short hood and one at long hood and one OBPU. The purchaser shall procure the unit (inclusive of hardware and software) for each locomotive.

The cost for Central server services and web usage services, Gradient and track data capture (one time cost) for specified routes shall be paid by the purchaser as on operational cost

Communication charges for GSM and CDMA is already included as a scope in REMMLOT specification.

Annual Maintenance Cost per locomotive shall be agreed upon for GOLD application requirements.

3.1 On-board Display and Interface System

- 3.1.1 The On-board Display and Interface System(ODIS) located on the locomotive is the key interface between GOLD and the Loco-Pilot. This shall be an industrial grade ruggedized TFT display according to DIALS Spec No MP.0.04.00.10 (Rev. 01) that shall indicate driving profiles and other information to the driver. It shall have a human interface module via the soft key based keypad.
- 3.1.2 It shall possess processing capabilities to handle communication from and to REMMLOT via RS485, Display the profiles and handle the human interface.
- 3.1.3 The driver shall interact with this module via the TFT screen with soft key based keypad interface. The TSR's and Journey details(Refer 2.4) shall be entered by the Loco Pilot into this module. The journey log shall be uploaded to the central server automatically via the mobile network in REMMLOT. The necessary on-board antennae and communication channels shall already be a part of the REMMLOT fitted in the locomotive.
- 3.1.4 The ODIS shall update speed advice via on-board odometer data received from Microprocessor control system via REMMLOT. The GPS in REMMLOT shall be used to auto-correct the accumulated distance errors by mapping the GPS co-ordinates of the hectometer posts to the current GPS data.
- 3.1.5 System shall determine the correctness & quality of the GPS signal received and in case quality of signal is not considered adequate to correctly identify its location, the same shall be indicated on the TFT display
- 3.1.6 The ODIS shall:
1. Show the optimal speed profile and current speed
 2. Show the train position including the start and the end of the train
 3. Show the optimal speed profile as well as the control mode power, speed holding, coasting and braking (slow) and shall do this on a colored graph that allows loco pilot to make the decision about throttle notch and braking.
 4. Give a clear indication for coasting, braking and powering
 5. Show the current time, target journey time (ETA).
 6. Indicate gradients, speed limits including TSR's and curves.
 7. Have a provision to select the train route via the Train ID.
 8. Continuously monitor the current speed profile and estimate the delay or advancement of the time taken by the current profile.
 9. The final screen display shall be finalized in consultation with the successful bidder.
 10. Be mounted on the control desks of the locomotive in both long & short hood configuration leading position.
 11. The loco pilot shall be able select faster or slower profiles from the keypad interface.
 12. At the end of the trip, the loco pilot shall be able to enter fuel information and shall be able to view a report on the journey and energy efficiency.
 13. The ODIS shall have a feature to auto-reload or provide a new optimal profile in case of a delay/advancement in the schedule. This feature is pre-configurable with a certain step size of delay/advancement It shall also be possible to manually select the most appropriate profile as per driver discretion.

3.2 On-Board Processing Unit

- 3.2.1 It shall download the required train, track and timetable data from ODIS and provide driving profiles to the driver for optimum energy consumption without compromising on arrival times. The OBPU is for the purpose of on-board simulation of profile and shall be capable to simulate a new optimized profile on board as and when required.
- 3.2.2 It shall download the optimal speed profile to both ODIS via RS485.
- 3.2.3 The OBPU shall be a rugged 32-bit processor capable of handling the simulation of optimal speed profiles. Depending on the processing requirements for a given optimization technique it may have a set of processors working together.
- 3.2.4 It shall have a USB interface for the purpose of software up gradation.

3.3 Power Supply:

ODIS and OBPU shall draw power from the locomotive auxiliary power that is at 72 volts/DC.

3.4 Communication and Data Transfer Modules:

- 3.4.1 Mobile Network connections, GPS receiver and antennae specifications, Central Web Server and Data up-linking shall be as per REMMLLOT Specification No. MP-0-0402-04 Rev. 05. The land Data Entry nodes for uploading / updating the TSR and Track Data by IR is through web server access and it is restricted by a password.
- 3.4.2 Database: This shall be a relational database management system, such as Microsoft SQL Server or Oracle database. This database shall hold the track data, TSRs/ESRs, timetable data and journey logs.
- 3.4.3 A browser-based application shall be provided which shall allow users to access the journey logs and generate / view reports of the same from the central server.
- 3.4.4 As an alternative to TSR Entry by Loco-Pilot, a browser based application shall be provided on agreement with the customer, which allows users to enter the TSR data(data such as speed restrictions, that are liable to change frequently) into GOLD database. The TSR data shall be converted to GOLD format and saved to the database, so that TSRs need to be entered only once in to central server and not repeatedly in each GOLD fitted locomotives.
- 3.4.5 The Central web server may be upgraded from that mentioned in REMMLLOT Specification No. MP-0-0402-04 Rev. 05, depending on the requirements of the GOLD System.

3.5 Timetable Management

GOLD shall require train, track and timetable data, including Temporary Speed Restrictions (TSRs), and the current journey information to provide advice to the driver for energy savings. In order to keep the track data up-to-date, GOLD shall check and upload track data, timetable data and the TSR data at the start of each journey.

Maintaining the Timetable data for the GOLD system may be a significant task due to the large volume of information. Similarly, maintaining the TSR data on a daily basis, which changes from one day to the next, may also be a complex and time-consuming activity especially when there may be several track routes and when they may come from multiple sources in various forms. As such, the timetable data and the TSR data shall be uploaded to server using standardized input process and GOLD ODIS will download this data at start of journey (repeated entry by driver is not required). In addition, the system shall allow users to view and edit this information as and when required, before being used by the GOLD ODIS that shall be installed on trains.

3.6 Data requirement:

The GOLD system shall need basic train, timetable information and track data based upon which the optimum profiles shall be generated. Following data is generally available and shall be made available by IR. In case some other information is needed, the tenderer shall spell it out clearly in their offer and the same shall be provided subject to availability with the purchaser. The format of data transfer between IR servers and vendor shall be decided based on technical discussion between the same.

Gradient data shall be provided by IR through track civil drawings and vendor shall carry out a gradient and GPS survey to ensure the accuracy of data and incorporate the same in the database so as to provide accurate driving advice.

3.6.1 Timetable Data Requirements

- Journey Header Data
 - Train ID or Head Code: unique identification of each journey within the timetable
 - Days of Operation: days of week on which the current journey is operated
 - Train and consist information; including type of rolling stock, locomotives etc.
 - Effective dates: start/end dates of the journey or the timetable (validity of time table)
- Journey Details
 - Locations traversed by the current journey: this is the order of locations traversed by the current journey. This includes all stations and junctions on the current rail network traversed by the journey.
 - Stopping mode at each location traversed by the journey, such as passing, dwelling, etc.
 - Arrival and departure times at select locations traversed by the journey.

3.6.2 TSR Data

- TSR Start/End Location

The start and end locations shall be specified in terms of route kilometers. In this case, the following details of the start and end locations shall be made available

- Start Track Segment

- Start Km
- End Track Segment
- End Km
- TSR Dates

Start and end dates of the TSR's shall be made available, Calendar at start of journey should be used to see if a TSR is valid or not
- TSR Speeds

TSR speeds for all types of trains shall be made available separately, e.g.: if the TSR speeds differ between passenger trains and other, then each TSR speed shall be available for each category.
- Directionality

Whether the TSR is applicable for the direction Up, Down or Both
- TSR Description (optional)

Other TSR details, such as Speed Restriction Number and Speed Restriction Year, may be made available for record keeping purposes.

3.7 Application Design:

The ODIS shall consist of an Advisory software which, once installed and configured, shall provide real-time advice to the Loco Pilot in the cab that, when followed, shall allow progress of the train to be regulated to give the lowest calculated energy consumption whilst achieving compliance with the timetable or desired journey time. This advice shall have to be based on profiles for each route, but also calculated in real-time based on current speed/location. Logged summary data of driving behavior shall be sent to the central web server via REMMLOT(As per Spec No. MP-0-0402-04 Rev. 05) for analysis and reporting.

The Application Design includes a browser based application for GOLD in co-ordination with the web server of REMMLOT(Spec No. MP-0-0402-04 Rev. 05) and a back end software in ODIS. Software shall preferably be in a higher-level language. The interface to the user (Uploading, Calibration, Configuring, Data pack, Downloading, Decoding etc.) shall be menu driven and user friendly. The ODIS shall

- Upload new route info to central server(through REMMLOT).
- Download Route profile data from the central server(through REMMLOT) to the ODIS.
- Download display s/w upgrades from the central server(through REMMLOT) to the ODIS.
- Display real-time advice (like when to start coasting/ braking etc.) to Loco Pilots based on profile recommendations and on their current locations / speed and next expected stop.
- Log driving compliance to advised speed profile for each journeybehavior for each journey.
- Automatically upload same to central server (through REMMLOT).

The Server based application shall

- Allow for analysis and reporting of logged data(MIS Module).
- Store and Manage timetables for passenger services and train running information for freight services and be capable of editing that information and uploading changes to the

ODIS.

- Manage temporary speed limits and emergency speed limits and upload these to the ODIS.
- If IR provides inputs, GLOD system server shall have an interface to the railway servers to get timetables and speed limits data.

3.8 Time Tables:

working time tables for coaching trains shall be provided by the purchaser. These shall be in electronic format. The bidder shall upload train table data, which needs to be stored on a central server (Spec No. MP-0-0402-04 Rev. 05 of REMMLOT) and uploaded to each train's ODIS. The offered software shall be capable of facilitating easy input of temporary/special train timetables as and when required. The offered system shall be able to adhere to the published timetable & at the same time save energy. Timetables are downloaded only at start of journey, so not real time.

3.9 Route data and GPS mapping

Route data e.g. line of route, stopping points, permanent speed restrictions, elevation, gradients, curvature etc shall be provided by the purchaser. An independent survey of gradient data is required to be carried out by the vendor for accurate advice. The vendor shall charge for the survey carried out on a per 100 route km surveyed basis. The successful bidder shall have to carry out the GPS route mapping of the sections taken up for GOLD implementation. For the routes mapped by the successful bidder the GPS co-ordinates shall be within an accuracy of +/- 10m. The accuracy of the mapping shall have to be demonstrated by the successful bidder to IR.

4 GENERAL REQUIREMENTS

- Failure of GOLD system shall not compromise, nor in any way affect the operational safety of the train. GOLD shall be universally suitable for all types of sections of Indian Railways like single line, double line, twin single line, multiple lines etc.
- GOLD shall be suitable for both freight and coaching trains. It shall be possible to upload coaching train time table on central server to enable the system to save fuel while maintaining punctuality.
- GOLD shall be suitable for all types of electric and diesel locomotives.
- GOLD shall be capable of working in all types of electrified as well as non-electrified territories.
- GOLD shall be suitable for all train speeds, loads and length.
- Journey logs of each GOLD unit shall be stored for a period of 45 days on the central server. The information stored on the central server shall be available on a controlled access basis to relevant supervisory/managerial personnel to review the performance of individual Loco Pilots/sections etc. It shall be possible to download all the events to a PC/ Laptop. Analysis & diagnostic software shall be provided to analyze the events on PC/ Laptop. The relevant supervisory/managerial personnel shall also be able to print reports of these journey logs in user friendly and easily readable format.
- It shall work on the locomotive power of 72 Volt DC

- The System shall start up automatically when the locomotive power is on and shall have security access via Loco Pilot ID.
- The system shall have a comprehensive server side data base to manage track and train data as well as timetable data, train running data and reporting
- The system shall be configurable to the display advice if the train deviates from the expected speed profile, or detects a GPS drift away from the track centerline.

5 Validation of the offer

- 1.The extent of fuel savings that can be effected on a particular route/ train depends also upon the sectional profile i.e., gradients, curvatures, speed restrictions etc. Therefore this document is not defining any threshold or qualifying limits of fuel savings in terms of a predefined value.
- 2.Before selecting a system it shall be tested in actual operation and the average fuel consumption/savings over several runs shall be evaluated against established values of a proven system (if any).
- 3.Bidder(s) whose offers are found to be technically suitable shall be called upon to make available their product (at their own cost) for trials on nominated routes/ trains as decided by the purchaser.
- 4.The exact modalities for trial and the trial scheme shall be finalized by IR in consultation with the short listed Bidder(s) prior to commencement of such trials.
- 5.In case there is more than one shortlisted Bidder for such trials, the trials shall be conducted on the same route, locomotive & type of trains for all the bidders. In such a case comparative evaluation shall be carried out for the shortlisted systems.
- 6.The decision of IR in regard to the outcome of these trials shall be final.

6 Qualifying Criteria

1. The bidder shall offer a system that has been proven in operations in Indian Railway passenger/freight(of at least 5000 route kms) and must have been installed in high HP locomotives (greater than 3000 HP). The system must have been in successful (with documented fuel savings) operation in Indian Railways. The system shall be capable of being used in both passenger and freight trains.
2. The bidder shall produce documentary evidence of meeting the above specified criteria and also of fuel savings achieved through implementation of the system.
3. Tenderer shall offer the entire GOLD system as given in the scope of supply by ensuring the interface with the locomotive microprocessor control system with REMMLLOT.

7 DOCUMENTATION

Manuals & guides: Successful bidder shall provide manuals and guides (number to be agreed at the appropriate stage) both in soft and hard copy format covering the following aspects

- Driver setup and operation
- Diagnostics/maintenance of software
- Alteration and addition of any information

- Administrator function and access
- Report generation
- Drivers operating instructions and trouble shooting handbook
- Training manual for Loco Inspector's i.e. Trainers
- Training manual for Loco Pilots
- Installation manual

8 SCOPE FOR ANNUAL MAINTENANCE CHARGES(AMC)

The Annual Maintenance charges shall be quoted per locomotive and will be inclusive of the hardware and software. The AMC for the first year shall be part of the quotation and the same for second through sixth year shall be quoted separately.

The scope of AMC is as given below

1. Delivery, transportation to site, commissioning, installation, configuration, tuning and performance of the system(inclusive of hardware and software) shall be the responsibility of the Vendor.
2. Production and development environment shall be set up by successful bidder
3. The bidder shall enclose documentary evidence along with escalation matrix that they have the necessary organizational infrastructure to provide support to IR for maintaining system health and fine-tuning system performance.
4. For AMC, quarterly payment shall be released after satisfactory maintenance provided by the vendor.
5. AMC shall cover free upgrades as and when due.
6. Total System Integration (e.g. RDBMS along with Active-Active installation) shall be the responsibility of the bidder.
7. Bidders shall disclose as to how they propose to provide on-site support for maintaining system health and fine-tuning system performance.
8. Documentary evidence for back-to-back agreement with the OEM to provide support including availability of spares and software upgrades for 5 more years from date of expiry of warranty is required to be attached along with the offer.
9. The vendor shall provide sufficient documentary evidence that the offered environment (i.e. Hardware platform, OS, RDBMS, and Active-Active solution together) has been successfully tested under the Lab conditions.
10. During the warranty period the vendor shall maintain the system in good working order. The service shall consist of preventive and corrective maintenance and shall include
 - Carrying out of all necessary repairs and replacements of parts without any additional cost.
 - Shall also include supply and installation of patches and upgrades
 - The vendor shall have a written commitment from the OEM to provide onsite support in case required.

- Maintenance coverage shall be on site all working days during day time (9am to 6 pm) and at least 98% (or more) uptime.
- The preventive maintenance shall be carried out at least once a quarter. The preventive maintenance schedule shall not affect the online operations. If the preventive maintenance brings application to halt, then the preventive maintenance time shall also be included in the down time.
- Bidder/server OEM shall have to maintain their own inventory of spares so as to give fast and efficient service.
- The engineer of bidder/ server OEM shall reach the site within 6 business hours. In the event of a part failure, i.e. CPU/memory card etc the replacement shall be installed within 24 hrs.
- The bidder shall provide the contact number i.e., home address, residential phone number, mobile phone number etc. of the engineers, Project Managers, Regional Managers of server OEM.
- The server OEM support provided shall be of the highest level and the same shall be very clearly mentioned in detail along with complete escalation mechanism in case of a failure.
- The system shall be treated as down if there is disruption of services due to system failure at a given site or location.
- For the purposes of calculating the down time, the starting time shall be the lodging of the complaint.
- In case of down time beyond 98% uptime, both during warranty and post warranty AMC shall attract the penalty clause, a cash penalty of Rs. 2000/- per hour or part thereof shall be levied.
- In case the problem is not resolved within the time slot allowed by Railways, the next planned downtime shall also be added in the down time for charging of penalty.

9 TRAINING

9.1 Scope of Training

- The Supplier shall arrange free of cost training to the personnel of Indian Railways for 500 man days in India or 250 man days abroad (in case the system is procured from overseas sources) to make them proficient in the operation of GOLD system, including, but not limited to, upkeep of database, generation of reports, trouble shooting, debugging of the system, providing adequate guidance to enable them to train their subordinate staff in these functions.
- Training to nominated end users and core team members shall be organized in suitable batches of appropriate duration in consultation with Indian Railways.
- Training material and documentation for each course shall be provided to each member.
- Details of the training proposed to be provided shall be detailed & agreed upon by the successful bidder within 45 days of the contract being signed.

10 ROLE OF RAILWAY PERSONNEL

IR shall have the option of associating its personnel with each stage of the work. The Successful bidder shall provide these personnel with all the necessary information and facilities to carry out their functions. But the fact that IR personnel are associated with the Successful bidder's personnel in the contracted work shall not in any way reduce the Successful bidder's responsibilities under this contract. Final responsibility to satisfy Railways of the satisfactory completion of the work shall rest with the Successful bidder.

11 Performance & Environmental Requirements

1. The two ODIS's shall be as per the DIALS Spec No MP.0.04.00.10 (Rev. 01)
2. The REMMLOT system shall be as per REMMLOT Spec No. MP-0-0402-04 Rev. 05.
3. The Microprocessor based locomotive control system shall be as per Spec No. MP.0.2400.26 Rev0.06
4. The OBPU as per REMMLOT Spec No. MP-0-0402-04 Rev. 05.

12 ACCEPTANCE TEST

Type and routine test schemes, inspection and acceptance norms shall be as follows:

1. The two ODIS's shall be as per the DIALS Spec No MP.0.04.00.10 (Rev. 01)
2. The REMMLOT system shall be as per REMMLOT Spec No. MP-0-0402-04 Rev. 05.
3. The Microprocessor based locomotive control system shall be as per Spec No. MP.0.2400.26 Rev0.06
4. The OBPU as per REMMLOT Spec No. MP-0-0402-04 Rev. 05.