# LIST OF AMENDMENTS

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Amendment Date</th>
<th>Revision</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>05/11/2014</td>
<td>0</td>
<td>First Issue</td>
</tr>
<tr>
<td>2.</td>
<td>05/07/2018</td>
<td>1-Draft</td>
<td>Following Changes have been incorporated in the Rev.01 of the specification:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. 2 MPiP camera for Inside and Outside view (earlier it was 700TVL analog camera for inside view which had effective pixel 0.4 MP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Network Video Recorder instead of Hybrid DVR at clause 3, 4.1. Requirement of stable voltage against voltage variation for DC-DC Converter or Power Supply Module as per IEC 60571. Electron beam cable incorporated at clause no. 4.3.</td>
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<tr>
<td></td>
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<td>3. Logging feature for malfunction of channel or any other abnormality in LCVR incorporated at Clause 5.11.</td>
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<td>4. Technical requirement of IP camera at Clause no. 6 updated.</td>
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<td>5. Pan India Support System for LCVR Suppliers at clause no. 9 incorporated.</td>
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<td>6. Requirement of MoU/Authorization from OEM of Camera and NVR for LCVR supplier at clause no. 9 incorporated.</td>
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<td></td>
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<td>7. Synchronization of GPS clock with LCVR incorporated at clause no. 5.4.</td>
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<td>8. Optional item of Video Management System incorporated at clause 5.12 along with requirement of 4G Cellular Network compatible hardware instead of 3G for LCVR.</td>
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<td></td>
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<td>9. Lock and Key arrangement for housing has been incorporated at clause no. 5.17</td>
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<td></td>
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<td></td>
<td>10. Addition of Clause no. 20 – Vendor changes in approved status.</td>
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LIST OF REFERENCED DOCUMENTS

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<td>1.</td>
<td>EN 50155</td>
</tr>
<tr>
<td>2.</td>
<td>IEC 60571</td>
</tr>
<tr>
<td>3.</td>
<td>IEEE 1482.1</td>
</tr>
</tbody>
</table>
0 Introduction
This specification covers the functional and technical requirements of the ‘Loco Cab Video and Voice Recording System’ (LCVR) for application on Diesel-Electric locomotives.

It is the responsibility of the manufacturer/supplier to develop circuit/detail design to meet the requirements of this specification.

1 Objectives and Scope of the specification
This document lists the requirements of Loco Cab Video and Voice Recording System’ (LCVR) for use on diesel electric locomotives of Indian Railways.

This document has been prepared with an aim of defining the requirements for Loco Cab Video and Voice Recording System’ (LCVR) which shall ensure effective and tamper proof video and voice recording of loco cab and track view for post event analysis.

2 Terminology / Abbreviations

NVR: Network Video Recorder
FIFO : First In First Out
LCVR : Loco Cab Video and Voice Recording System
GPS : Global Positioning System
4G : Fourth generation of broadband cellular network technology
CHM : Crash Hardened Memory
TCP/IP : Transmission Control Protocol/Internet Protocol
HTTP : Hyper Text Transfer Protocol
DHCP : Dynamic Host Configuration Protocol
RTP : Real-Time Transport Protocol
RTSP : Real Time Streaming Protocol
PPPoE : Point-to-Point Protocol over Ethernet

3 Brief description of the system/equipment/components

The LCVR system shall contain following major sub-components. The list is indicative and the vendors shall provide further details as per their own design.

- IP based Digital Cameras (2 nos. Inside Camera in each cab and 1 Outside Camera on either end i.e. IP Cameras of 4 nos. for single cab and 6 Nos. for dual cab).
- Network Video Recorder along with data storage memory.
- DC-DC Converter to feed the system from loco control voltage of 72VDC (Nominal).
- Required cables and interfacing equipment
- Hardware for mounting and cabling
- Microphone for voice recording

4 General requirements

The equipment shall meet the following general requirements:

4.1. LCVR system shall be combination of IP based digital cameras, in-built microphones with camera or additional microphones, network video recorder (NVR) along with data storage memory suitable for mobile vehicle operations. The integration of the camera and microphones with mobile network video recorder installed in loco cab shall be based on standard interface.

4.2. The indication of health of each channel shall be displayed in each cab (preferably LCD based display) at suitable location to monitor that recording is working.
4.3. The Control Voltage available to Diesel loco is 72 V DC from battery. The input voltage to the system may be according to OEM’s design. However, to make compatible the system with Diesel loco power supply, firm has to provide individual DC-DC Converter of suitable capacity. The DC power from loco can be tapped for input to DC-DC Converter through MCB of adequate rating.

4.4. The control voltage of 72 V DC supply source normally consisting of accumulator battery and/or an auxiliary generator is available. The nominal and limits of voltage in which the equipment shall operate satisfactorily are as under.

<table>
<thead>
<tr>
<th>Type of Locomotive</th>
<th>Nominal Voltage</th>
<th>Limits of voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel-electric</td>
<td>72 Volts DC</td>
<td>50 to 90 Volts DC</td>
</tr>
</tbody>
</table>

Voltage fluctuations lying between 0.6 to 1.4 times of Nominal voltage and not exceeding 0.1 second shall not cause any deviation in functioning of LCVR (Clause 5.1.1.2 of IEC 60571). Voltage fluctuations lying between 1.25 to 1.4 times of Nominal voltage and not exceeding 1 second shall not cause damage to the unit. The unit may not be fully functional during these fluctuations (Clause 5.1.1.2 of IEC 60571). Cables for power supply should be Electron beam irradiated cables.

4.5. System shall use video signals from various types of CCD (Charged coupled devices)/CMOS or better colour cameras installed at different locations and audio signals from microphones to process them and record all the cameras after compression using open standard H.264 (ISO/IEC 14496-10) for video compression and G.711 for audio compression.

4.6. System shall ensure that once recorded, the video cannot be altered, ensuring the audit trail is intact for evidential purposes.

4.7. System shall provide 1 TB data storage of all the camera recordings @ 25 FPS, at 4 CIF or better quality using necessary compression techniques for all cameras (extended capacity of cameras i.e. present capacity + 25%) with simultaneous storage of audio signal.

4.8. Industrial grade Vibration and Shock Proof Solid State Drive (SSD) shall be used for data storage with easy removal of SSD Hard drive for offline downloading the Data. There shall be sufficient memory to Store 1 TB data on FIFO (First in First Out) basis. The firm shall furnish the information of SSD Hard drive i.e. OEM Datasheet etc.

4.9. Encoders shall compress the digital video using various compression algorithms and store the compressed digital video and audio signal received through individual channel in local hard disk of Network video recorder. Encoders shall have less than 200 ms of latency and shall support dual stream.

4.10. The recording resolution and frame rate for each camera shall be user programmable.

4.11. All the cameras & control equipment shall be suitable for operation from -20°C to 55°C ambient and relative humidity (RH) up to 90% non-condensing.

5 Functional requirements

The equipment shall address the following functional requirements.

5.1. All Cameras shall be Day/ Night cameras with option of audio feature.

5.2. Housing of cameras shall be of IP 66 or better rating for Inside camera and IP 67 or better for outside camera.

5.3. The recording shall support audit trail feature as given at clause 4.6

5.4. Recorded video shall display Camera ID & location of Camera with date/ time stamp. Camera ID and Location of camerashall be programmable by the system administrator with User ID & Password. Date/Time stamp shall be updated with GPS clock.

5.5. The recorder shall be Network Video Recorder for mobile applications compatible with IP based digital camera.

5.6. Facility of camera recording in real-time mode (25 FPS)/ 15/ 12.5/ 10 or lower FPS as well as in any desired combination must be available in the system.

5.7. The recorder shall be fully user-configurable allowing every camera input to be set individually.
5.8. **NVR** (recorder) shall be able to provide power to all cameras. There shall be no need for local power supply for each camera.

5.9. Facility of Camera recording in CIF, 2CIF, 4CIF, D1, 2 Mega Pixel as well as in any combination i.e. any camera may record with any quality.

5.10. The offered system shall have facility to export the desired portion of clipping (from a desired date/time to another desired date/time) on external drive. Viewing of this recording shall be possible on standard PC using standard software like windows media player etc.

5.11. Acknowledgeable Audio visual alarm feature is required to indicate the failure of recording of any of the audio and video channel in each cab of the locomotive. The logging of data for failure of channel or any other abnormality in the system should be stored in the NVR.

5.12. System shall have hardware available for 4G and GPS connectivity for remote monitoring. Railway may ask for enabling the feature of remote monitoring. SIM card for each NVR for wireless data transmission and required server space shall be optional item for remote video management system. The optional item shall be provided by the LCVR supplier at an additional cost, if specifically asked for the same in the tender. The LCVR system should have the feature of Video management System similar to the system being used in other commercial applications for security surveillance. The system should be compatible for interfacing with Crash Hardened Memory (CHM) complying IEEE 1482.1 to store data simultaneously as future requirement and scalable feature. The firm may submit the undertaking for supporting the interfacing with crash hardened memory, if provided by Railways. The firm shall be bound to integrate the system with these requirements at later stage whenever asked. The CHM shall be provided by Railway or can be procured from the LCVR vendor.

5.13. System shall have facility of additional camera installation beyond the originally planned capacity. NVR shall have at least 8 cameras input configurable as IP camera and 6 audio inputs. The recorder shall have minimum 2 digital outputs for system interfacing.

5.14. The recorder shall have a USB-2 interface on the front panel for service and maintenance.

5.15. The recorder shall have an Ethernet port via an M12 connector.

5.16. The recorder shall be supplied in a compact black aluminum enclosure of maximum size of 3U sub Rack.

5.17. Mounting of camera and NVR shall be as such that it shall be housed in a sealed, tamper resistant housing with Lock and Key arrangement along with relevant hardware/fasteners required for installation to deter theft of SSD. NVR as well as any sub-unit of LCVR system with common hand tools. Lock shall be of Southco/EMKA/Dirak make or similar. Mounting arrangement shall be made to isolate vibration to avoid transmission of shock and vibration to the equipment to the extent possible.

5.18. The recorder shall have recording modes viz. continuous, manual, or programmed modes on date, time and camera-wise. All modes shall be disabled and enabled using scheduled configuration. It shall also be possible to search and replay the recorded images on date, time and camera-wise. Different recording speeds (fps) and resolution for each recording mode for each camera shall be possible.

5.19. Audio recording shall be synchronized with respective camera.

5.20. The application software shall allow retrieval of data instantaneously or any date/time interval chosen through search functionality of the application software. The system shall also allow for backup of specific data on any external device in a format which can be replayed through a standard PC based software.

5.21. The software shall Support flexible 1/2/4 Windows Split screen display mode or scroll mode on the PC monitor or on preview monitor as per site requirement.

5.22. The software shall have zoom facility to view particular patch.
6 Technical requirements
The proposed system shall meet the following technical requirements:

<table>
<thead>
<tr>
<th>Technical Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Image Sensor</strong></td>
<td>1/3” CCD/CMOS or better</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>HD 2 Mega Pixel for Outside and Inside View</td>
</tr>
<tr>
<td><strong>System Compatibility</strong></td>
<td>ONVIF</td>
</tr>
<tr>
<td><strong>Protocols</strong></td>
<td>TCP/IP, HTTP, DHCP, RTP, RTSP, PPPoE</td>
</tr>
<tr>
<td><strong>Ethernet</strong></td>
<td>10/100Base-T</td>
</tr>
<tr>
<td><strong>Lens</strong></td>
<td>Focal length -3.6 mm or better (Fixed lens)</td>
</tr>
<tr>
<td><strong>Night Vision</strong></td>
<td>IR (Minimum IR Distance of 5mtrs. for inside and 30 mtrs. for outside camera)</td>
</tr>
<tr>
<td><strong>Signal to Noise Ratio</strong></td>
<td>Min. 50 dB for the analog camera and WDR for Min 100 dB for IP camera.</td>
</tr>
<tr>
<td><strong>IP Rating</strong></td>
<td>Dust protection with dehumidifying membrane, IP-67 to IEC 60529 for outdoor camera and IP 66 to IEC 60529 for Inside camera and vandal proof (Impact rating IK-10 to IEC62262)</td>
</tr>
<tr>
<td><strong>Operating Temperature</strong></td>
<td>-20 Deg. C to 55 Deg. C Ambient</td>
</tr>
<tr>
<td><strong>Synchronization</strong></td>
<td>Internal</td>
</tr>
<tr>
<td><strong>Backlight compensation</strong></td>
<td>Automatic</td>
</tr>
<tr>
<td><strong>Automatic white balance</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Video output</strong></td>
<td>M-12 or Aviation plug, Rugged RJ-45/M-12</td>
</tr>
<tr>
<td><strong>Power source camera</strong></td>
<td>Less than 15 Watt</td>
</tr>
<tr>
<td><strong>Standard compliance</strong></td>
<td>Rolling Stock: EN 50155:2007 or latest compliance (shock, vibration, temperature, EMC)</td>
</tr>
</tbody>
</table>

Note: International certification by Certification body UL, CE, FCC, etc. is desirable to ensure quality product.

7 Safety requirements
The equipment shall meet all statutory and regulatory criteria required for safety of users.

8 Environmental/Climatic requirements and Test Compliance
The equipment shall conform to environmental conditions and Test compliance detailed in the EN 50155: 2007 or latest.

8.1 Reference environmental conditions
The following is the normal operating environment under which this equipment is required to operate. This data is provided for guidance only.

<table>
<thead>
<tr>
<th>Environmental Condition</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Atmospheric temperature</strong></td>
<td>Maximum temperature of metallic surface under the sun: 75°C. Minimum temperature: -10°C (Also snow fall in certain areas during winter season.)</td>
</tr>
<tr>
<td><strong>Reference site conditions</strong></td>
<td>Ambient temperature: -20 °C to 55°C Humidity: 90-100%</td>
</tr>
</tbody>
</table>
Altitude: 1776 m above mean sea level

Humidity 100% saturation during rainy season
Rainfall Very heavy in certain areas
Atmospheric conditions Extremely dusty and desert terrain in certain areas. The dust content in air may reach a high value of 1.6 mg / m³. In many iron ore and coal mine areas, the dust concentration is very high affecting the filter & air ventilation system.
Coastal area Humid & salt laden atmosphere with maximum pH value of 8.5, sulphate of 7 mg per litre, maximum concentration of chlorine 6 mg per litres and maximum conductivity of 130 micro siemens/cm

| Wind speed | High wind speed in certain areas, with wind pressure reaching 150 kg/m² |

Table 1: Reference Environmental Conditions

9 Documents required from supplier
The vendor shall provide the following technical documents as part of their proposal.

- In case of already developed systems, the equipment manufacturer must provide to RDSO the prototype test compliance as per EN50155 and the required details with drawings required for the purpose of evaluation of the design and its functionality. All documents shall be supplied in both hard and soft (PDF) copies.
- In case the supplier is outsourcing the sub assembly such as Camera, NVR, etc. which are commercially off the shelves product and have been working in other mobile applications, the supplier shall furnish the details of credentials and MOU/Authorization letter from the OEM.
- In case of new or developing design, the process of design of the system clearly indicating the different stages, milestones and project duration.
- Performance specification, Data Sheet of the equipment viz. NVR, Camera, SSD, DC-DC Converter etc. and the certification from International/national certification agency such as CE, FCC, UL, etc. (if available).
- The supplier shall have Pan India Support System for maintenance and technical support for LCVR system. The firm shall provide the necessary credentials in support of the Pan India support System.
- Instruction Bulletins, data downloading manual and Troubleshooting Manual of LCVR system.

10 Tests for Verification & Validation
Following tests shall be conducted for testing the equipment for compliance and suitability as per the requirements:

- Visual check.
- Verification of test certificates and reports submitted.
- Verification of compatibility for fitment on locomotive.
- Fitment and trials on locomotive
- Extended field trials for performance evaluation. Performance shall be closely monitored and evaluated by RDSO.

Notwithstanding anything that may be specified in this specification, the final responsibility for the suitability of the design shall lie with the firm and the firm shall carry out all modifications for satisfactory operation of the LCVR system during the period of field trials.

Any safety related modifications issued by IR from time to time shall be carried out by the vendor.

11 Numbering
Each unit of system i.e. NVR, Camera, SSD, Microphone, DC-DC Converter (If required), etc. shall contain a number plate indicating

a. Serial number
b. Date of manufacturing
c. Name of manufacturer

d. Model number.

Major sub-assemblies going into each unit shall also be numbered and recorded with the supplier for future reference.

12 Referred standards

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

- EN 50155
- IS 2500
- IEEE 1482.1
- H.264
- G.711

13 Life cycle management

The equipment supplier shall ensure that the lifecycle requirements of the equipment be met as detailed in the paragraphs below.

13.1 Expected life

The expected life of the equipment shall be 12 years or more.

13.2 Support during lifetime

The equipment manufacturer shall ensure that the following support is available on demand during the equipment lifetime:

- Service / spares support for the equipment
- Options for comprehensive maintenance contracts
- Modifications in equipment design to meet new requirements or to improve reliability

The options for demanding these support services shall be reserved by the Indian Railways and the equipment manufacturer shall provide the same on demand.

The equipment manufacturer shall submit an undertaking to support the equipment during its declared lifetime. This undertaking shall be provided during type testing and design approval and also while entering into purchase contracts.

Note: Cost of the services shall be determined through a mutually acceptable process between the manufacturer and the users on the Indian Railways.

13.3 End of equipment life management

The equipment manufacturer shall provide options to upgrade / refurbish equipment at the end of life of the equipment when requested by the Indian Railways.

The equipment manufacturer shall submit an undertaking to provide options for end of life management when required by Indian Railways. This undertaking shall be provided during type testing and design approval and also while entering into purchase contracts.

14 Warranty

The manufacturer shall provide warranty as per IRS terms and conditions.

15 Training

The supplier shall train adequate number of IR personnel in operation and maintenance of the offered LCVR. Adequate documentation shall be provided. Personnel of Indian Railways shall be nominated to attend the training.
The equipment manufacturers shall arrange training for operations and maintenance of the equipment, as an integral part of the equipment supply.

16 Sampling plan
Sampling shall be done as per IS2500 wherever not specified but required. Sampling shall be done as per the requirements wherever specified in this document. If the specific contract includes specific clause for sampling, the same shall be applicable.

17 Painting, labeling and marking
The equipment shall be appropriately painted for operational use, 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.

The offered system and all major components and parts shall have proper identification and traceability to facilitate failure analysis and life cycle data.

ID plate Name of Component, Make, Sl. No, Date of Manufacture, Ratings shall be provided on all assemblies/subassemblies.

18 Packaging and delivery/shipment
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.

19 IPR disclaimer
The vendor must also provide the following undertakings in signed copies:

19.1 Undertaking by equipment manufacturer
All vendors shall provide a signed copy of the undertaking on “INFRINGEMENT OF PATENT RIGHTS”.

The undertaking shall 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 RDSO and right of Railways/RDSO on such IP is acceptable to them.

19.2 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 document or any part thereof, without express authorization is strictly prohibited. Offenders will be held liable for the payment of damages. Indian Railways/RDSO is granted right to use, copy and distribute this document for the use of inspection, operation, maintenance and repair etc.

20 Vendor changes in approved status:
All the provisions contained in RDSO's ISO proceeding laid down in document no. QO-D-7.1-11 dated 19.07.2016 or latest (titled: "Vendor changes in approved status") and subsequent version/amendment
thereof, shall be binding and applicable on the successful vendor/ vendors in the contract floated by Railway to maintain quality of products supplied to Railways.