GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

MASTER COPY

TECHNICAL SPECIFICATION

FOR

DRIVERS VIGILANCE TELEMETRIC CONTROL SYSTEM

FOR ELECTRIC LOCOMOTIVE

Specification No. RDSO/2006/EL/SPEC/0046, Rev. '1'

Issued: April 2007

ELECTRICAL DIRECTORATE
RESEARCH, DESIGNS & STANDARD ORGANISATION
MANAK NAGAR, LUCKNOW – 226011

1.0 FOREWORD

Alertness of railway train engine crew is one of the ingredients that ensure safety. To monitor their alertness and assist them in this regard, different philosophies for vigilance monitoring are employed. Vigilance equipment presently used on locomotives on Indian Railways is based on count of selected operations performed by the driver during a given period, to infer that the driver is active and therefore alert. Such equipment is in use on limited number of electric locomotives on Indian Railways.

1.1 Another means is to directly measure and analyze variations in biometric parameters to determine the state of alertness and also predict likely hood of the driver falling into state of relaxation. This specification covers requirements for procurement, trial and evaluation of equipment called Drivers Vigilance Telemetric Control System, based on principle of measurement of variations in skin's galvanic response. Indian Railways propose to acquire a limited number of such devices (hereinafter called DVTCS) on trial to establish their efficacy, reliability and dependability in monitoring vigilance of engine crew and assisting them in staying alert, on board the driving cabs of electric locomotives of trains worked on specified routes.

1.2 It is proposed to carry out trial for a period of one year. Half of the equipment procured would be provided on selected electric locomotives to work in Waltair-Kirandul section of the East Coast Railway and balance on locos that would be run in captive circuits on Waltair-Secunderabad route on East Coast and South Central Railways. (The station names Waltair & Vishakhapatnam refer to the same town/station)

1.3 In event of need for any clarification on the content and meaning of any clause of this specification, interpretation by RDSO shall be final and binding.

2.0 ABBREVIATIONS AND DEFINITIONS

'IR' means Indian Railways

'RDSO' means Research Designs & Standards Organisation

'Tenderer' means Firm/companies participating in the tender

'Supplier' means the person, firm or Company with whom the order for supply of the work has been placed.

'Purchaser' means the President of the Republic of India as represented by the Railway organisation entering into contract.

'Inspecting Officer' means person, firm or department nominated to inspect the locomotive or the representative of the inspecting officer so nominated

'OEM' means Original Equipment Manufacturer

'IEC' means International Electrotechnical Commission

'IEEE' means Institution of Electrical and Electronics Engineers

'UIC' means Union International des Chemins de fer

(International Union of Railways)

'ISO' means International Standards Organisation

3.0 CLIMATIC AND ENVIRONMENTAL CONDITIONS

Atmospheric temperature	Under Sun : 70°C max. In shade: 50°C max. Minimum temperature: 0°C
Humidity	100% saturation during rainy season.
Altitude	From MSL to 1000M above MSL
Rain fall	Very heavy in certain areas Average Annual rainfall up to 3500mm. Precipitation in 24 hrs. may be up to 200mm.
Atmosphere during hot weather	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/m^3. In iron ore and coalmine areas, the dust concentration is very high affecting filter and air ventilation systems.
Coastal area	Locomotives and equipment are required to be designed to work in humid and salt laden atmosphere with maximum pH value of 8.5, sulphate of 7 mg per litre, max. concentration of chlorine 6 mg per litre and maximum conductivity of 130 micro siemens /CM
Vibration levels	The equipment shall be designed to withstand the vibrations and shock encountered in service satisfactorily as specified in IEC-61373 publication for shock and vibration on Rolling Stock vehicle.
Electromagnetic Pollution	High degree of electromagnetic pollution is anticipated in locomotive machine room, where the equipment will be mounted. Necessary precaution should be taken in this regard. The equipment shall be designed to cater to the EMC/EMI requirements as per IEC-61000-4-6

4.0 GENERAL REQUIREMENTS

4.1 The equipment covered in this specification should be proven in field used and the supplier shall establish evidence of provenness. The design and manufacture of the equipment should be based on sound engineering practice, offering high reliability and dependability in actual operating conditions. The supplier shall also provide figures of quantitative reliability data in terms of Mean Time between failure (MTBF) / reliability indices.

4.2 The tenderer/supplier expected to study and be familiar with the electric locomotives where the DVTCS is to be installed, commissioned and put on trial. It shall be ensured that any Electromagnetic Interference (EMI) generated by the DVTCS equipment is not harmful to the locomotive equipment. It should also be conversely ensured that the DVTCS is suitable for the EMI environment inside electric locomotive.

4.3 The loco-mounted equipment should be designed for economically useful life of at least 10-12 years. The supplier shall indicate the life of the wrist-worn equipment.

4.4 Language of communication shall be English.

4.5 Association During Trial

4.5.1 The supplier shall be required to be present in the initial and concluding period of the trial for compilation of the valuation report.

4.5.2 During the period of one year trial, suppliers engineer shall associate from the date of supply of the first supplied set till 2 weeks after commissioning of the last supplied set; association of the supplier's engineers shall be mandatory in concluding phase i.e. 2 weeks after completion of one year of the last of the sets commissioned.

4.5.3 For the intervening period the supplier shall arrange to train the railways nominated supervisors in extraction of data and upkeep of equipment. If the supplier considers it necessary he may arrange to station a local representative at site (to be provided by the railway as a site office). Costs of operating the site office viz., staff, telephones, fax etc. shall be borne by the supplier.

4.6. DOCUMENTATION

4.6.1 The tenderer shall submit the following information with the offer.

- Functional Description with schematic diagram
- System design concept and salient features including indications and fault diagnostic feature
- Mechanical interface diagram (Outline General Arrangement)
- Modifications needed in the present locomotive to accommodate the offered system
- Clause by clause compliance
- Details of technical support and training offered
- Supply experience of same / similar equipment
- Logistics proposed for support during warranty and trials
- List of special tools, jigs and fixtures needed for assembly, testing, commissioning, maintenance and repair.
- Indicate approach for manufacturing and servicing the equipment in India in case IR chooses to adopt the scheme on regular basis
- Mechanical drawings of each subassembly with details of dimensions, mounting arrangement and weight. Details of mounting accessories should also be provided.
- Test protocol with procedure of testing.

4.6.2 Successful tenderer shall submit following documents after award of contract.

- Technical documentation explaining the complete scheme, characteristics, ratings, interfaces, diagnostics, protection and control etc.
- Detailed drawings of each system/sub-system with interface details.
- Procedure for parameter alteration, software download, diagnostic upload, analysis etc.
- Operation and Maintenance manual.
- Spares catalogue & price list.

5.0 FUNCTIONAL REQUIREMENTS:

5.1 DVTCS equipment shall consist of the following sub-assemblies:-

i) Transmitter

ii) Receiver-cum-indication unit

iii) Controller.

5.1.1 **Transmitter.** The transmitter shall be worn by the driver on the wrist like a wrist watch. Weight of the wrist worn equipment shall be mentioned in the offer. The wrist straps shall be sized for the average Indian male and should be adjustable to ensure required fit for good skin contact.

The frequency used by the transmitter shall be suitable and legally permissible for use in India for such applications. Frequency band of 146 MHz to 174 MHz for VHF applications, 876 MHz to 960 MHz for mobile train radio communication and 7 GHz to 18 GHz for microwave communication are presently used on Indian Railways.

Different units of transmitters shall be functionally interchangeable.

5.1.2 **Receiver-cum-Indication Unit.** One no. of receiver-cum-indication unit shall be mounted in the locomotive cabs in the visibility of driver to receive the RF signal from transmitter and will display the level of driver's alertness in an LED matrix bar graph display. It will also generate audio alarm when driver's alertness falls below threshold level.

5.1.3 **Controller:-** It will be mounted at a suitable location inside the locomotive and will be connected with the receiver-cum-indicator unit.

5.2 Logic should be built such that as and when driver's alertness level is detected low to infer a state of relaxation or loss of attention, an audiovisual alarm shall generate.

5.2.1 Upon getting any audio visual alarm, driver shall be required to press a vigilance acknowledge switch, to be provided at suitable location in each cab. where upon the system will remove the alarm and reset itself.

5.2.2 In case the driver fails to acknowledge the audio visual alarm within pre-defined time of 8 seconds (duration to be fine tuned during trials), the DVTCS shall cause application of penalty brake. Such event should be logged in diagnostic memory of the DVTCS.

5.2.3 The system will reset from penalty brake mode only after an elapsed time of 3 minutes. (duration to be fine tuned during trials) and only after positive act of resetting the DVTCS system by the driver.

5.2.4 All signals for 'acknowledge' & 'reset', when taken from push button. shall recognize the 'release' of the specified button/switch as the position act. The logic should sense the press and release action by the driver and should ignore if kept continuously pressed.

5.3 The controller shall also be interfaced with an electro-pneumatic device connected on the train brake pipe to vent the brake pipe pressure to apply penalty brake on the train when it detects that the driver is not alert and has not responded to the audio alarm.

5.4 The controller shall be provided with fault diagnostic features and diagnostic memory to record important events and alertness of driver. The event record shall be maintained for at least one month and should be designed to be down loaded on a Personal Computer or a Laptop computer.

5.5 In the event of any malfunction with the DTVCS or any of its components, it shall be possible for the drivers to manually over-ride, by operation of a bypass switch, the DTVCS such that operation of the locomotive can be continued as if the DTVCS was not provided ab-initio. The event shall however got logged in the memory, indicating the date and time of its manual isolation and also its subsequent restoration.

5.6 **Vigilance Suppression**: There shall be a provision to suppress the operation of DVTCS when continuous proof of driver's vigilance is not required.

5.6.1 The power supply to the DVTCS shall be routed through Pantograph selection switch ZPT so that only the unit in the working cab is active at any time.

5.6.2 When vehicle is stationary or the speed is very low, no vigilance monitoring should be performed. For vigilance suppression under such condition,, a "speed less than 2 kmph" signal shall be made available in form of a potential free contact from the existing speedometer for the DVTCS to interface.

5.7 The equipment shall work on 110 V DC nominal battery supply. The voltage may vary from 70V to 137V DC. There may be voltage surges of the order of 300 V super imposed on the battery supply due to polluted electromagnetic environment. The equipment should be suitable for working under such supply and environment.

5.8 Inputs to the DVTCS from the locomotive shall be so protected to ensure that in case of any fault on the DVTCS, the corresponding signal of the locomotive should not be adversely affected and locomotive should continue to operate normally.

5.9 The temperature inside locomotive standing in the sun may reach as high as 70°C, which will come down to 55°C due to air flow when the locomotive starts. The equipment shall be suitable for working at such high temperatures for upto 15 minutes.

5.10 The device shall annunciate its health (of being in working order) by display of a glowing green LED in a prominent position.

5.11 The DVTCS equipment shall have flexibility / expandability to receive additional four electrical inputs from 'drivers' desk equipment to indicate actions by the driver. for example, operation of the Master Controller, Horn, Sander and train brake application. However these inputs shall not be wired in the instant procurement and the trial period.

6.0. SUPPLIER'S RESPONSIBILITIES

6.1 The tenderer/supplier is expected to familiarize himself before tendering, with the layout of machine room of locomotives on which the equipment will be interfaced, the crew booking points from where wrist worn equipment will be issued to the engine crew and its return after completion of a round trip which may span up to 60 hours.

6.2 Before commencement of the supplies, criteria for evaluation of the efficacy, reliability and dependability shall be established with the purchaser after mutual discussions so that there is clarity and understanding in interpretation of the results from captured data.

6.3. The supplier shall despatch only such equipment, which have been inspected by an authorized representative of the purchaser in satisfaction of meeting requirement of the specification.

6.3.1. The Supplier shall supply all materials, spare parts, special tools, test equipment spares and appliances which may be necessary for the complete and efficient installation, testing and commissioning on the locomotives, even though such material or work is not specifically mentioned in this specification. The supplier shall also provide technical supervision for the installation, testing and commissioning of the DVTCS on the locomotives.

6.3.2. The Supplier shall further, notwithstanding any exercise by the Inspecting Officer of the power of superintendence, be responsible for the sufficiency of the packing, marking etc. of all imported parts of the work to ensure their delivery in India without damage

6.3.3 Supplies against this contract shall be designed in accordance with the specification and the supplier's technical proposal for satisfactory performance of the equipment in service, notwithstanding any approval which the engineers or the Inspecting Officers may have given with respect to:

i) detailed drawings prepared by the suppliers,

ii) a sub-supplier's material,

iii) other parts of the work involved by the contract,

iv) tests carried out by the supplier, engineer or Inspection Officer.

6.3.4. The supplier shall comply with the instructions of the Inspecting Officer, if in his opinion further precautions than those adopted by the supplier are necessary. for the proper execution and safe delivery in India, of all parts of the work.

6.4 The supplier shall install equipment on locos at Waltair and Secunderabad electric loco maintenance depots and wire these locos for successful operation. Assistance would be provided by the engineers in-charge of the electric loco maintenance depots for identification of the pneumatic/electrical interfaces to which the device is to be connected. Any other assistance required by the supplier, from the electric loco maintenance depots, shall be mentioned while tendering.

6.4.1 The supplier shall depute a team of engineers for commissioning, testing and field trials of the equipment in service and arrange the required equipment and carry out detailed tests and field trials.

6.5 The levels of alertness and the speeds for which the devices are required to be tuned, shall be mutually agreed to between the purchaser and supplier before commencement of the supply.

6.6 The tenderer/supplier shall furnish the format, in soft and hard copies in which data will be captured from the devices on completion of each round trip and shall give the programme for data compilation for evaluation.

6.7 Before the commencement of the trial with the first set, the supplier shall associate in familiarizing the operational and maintenance supervisors/staff in use of the equipment.

6.8 Indian Railway Normally do not permit supplier's engineers to travel on locomotive driving cabs. In the event of it becoming essential for the supplier's engineers to undertake a journey in the driving cabs of the locomotives in interest of trials, special

permission shall be obtained from the engineer in charge of electric loco operation, after indemnifying the IR against any loss or injury during travel on the locomotive cab.

6.9 On completion of the trial period, Indian Railway may propose to return the sets equipment to the supplier for which the supplier shall quote the buy back price.

6.10 Purchaser shall supply free of charge, within the railway premises, basic facilities like space for site office, water & electricity to the extent possible for maintenance of a site office for the supplier, during the currency of the trials.

6.11 **Training:** After signing of the contract, the supplier shall arrange for the training in India for 5 days for 5 to 10 maintenance & operating personnel of the purchaser. The supplier shall also be required to train the engine crew & their superiors' staff on board the locomotives in verifying method of the making of the devices before start of the journeys. Details of the training shall be worked out during contract finalisation stage.

7.0 SCOPE OF SUPPLY

7.1 The scope of supply will include: -

i. 20 sets of equipment including transmitters, receiver cum indicators, controllers, switches, and audio-visual alarms for

- 10 sets to be tried in Waltair-Kirandul section, and
- 10 sets to be tried in Waltair-Secunderabad section.

The distribution of number of sets within these 20 may, however, get changed depending on requirement.

ii. Transducers and signal conditioners – requirement as above.

iii. Any special communication cable required for wiring to the locomotive.

iv. Operation and Maintenance Manual – 5 sets.

v. Suitable software and data cable for down loading and offline analysis of diagnostic data, along with license / authority to use it.

vi. Two portable data logging and processing units, preloaded with suitable software for down loading and analysing the failure data of the equipment.

vii. Any additional items required as essential, within the meaning of clause 5.0 of this specification.

7.2 All consumables to be supplied (batteries included) during the course of the trial shall be included as part of equipment to be ordered against specification.

8.0 TESTING

8.1 Prototype tests and routine tests of the DVTCS equipment shall be carried out generally in accordance with IEC: 60571. Vibration test shall be done as per IEC: 61373 on the prototype unit. Representatives of Indian Railways from RDSO shall carry out the tests and inspection of the equipment. Prototype test of equipment shall be carried out by the manufacturer at his own responsibility and cost and in the presence of and to the satisfaction of representatives of RDSO.

8.2 The supplier will formulate and submit a type test protocol / plan for approval of RDSO before undertaking manufacture. It shall, however, be open for RDSO to waive any of the tests in case of equipment and sub-assemblies, where the manufacturer can establish to the satisfaction of RDSO that such tests have already been carried out earlier and where equipment has been proved in prolonged service.

9.0 GUARANTEE / WARRANTY

9.1 The supplier shall make good any defect/failure of equipment supplied due to defective design, material or workmanship up to the period of i) 18 months from the date of commissioning or ii) 24 months from the date of despatch of material, whichever is earlier. The supplier shall replace/repair all such equipment during the guarantee period at his expense including customs duties expences.

9.2 Replacement and repairs that the purchaser calls upon the supplier to deliver or perform under this warranty shall be delivered/performed satisfactorily by the supplier within 30 days.

9.3 The supplier shall maintain a bank of spares at the nominated places, to be decided mutually with the purchaser, to ensure timely replacement / repair of any defective equipment under warranty obligations, so that trials are not interrupted

9.4 During the warranty period the supplier may be required to maintain a service centre group in India as indicated in clause 4.5.3.

10. CLAUSE BY CLAUSE COMPLIANCE AND DEVIATIONS

The tenderer shall furnish with the offer clause by clause compliance to the specification and where there exist deviations from the specification, these shall be highlighted and alternatives offered (supported with reasons). Since this specification relates to trial of the equipment, the deviations, if any, shall be discussed and mutually decided upon before placement of the order.

11. EVALUATION OF TRIAL RESULTS

The evaluation of the performance of the sets proposed under this specification shall be required to be carried out for each of the sets and in accordance with the formats and terms as indicated in clause. These shall be prepared with the assistance of the supplier's engineers/representatives and any observations connected with the recorded data or inference shall be entered for every periodical report. The report shall be prepared for each month bringing out evaluation of the captured data and in particular the following:

(a) Kilometres earned and equipment hours logged.

(b) Number of instances where low level of alertness/alarm registered (with date & time).

(c) Number of instances out '(b)' above that were either "protective" or spurious (with date & time).

(d) Number of instances of low level of alertness where alarm did not register (with date & time).

(e) Instances of manual over rides and period of isolation (with date & time).

(f) Defects/problems encountered in operation of DVTCS (with date & time).

(g) Attention during service.

(h) Warranty replacement & repairs.

The final evaluation report will be based, apart from the monthly evaluation reports, on reports from officers in charge of electric loco operation and maintenance. IR are not obliged to provide the supplier, the IRs interpretation of the evaluation or IRs appreciation.

****