

General Specifications

This document describes the requirement of supply, installation, testing & commissioning of CCTV system for 70 nos. of RS1 trains of Delhi Metro Rail Corporation Limited (DMRC).

The contractor shall carry out all required works and activities with regard to design, manufacture, supply, testing and commissioning of CCTV System inside the DMRC RS1 trains and shall be responsible for break down/maintenance support of CCTV System during the defect liability period of two years from the date of issuing of 'Taking Over Certificate' by DMRC from the last train.

The configuration of DMRC RS1 train is as follows;

DTC – MC – TC – MC – TC-MC- MC - DTC (8 Car formations)

DTC – MC-TC-MC-MC-DTC (6 Car Formations)

DTC: Driving Trailer Car, MC: Motor Car, TC: Trailer Car.

1.0 Scope of Supply

1.1. Hardware

The CCTV system proposed shall work on train basis. The contractor shall provide all components related to the satisfactory working of CCTV system and shall not be limited to the following;

Sr. No.	ITEM DESCRIPTION	QTY.		
		DTC	TC	MC
1	Saloon Camera (IP based)	4	4	4
2	Cab Camera (IP based)	1	-	-
3	Rear-View External Camera	2	2	-
4	Catenary Visibility Camera	1	-	-
5	PoE switch (Managed)	1	1	1
6	Network Video Recorder (Having SSD, with minimum 15 days recording Capacity)	1	1	-
7	CCTV Display Monitor	1	-	-
8	Software	Complete package for integration and configuration of all aggregates.		
9	CAT 6 Cable	The cable between Recorder to Saloon Cameras, Cab Cameras, Platform camera and OHE camera, Recorder of one car to Recorder of another Car, and display on both ends.		
10	Required software, connecting cables for downloading, viewing with the search function of data from the recorder.	4 set		
11	Male & Female connectors, pins & sockets etc	1 Set/Car	1 Set/ car	1 Set/Car

2.0 Detailed Scope of work

- 2.1 Camera shall comply with the contractual requirements mentioned under Technical specifications of this contract.
- 2.2 All the components/hardware etc. required for complete installation, testing & commissioning as well as the smooth operation of the CCTV system shall be provided by the contractor.
- 2.3 Visual images from each camera shall be recorded with time and date stamp in the non-volatile memory of three recorders simultaneously on FIFO basis without any limitation of the repetitive writing of the data and minimum 15 days of recording capacity is required.
- 2.4 Recorders shall have **safety storage /emergency recording function**. i.e. in case of SSD failure, the data should store on additional storage device (SD card) **or redundant SSD drive**.
- 2.5 In case of loss of signal to NVR due to failure of any one or all the cameras due to any reason, **there shall be visual indication on the NVR and on HMI, for the respective camera**.
- 2.6 The CCTV recording from any of the recorders shall be possible to download using a standard laptop with specified interface cables. The recording shall be with time and date stamping and required software to download and play it at different speeds for viewing with search function shall be provided.
- 2.7 The view of all CCTV cameras of all cars of a train shall be possible to view on a separate HMI touch screen to be provided in the cab on the driver's desk. The HMI touch screen shall be as per the specifications given under Technical Specifications of this contract. The HMI touch screen should have all the basic functions including that of adjusting the brightness, contrast, color, sharpness etc. The live view of CCTV cameras of all cars of a train should be possible to view on the HMI screen in the active cab on a selectable basis.
- 2.8 The contractor shall provide all required hardware such as bolts, nuts, washer and other fasteners as required for installation of CCTV system components as per the requirements specified in ISO 3269.
- 2.9 The CCTV system shall fully meet the requirement of EMI/EMC for Railway application as per EN 50155.
- 2.10 The contractor shall be responsible to support against breakdown/failure of any of the CCTV system's components during Defect Liability Period of two years from the date of handing over of last train with fully commissioned system.
- 2.11 The list of warranty spares to be maintained by the contractor at site to provide support during warranty period shall have to be furnished by

the contractor in his technical offer.

- 2.12 The contractor shall have to submit following documents as a part of their offer;
- a) Description of CCTV system as a whole with required drawings.
 - b) The certificates from respective OEMs of CCTV system components, on their letter head about compliance of specified specifications.
 - c) Testing and Commissioning plan.
 - d) Operation and Maintenance manual of respective OEM for all the CCTV system components
- 2.13 The contractor shall provide required training for operation and maintenance of CCTV system to DMRC staff at the site.

3.0 Design Responsibility

The Contractor shall be responsible for the design of the CCTV system, which shall include but not be limited to the following

- 3.1 The development of the design shall be carried out in conjunction with the information contained in this Specification.
- 3.2 The Contractor shall be responsible for the development and completion of the design of any other item/s of the Work as needed during the execution of the Contract.
- 3.3 The Contractor shall inspect, examine and verify the DMRC's requirement as described in the specification before adopting in the design of the equipment.
- 3.4 The Contractor shall ensure that the information contained in his submissions has been well co-ordinated with the overall requirements of the Work.

4.0 Commissioning and Testing

- 4.1 Contractor shall be responsible for carrying out performance tests of the CCTV.
- 4.2 Consignee will have the right to witness any of these tests at any stage of test progress. The commissioning test of the complete vehicle will be performed by the contractor for the CCTV assembly at consignee premises.

5.0 Spare parts, Special tools, and Testing Equipment

- 5.1 The Contractor shall propose the methodology and required interface cables/adaptor to communicate and download CCTV recording from the recorder if, it is of a special type. The contractor will also have to supply the required tools and software to download and view CCTV recordings at different speeds along with search function.

6.0 Availability of spares

- 6.1 Contractor shall ensure the availability of spares of CCTV system at least for 10 years if DMRC wants to purchase them in future on

requirement basis from the date of commissioning of CCTV system. The Tenderer while quoting will clarify for the same.

7.0 Operation and Maintenance Manual

7.1 The Contractor shall provide the OEM's Operation & Maintenance manual for all the components used in the CCTV system.

8.0 Maintenance during DLP

8.1 The CCTV system shall be maintained against any defect/failure/malfunction by the successful Tenderer during the Defect Liability Period (DLP) of 24 months from the date of handing over of installed and commissioned system on the Last train to DMRC. The Tenderer shall submit in the offer, the details as to how they propose to carry out the maintenance during the defect liability period. During DLP, the contractor shall maintain sufficient spares in the depot for ready replacement in case of a fault in any component/equipment. The contractor will be required to submit a list of all such DLP spares. These DLP spares, if not used during DLP, may be purchased by DMRC on mutually agreed rates on completion of DLP.

9.0 Packing

9.1 Contractor shall ensure proper packing of the CCTV equipment to avoid damage during transit, handling and storage.

10.0 Certifications

10.1 All the components of CCTV system shall carry the mandatory certifications mentioned in the technical specification. Compliance of these certifications must be submitted on OEM's letter head.

11.0 Warranty

11.1 Refer general terms and conditions (GCC) of the tender.

12.0 Training

12.1 The Contractor shall provide training to the DMRC personnel and the maintenance staff of DMRC for operation and maintenance of CCTV system.

13.0 Penalty

13.1 The penalty will be as applicable.

14.0 Do's and Don'ts for Staff

DO'S

1. In case of fire/ anything unusual on electric equipment or wires, inform the respective Engineer-in-charge.
2. Extinguish the fire by special extinguishers (carbon tetrachloride or carbon dioxide type, if available).
3. Ensure no water jet to be directed at the fire under any circumstances.
4. Keep clear of the track and avoid contact with the rails when electric train within 250m.

5. Special care should be taken to carry long pipes, poles or ladders so that it should not come in contact with or within 2 meters of live OHE.

DON'Ts

1. Do not approach within 2 meters of any traction wires or live equipment.
2. Do not work on or near traction wires or any live equipment unless they are made dead, earthed and shut down notices/ permit to work obtained.
3. Do not enter any switching station or remote-control center unless specially permitted.
4. Do not touch a person in contact with live traction wires. Remove body only after the power supply is switched off & earthed.
5. Do not touch any traction wire hanging from the mast or fallen on the ground and do not allow anyone else to touch it.
6. Do not lift or raise your tools towards traction wires.
7. Do not damage the plinth continuity, connection to BEC, OPC and handrail continuity.
8. Do not use steel tape or metallic tape or tape with woven metal reinforcement in electrified area.
9. Do not forget to give artificial respiration to the victim as per the prescribed procedure laid down at shock treatment charts.
10. Do not throw garbage in haste. Dispose it properly at a designated place.
11. The contractor has to submit an undertaking in specified Performa w.r.t Dos & Don'ts related to the danger of work in the vicinity of 25KV traction.

15.0 Safety

- 15.1 Contractor shall adopt the necessary safety procedures to avoid any type of accidents to Employer's personnel, any other personnel & to avoid damages to DMRC assets.
- 15.2 The contractor shall display necessary signage while carrying out the work.

16.0 Accidents

- 16.1 It shall be the sole responsibility of the contractor to adopt all the safety measures & deploy personnel who are adequately trained in safety.
- 16.2 If any accident occurs within the Depot and associated area due to maintenance work or due to negligence on the part of the contractor's personnel it shall be the full responsibility of the Contractor.
- 16.3 If any damage occurs to the material & equipment due to maintenance work, the cost of damage will be recovered from the contractor's bill.

17.0 Indemnity

- 17.1 Tenderers have to submit Indemnity (To be filled by contractor & contractor staff individually) before the start of work as per Annexure-II&III of Employer's Requirement as per Sub-Clauses 4.16 and 6.7,Sl No.

Technical Specifications

1.0 Technical Requirements:

1.1 The Passenger Saloon Surveillance System (PSSS) shall comprise of a close circuit television (CCTV) network using surveillance cameras, routers and cables, monitors and other accessories. The fully expended system shall be designed for minimum 25fps. To ensure maximum optimization of CCTV footage storage space, the system fps shall have the provision of configuration as per DMRC's requirements. The minimum angle of view shall not be less than 87° (horizontal) & 50° (vertical). The picture quality shall be level E as minimum at 100% ROTAKIN measured according to EN50132-7 clause 13.9.2

The Passenger Saloon Surveillance System (PSSS) shall be designed to function under below mentioned climatic conditions:

Description	Limiting values
Maximum ambient temperature	47°C (See note below)
Minimum temperature	3°C
Humidity	100% saturation during the rainy season
Rainfall	Rain during Summer season generally occurs from June to September. However, occasionally rain also takes place during the winter season. Average annual rainfall of Delhi is approximately 850mm and maximum rainfall in any 24hr period is up to 250mm
The atmosphere during the hot season	Extremely dusty including bird feathers
Maximum wind speed	150 Kmph
SO2 level in atmosphere	80-120 mg/m ³
Suspended particulate matter in the atmosphere	360-540 mg/m ³
Shock & Vibrations	The sub-systems and their mounting arrangements shall be designed to withstand satisfactorily the vibration & shocks encountered in service as specified in IEC 61373 & IEC 60571.

Note: The temperature of the outside train body when exposed directly to the sun, for long periods of time during peak summer, may be assumed to rise up to 70°C.

- 1.2. Each car shall be provided with at least four surveillance camera devices at appropriate location to cover the maximum passenger saloon area for surveillance. Surveillance cameras in both DT cabs shall be provided for monitoring of detrainment door and driver desk. The cameras shall be suitably selected with respect to resolution, clarity of images (not inferior to 1280x960 Resolution & 25 fps) and illumination conditions for on-train applications and shall be of proven design. Mounting of camera shall be unobtrusive, flushed with, or recessed into the interior panel. Monitor shall have facility to enable multiple views of the saloon simultaneously. The system shall be based on open environment/protocol like Ethernet for ensuring interchangeability of cameras. The PSSS system (including NVRs) shall have self-diagnostics features and shall be capable to communicate the individual health statuses (including the intimation of faulty conditions) to the train operator/maintainer automatically. The contractor shall attain DMRC's approval for schematics of the above provisioning at design stage.
- 1.3. External cameras shall also be placed on the outer sides of DT & T cars as a minimum, for gathering rear view of the platform. Selection of the number of cameras shall be finalized during design and the above shall ensure clear view of passengers on platform to Train Operator before start at each station till train leaves the platform completely. **The system shall automatically switch to rear view when the train stops and shall go back to default mode after the train leaves the platform.** Train operator shall have full flexibility in selection of camera(a) as per his need. The HMI screen shall be large enough to accommodate the simultaneous view up to four (selectable) rear view/saloon cameras with acceptable clarity. Additional front facing cameras shall be provided outside both DT cars for catenary visibility, separately. **The saloon and external cameras shall comply with the specifications laid down at Annexure-A to the Technical Specifications of the contract.**
- 1.4. The HMI shall be a surveillance touch screen. The maximum resolution of view on the HMI screen in cab shall not be less than 1280x720 along with 25fps. Provision for configuration of image acquisition (i.e. changes in image resolution and fps) shall be provided to DMRC. DMRC's engineers shall be trained by the contractor for the above. Each camera view on the HMI shall come with adequate image stamping i.e. Car No., Date, Time, Train No. etc. overlaid in the image. The contractor shall attain DMRC's approval for the HMI specifications and schematics during design stage. **The HMI shall conform to the specifications laid down at Annexure-A to the Technical Specifications of the contract.**
- 1.5. Under normal operation, the views gathered from each of the camera located in the train shall be sequentially played on the monitor screens (HMIs) of both the cabs. Adequate controls shall be provided for necessary surveillance requirements and priorities. The CCTV monitoring and display

system (HMI) in DT cabs shall have under mentioned control functionalities as a minimum:

- a) Mode Selection: Manual Switching and Automatic Cycle playing.
 - b) Video play back function from NVR.
 - c) Provision of selection of cameras of any car by single touch.
 - d) Provision of toggling through views, by previous and next tabs.
- 1.6. In case of activation of Passenger Emergency Alarm in any of the cars, the views from camera provided near the location of activated Passenger Emergency Alarm shall be displayed in the monitors. However, the train operator shall be able to select any other camera, as required. The cameras shall have inbuilt zoom function. It shall be possible to filter, zoom and select images in off line mode for investigation purpose. The images shall be with time stamping and it shall be possible to link them with respective location of train. Similarly, in case of door obstruction/obstacle the camera(s) shall focus on door way and alert the train operator by flashing the image.
- 1.7. The visual images from each camera shall be recorded in non-volatile memory of Network Video Recorders (NVRs) without any limitation of repetitive writing of the data. The NVRs shall be realized vide SSD memory devices having storage capacity not less than 2TB each, installed in every unit of the train consist. The specifications for image/video acquisition in NVRs shall be configured for storing CCTV footages for not less than 15 days. The memory of above NVRs shall be expandable by simple plug-in of commercially available memory media and configuration through maintenance software. Additionally, each camera shall also have internal recording capacity for at least 24 hours. The memory shall be expandable by simple plug-in of commercially available memory media. The records shall be easily accessible and downloadable without requiring the removal of memory cards from cameras. The Contractor shall provide equipment and means for the memory expansion of NVRs and internal memories of cameras. At least one set of such equipment shall be provided to each of the concerned depots. Provision shall be made for single-point download of video files of entire train. The Network Video Recorders shall conform to the specifications laid down at Annexure-A to the technical specifications of the contract.
- 1.8. The train shall only provide 110V DC voltage for the PSSS. Any other voltage levels which the PSSS may require, if any, shall be provide the PSSS itself. The DC-DC converter used (if any) shall have suitable redundancy.
- 1.9. Each electronic equipment used in Passenger Saloon Surveillance System shall essentially conform to latest revision of EN-50155 and EN-50121-3-2 standards. Electronic equipment shall not be damaged, nor shall malfunction when subjected to direct spikes and surges on the supply and

indirect burst transients as defined in IEC 60571: *Electronic Equipment used on Rail Vehicles*. Contractor shall submit requisite certifications for compliance to the above.

1.10. Electronic components shall only be purchased from suppliers having as a minimum, ISO 9001/2 certification.

1.11. The proposed cables of PSSS network shall be proven on metro Rolling Stock. The Contractor shall submit detailed specifications of proposed cables for DMRC's review and approval. The wire/Cable shall be of type CAT-6, shall comply with EN50305 & EN45545 for flame resistance, and BS6853 for fire retardant properties. The insulation of all wires and cables including those used with in equipment/sub system shall be halogen-free flame- retardant and formulated to minimize generation of smoke, toxic emissions, and corrosive fumes.

The wires shall be 2 twisted insulated conductors of 4 pairs and shall comply electrical characteristic as per IEC: 11801 CAT: D and shall comply Mechanical characteristics as per DIN-5510-2 protection level 1 to 4. The contractor shall submit the certificate of compliance of above standards from respective OEM on their letter head. **Cables of make Belden, Harting, CATLine, Leoni or any other make of equivalent specifications.**

1.12. For car to car connections separate arrangement has to be provided by the contractor with a provision to detach them during uncoupling of cars.

2.0 Software Requirement

2.1 Recorded video analysis feature:

- a) Software shall enable playback of recorded video stream.
- b) One or more video streams shall be possible to be selected and shown simultaneously in a multiple display.

The sequence of interest may be possible to be flagged with markings on the time bar. These sequences may be possible to be exported by the software for either writing to analysis in a file or to be copied into a CD, DVD or USB storage.

- c) Enlarging of the selected images to emphasize key detail shall be possible.

2.2 Pertaining to CCTV maintenance software, the contractor shall provide, as minimum, the following:

- a) Software for downloading, Diagnostics & maintenance.
- b) User/OEM's manual for individual CCTV system components' troubleshooting & maintenance.
- c) Two backup copies of application software.

2.3 The contractor shall ensure that no license is required to use supplied software along with the equipment and there are no restrictions attached

to the use of any information supplied by the contractor which might later prevent or hinder the user from using system for viewing the video using the supplied software.

3.0 Requisite Redundancy in Design

- 3.1 Each saloon's video monitoring system shall run independently. Failure of one saloon's video controller shall not affect the normal monitoring functionality of any other saloon.
- 3.2 The ethernet switches in each car shall have at least two switch modules, so that, even if one module gets failed while the other-one is functioning normally, then at least half of the saloon CCTV devices can remain connected to the network and can function normally. The ethernet switches used in the network shall be Managed PoE switches.
- 3.3 The ethernet switches shall have the port by-pass functionality i.e. if in case one car's switch fails, the adjoining cars shall still receive the CCTV signals and function normally; and the whole CCTV network shall not get interrupted.
- 3.4 Each camera shall communicate to the NVR with independent ethernet interfaces. Failure of one camera in any case shall not affect the normal functioning of other cameras in the network.
- 3.5 Dual power module design shall be used for each of the Ethernet Switches and NVRs in the PSSS network to ensure redundancy of power.

4.0 Requisite Type-Tests and Routine-Tests for the PSSS System

- 4.1 The individual equipment and the PSSS system on whole shall be type-tested and routine-tested in accordance with detailed respective test procedures to be drawn up by Contractor and agreed by DMRC which shall take into account the requirements of respective IEC Publications or other appropriate international standards, special tests specified in Clause 4.4 of this technical specifications of this contract, and tests program drawn up by the Contractor to demonstrate that the individual equipment and the PSSS system on whole meet the specified requirements of this contract. The contractor shall attain the approval of Type test specifications by DMRC prior to the conduct of Type Tests.
- 4.2 All such tests shall be carried out at the contractor 's cost, wherever performed, in the presence of and to the satisfaction of DMRC. DMRC reserves the right to witness any or all of the tests. The contractor shall ensure timely intimation of Type-Test Plan and seek approval of the same prior to the conduct of Type-Tests. In addition to "mandatory" tests as prescribed in IEC/EN standards, DMRC may also require any of the prescribed "optional" tests to be carried out without any additional cost to DMRC.

After the conduct, the results of all tests shall be submitted to DMRC, who will record his conclusions as to whether or not the equipment being tested has passed satisfactorily.

In case of repletion of tests, as decided by DMRC, the entire cost for the re-conduct including that of DMRC's representative(s) shall be borne by the contractor.

- 4.3 As a minimum, all electronic equipment of the PSSS system shall comply with the requirements of EN50155/IEC60571. Wherever any equipment or sub-system is not specifically covered by an internationally recognized specification or test procedure, or where the type and routine tests prescribed by IEC or other international standard do not adequately cover the requirement, tests which are acceptable both to the Contractor and to DMRC, shall be devised.
- 4.4 The contractor shall conduct, but shall not be limited to, the under mentioned Type Tests on the Passenger Saloon Surveillance System equipment:
 - a) In accordance with EN50155- Dry heat test, Supply interruption test, Polarity reversal test, Supply variations test, Cooling test, Damp heat cyclic test, Supply overvoltage test, Insulation measurement test, Voltage withstand test, Low temperature storage test, Equipment stress screening test and Salt mist test.
 - b) In accordance with EN60529- Ingress Protection Test.
 - c) In accordance with EN50121-3-2 (Class A) - Surges test, Transient burst susceptibility test, Electronic discharge susceptibility test, RF Interference test and RF disturbance test.
 - d) In accordance with IEC 60068-2-14 - Change of Temperature Tests.
 - e) In accordance with IEC 61373 – Shock & Vibration Test.
 - f) On-board functionality test after Installation and Commissioning of the PSSS System in train

5.0 Scope of retrofitting work

- 5.1 The retrofitting works under this contract shall consist of, but not limited to, all material, labor, equipment, tools and necessary machinery as required to completely execute all works in toto for commissioning of passenger saloon surveillance system in trains, as per the contract requirements.
- 5.2 Cutting of slots for Saloon Camera installation in the coving panels & Catenary Monitoring Camera in driver's Cab. Locations shall be selected to ensure the coverage full-filling 'no bind-spot criteria' in every car.

- 5.3 Installation of ethernet network switches in electrical panels of each car.
- 5.4 Installation of NVRs in electrical panels. (One in each unit)
- 5.5 Ethernet network wire laying through cable ducts in each car for ensuring the network connection between Cameras, Ethernet Switches, NVRs and HMIs to meet each of the General & Technical requirements of this contract.
- 5.6 Cutting of slots in driving cabs for installation of CCTV Monitoring and Display System (i.e. HMI)
- 5.7 Cutting of slots on both side of DT and T cars for installation of External Cameras. Installation of external cameras and connection to the ethernet network.
- 5.8 Cutting of slots on front side of DT cars for installation of Front Cameras for Track and Catenary monitoring. Installation of front cameras and connection to the ethernet network.
- 5.9 Formation of ethernet based CCTV network in complete train consist by ensuring car to car connection via coupler pins or otherwise.
- 5.10 **Interfacing with TIMS, through L3 Switch, for meeting interface requirements of this contract.**
- 5.11 The contractor shall systematically identify and formally document all design, manufacturing and operational interface between the equipment within the train, and between the train and external systems, facilities, operations and the environment likely to affect or be affected by the train.
- 5.12 All other works deemed necessary for installation & commissioning of PSSS system as per the contractual conditions.

6.0 Requisite Design Submissions and Approvals

- 6.1 The objective of design submission process is to ensure that the proposed resulting works comply with the specifications, are capable of being produced consistently to exacting quality standards, achieve low life cycle costs and can be operated safely to the satisfaction of DMRC.
- 6.2 The design submissions from the contractor shall include Design Calculations, Design Philosophy, Test Reports, Equipment/Component Specifications and Schematic Drawings. The aforementioned design process shall be accomplished in two stages viz. Pre-Final Design Stage and Final Design Stage.
- 6.3 In the Pre-Final Design Stage, the conceptual designs are required to be developed by the contractor and submitted to DMRC for review and approval. In this stage, each element of the system shall be considered and preliminary specifications with supporting calculations shall be

submitted. Preliminary electrical and control schematics shall be developed by the contractor to illustrate how various operational and functional requirements of this contract are being achieved. Software design and development shall also be carried out at this stage. Manufacturing units shall be allowed to commence production only after DMRC accords approval against the Pre-Final Design submissions.

- 6.4 After DMRC's review of the design submissions, the Contractor shall update the documentation incorporating DMRC's observations and also other design requirements. For all subsequent submissions, the Contractor shall demonstrate that all the previous comments intimated by DMRC has been incorporated. The Comments previously issued by DMRC shall also become part of the submission.
- 6.5 The Final Design Documents shall comprise of complied submissions of Type Test Reports and As-Built Drawings of the PSSS system besides the DMRC's approved set of Pre-Final Design submissions of PSSS system.
- 6.6 The Contractor shall deploy Design staff having sufficient experience in Delhi at all times during the contract, to maintain liaison with DMRC.
- 6.7 The contractor shall submit 5 Nos. of ring-bound paper-copies for each of the document submissions made during Pre-final and Final design stages of the contract.

7.0 OEMs Approval

It shall be obligatory for the contractor to obtain 'Notice of No Objection' from DMRC for selection of OEMs (if other than contractor themselves) for all items of supply mentioned above. DMRC's discretion on the same shall be final and binding.