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Guidance on the Fitment and Functionality of Forward and Rear Facing Cameras on Rolling Stock

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This Rail Industry Guidance Note does not supersede any other Railway Group documents.

Supply

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Guidance on the Fitment and Functionality of Forward and Rear Facing Cameras on Rolling Stock

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Part 1 Introduction

1.1 Purpose of this document

This document gives guidance on fitting forward and rear facing camera systems on rolling stock. It enables railway undertakings to adopt a common methodology in the fitment and functionality of the forward and rear facing camera systems. It does not constitute a recommended method of meeting any set of mandatory requirements.

This document has been developed with the input from duty holders already operating forward and rear facing camera systems. The British Transport Police provided advice on requirements of forward and rear facing camera systems appropriate for evidential purposes. In developing the document the drafting group considered a range of options for inclusion compared to the costs of adopting such options. The guidance included provides information on the most recently available information and it is recognised that technology in this field is constantly developing. However, adopting a closed circuit television camera system set out in this guidance note provides an opportunity to meet the key safety and performance benefits associated with forward and rear facing camera systems.

This document has been prepared on the basis that the forward and rear facing camera systems operate automatically and either independently of each other and any other system on the rail vehicle or as part of any existing closed circuit television camera system. This document also gives guidance on the interfaces with other rail vehicle systems that could be used as trigger inputs to the forward and rear facing camera systems.

Areas covered by this document are:

a) Forward and rear facing closed circuit television camera systems detailing the visual data to be stored on the rail vehicle.

b) Interfaces with other rail vehicle systems.

c) Off-train equipment including reader / download interface requirements.

d) Management of the recorded data, including the downloading, viewing and access to the data.

1.2 Copyright

1.3 Approval and authorisation of this document

The content of this document was approved by:

Rolling Stock Standards Committee on 19 March 2010.

This document was authorised by RSSB on 30 April 2010.

Part 2 Guidance on the Fitment and Functionality of Forward and Rear Facing Cameras on Rolling Stock

2.1 Background

2.1.1 The fitment of forward and rear facing closed circuit television camera systems (FFCCTV) is being undertaken as a means of recording visual evidence for operational use and incident investigation.

2.1.2 A number of significant safety and performance benefits associated with FFCCTV camera systems and the images captured by them have been identified. Principally FFCCTV camera systems can be used to assist in:

a) Investigation of incidents, accidents and near misses.

b) Facilitating train service recovery, for example through confirmation of incidents as non-suspicious, or removing the requirement for extended down time while assets are tested, for example when resolving signalling irregularities.

c) Crime prevention, for example prevention of cable theft through identification and arrest of individuals who are involved in trespass and other railway crime incidents.

d) Undertaking infrastructure surveys.

2.1.3 CCTV camera systems are already fitted on rail vehicles to monitor the interior of passenger saloons and are also used in conjunction with driver only operation (DOO) of multiple units. The specific functional and data recording requirements of these CCTV camera systems are outside the scope of this document.

2.1.4 Where capacity exists in the other installed CCTV camera systems it may be appropriate to incorporate the recording of FFCCTV camera system data as an additional input to the existing CCTV camera system.

2.1.5 The capability of the existing CCTV system should be assessed against the requirements set out in Section 6.5 which are considered by the British Transport Police as essential requirements for FFCCTV camera systems. It should be noted that the ability to record clear images from a moving train travelling at speed is significantly different to that used to record images in a rail vehicles interior.

2.1.6 Where the FFCCTV camera system's requirements are incompatible with the existing CCTV camera systems on the rolling stock then a separate FFCCTV camera system may be more appropriate.

2.1.7 This document gives the functionality of the FFCCTV camera system needed to enable the recording, downloading, viewing of and access to the recorded camera data by authorised personnel.

2.1.8 The term FFCCTV is used as an abbreviation throughout the document. Whilst specifically referring to the forward facing CCTV camera system it also includes the installation of the rear facing CCTV camera system at the rear of the train.

Part 3 Forward and Rear Facing Closed Circuit Television Camera System

3.1 General

3.1.1 An on-train FFCCTV camera system should be capable of:

a) Capturing visual data.

b) Storing data for a minimum period.

c) Downloading data.

d) Immediate playback of data.

e) Accepting inputs from on-train systems.

3.1.2 The FFCCTV camera systems at the front and rear of the train should operate automatically and either independently of other systems on the rail vehicle or as part of any existing CCTV system. The FFCCTV cameras should switch on when the driving cab is enabled and remain active during train operation.

3.1.3 Where adequate power supplies and video storage capacity are available consideration may be given to keep the FFCCTV system continuously active. The FFCCTV camera system is then able to record instances of trespass or vandalism whilst the rail vehicle is stabled.

3.2 FFCCTV camera system requirements

3.2.1 The FFCCTV camera system should have two modes of operation, colour (day) mode and black / white (night) mode. The colour (day) mode should be capable of operating over the light range of 1 Lux to 10,000 Lux. The black / white (night) mode light range should extend into the colour mode light range and operate down to 0.05 Lux.

3.2.2 The FFCCTV camera system should automatically switch between day and night modes of operation and also occur during entry and exit of tunnels. The change over between colour (day) and black / white (night) modes should include the camera outputting in both colour (day) and black / white (night) modes. An alternative to the dual mode camera system would be to fit separate colour (day) and black / white (night) mode cameras.

3.2.3 The FFCCTV camera system should be fitted with a lens that has an automatic gain control or electronic iris with a fast dynamic response to deal with rapid changes between sunlight and dark conditions, for example entry to / exit from tunnels. An alternative would be to have a camera with a high dynamic range, this type of camera is capable of capturing darker and brightly lit areas in the same image.

3.2.4 During daylight operation the FFCCTV camera system should be able to record the colour aspect displayed by line side railway signals and particular attention should be given to the colour resolution of the FFCCTV camera signal output. Avoidance of blooming and blurring is also important and can be achieved by the use of low noise image sensors.

3.2.5 The FFCCTV camera system will be recording moving images in contrast to those camera systems used to monitor a rail vehicles interior where most of the images are stationary relative to the camera. The use of high definition (HD) cameras should be considered as these give clear, crisp pictures with vivid colours with up to five times more detail than standard definition camera systems.

3.2.6 The images recorded by the FFCCTV camera system should be capable of being reproduced as still images. This is the preferred means of presenting evidence during investigation or inquiries. (Part 6 gives further information on the management and use of the FFCCTV recorded data.)

3.2.7 There are two types of image scanning in HD CCTV camera systems, progressive and interlaced. The camera image sensor should use progressive scanning, which results in a more detailed image on the screen and is less susceptible to the flicker commonly associated with interlaced scanning. Interlaced scanning is not suitable for this application.

3.2.8 An example of a typical HD CCTV camera system output is 1920 x 1080p. The suffix 'p' is used to indicate a progressive scan.

3.2.9 The downloaded frame rate from the camera to the digital video recorder (DVR) should be selected to suit the maximum speed of the train so that it is possible to view a continuous series of recorded images along the route of the moving train. A minimum frame rate of at least 12 frames per second (fps) should be used. A frame rate of 20 - 25 fps should be considered for trains that operate at speeds greater than 100 mile/h (160 km/h).

3.2.10 CCTV cameras capable of downloading images between 20 - 25 fps are also beneficial for lower speed applications. The higher frame rate allows more data to be recorded in the event of an incident or during a line survey.

3.2.11 Data connections to the FFCCTV camera should be suitable for their railway applications; it should be adequately protected from the environment and from vibration. The cable should be securely clamped to the camera and DVR enclosure. The cable should not be supported by the connector body alone. A commonly used connection for camera and cable connections is the Ethernet RJ45 connector.

3.2.12 If it is intended to source video cameras and FFCCTV camera systems from different suppliers, then it will be necessary to define the system interface. One example to aid compatibility is the use of the Open Network Video Interface Forum (ONVIF) software standard.

3.3 Positioning of the FFCCTV camera and lens assembly

3.3.1 The FFCCTV camera and lens assembly should be orientated to record landscape views. As a minimum, the camera and lens assembly should be capable of recording images that include the viewing envelope for a seated driver as derived from GM/RT2161, see Appendix A. The point of focus and depth of field should be consistent with these sighting requirements.

3.3.2 The FFCCTV camera and lens assembly should be positioned in the cab behind the windscreen or externally in an enclosure on the end of the vehicle. The camera should be positioned as close as possible to the driver's sightlines to minimise the effects of parallax whilst not interfering with the drivers viewing envelope.

3.3.3 Internal cab mounted installations should be positioned:

a) In the swept area of the windscreen but not located where the windscreen wiper could be parked.

b) As close as practicable to the inside of the cab windscreen to avoid internal reflections.

3.3.4 The internally mounted camera, lens assembly and cable connections should:

a) Be enclosed to protect the camera and lens assembly from tampering.

b) Not be accessible without removing the camera enclosure using a special tool.

c) Be sealed to prevent the ingress of dust, paper and other materials between the windscreen and the camera lens.

3.3.5 The installation of the camera, lens assembly and its housing should not impede replacement of the cab windscreen. When selecting a seal for the camera enclosure, effects of the cab windscreen heating system should be considered.

3.3.6 Externally mounted camera installations on the rail vehicle ends should incorporate appropriate environmental protection to meet the requirements of Ingress Protection rating 66 (IP66). To maintain the vision requirements, provision of demisting and camera lens wipers should be considered and should be linked to the activation of the cab window wipers.

3.4 Data storage capacity

3.4.1 The FFCCTV camera system should be capable of recording and retaining data on the DVR for a period of 560 hours without compromising the quality of data. This equates to an average of 18 hours recording per day for a minimum of 31 days and is consistent with the police evidential requirements set out in Section 6.5.

3.4.2 The FFCCTV camera system should be configured so that the DVR does not overwrite stored images until the storage capacity of the DVR is full. The video files should then be overwritten on the basis of first in / first out.

3.4.3 Incorporating a large storage capacity DVR permits the recorded images to be retained on the vehicle. This allows longer periods between extracting / downloading of the recorded images following an incident or for the purposes of an investigation. Where the DVR storage has less than 31 days data storage capacity then to satisfy the police evidential requirements it may be necessary to introduce a downloading and archiving regime.

3.5 File structure of the FFCCTV recorded data

3.5.1 The file structure of the FFCCTV recorded data should allow:

a) Selection of recorded images based on the entry of specific operational parameters such as time, train and car identification.

b) The correct time stamping on recorded images.

c) Identification of main recorded events for example starts / stops and alarms.

3.5.2 Separate files should be created and recorded each time the FFCCTV camera system becomes active. It may be useful to sub-divide the video files into manageable data blocks. For example, on long train journeys a new file could be created each time the train formation leaves a station.

3.5.3 If the video files are sub-divided the FFCCTV camera system should ensure that there is no loss of video data.

3.6 Recording of date, time, source and location information

3.6.1 The DVR should record the date and time. The date and time should be displayed on any form of playback system. The date and time should relate to the recording of the original live image and not any subsequent data handling. This will provide evidence that the video data has not been altered, tampered with or corrupted in anyway.

3.6.2 The DVR should be capable of automatically adjusting the recorded date and time in conjunction with changes in Greenwich Mean Time (GMT) and British Summer Time (BST).

3.6.3 Should there be more than one DVR on the train formation the DVR clocks should be synchronised to within ±1 minute. This will allow consistent timelines when viewing the recorded data.

3.6.4 To ensure the source of the recorded images stored on hard disc drives is traceable to a particular service, the images should include the rail vehicle's identity in a data field. The rail vehicle's identity will allow the vehicle's diagram records to be traced to particular services. This could be achieved by using a coding plug or dongle that incorporates the rail vehicle's details.

3.6.5 Consideration should be given to enabling the DVR to include the geographical position of the rail vehicle whilst the FFCCTV camera system is recording. The FFCCTV camera system should be able to tolerate intermittent loss of the GPS signal if this is used to generate the location information.

3.7 Image recording rate

3.7.1 The DVR should be configured to record at the image rate supplied by the FFCCTV camera. For example, a FFCCTV camera supplying images at a rate of 20 fps should be paired with a DVR capable of recording images at 20 fps.

3.7.2 If the DVR is recording at the FFCCTV camera image rate, when the train is stationary, a significant quantity of the hard disc will be filled with the same view. An alternative strategy to increase the storage capacity of the DVR for MJPEG systems could be to use specific speed thresholds to trigger a change in the recording rate.

3.7.3 The FFCCTV camera system could use a speed input signal to determine if the train is stationary. With the train in motion (greater than 5 km/h, or video motion detection) the normal frame rate should be recorded. When the train stops, the normal recording frame rate should be maintained for period of at least 30 seconds before the FFCCTV camera system adopts the stationary mode. The minimum frame rate for a stationary train with an active cab should be 4 fps.

3.7.4 Where a DVR is provided with the ability to record at different recording rates it would be beneficial to provide an input that preselects the highest recording rate. The use of the highest recording rate could be useful for carrying out line surveys. This survey mode would use up the capacity of the hard disc at a faster rate. The selection of survey mode should be by authorised personnel only and require an access key.

3.7.5 Where more advanced and efficient compression technology such as MPEG4 / H264 is used, reducing the recording rate when the train is stationary results in little improvement with regard to recording capacity. With such systems it is preferable to maintain the normal camera frame rate to capture fast changing events in the recorded scene.

3.8 Use of video buffers

3.8.1 An option to make better use of the DVR storage capacity could be to use a video buffer in the FFCCTV camera system which holds the images before being stored onto the hard disc. The use of a video buffer could then allow the recording frame rate to be varied between normal and incident event recording.

3.8.2 At the time of an incident it would be useful to increase the number of recorded images. The use of a video buffer would allow the capture of video images leading up to the incident to be recorded at the maximum image rate. An incident trigger, for example could be the application of the train's emergency brake whilst the railway vehicle is in motion. Other examples of incident triggers are set out in 4.7.

3.8.3 When the incident mode is triggered the DVR should transfer at least one minute's worth of pre-event recorded video images from the video buffer at the highest rate to the hard disc. The DVR should continue to record a minimum of four minutes post-event images at the highest frame rate. The FFCCTV camera system should then revert back to recording at the lower frame rate.

3.8.4 The five minute periods of incident mode recording should also incorporate additional index markers. The index markers should provide a means to rapidly search the images during subsequent analysis of the recorded data.

3.9 Alternative to a video buffer

3.9.1 An alternative option to a video buffer could be to configure the DVR to allocate a dedicated capacity on the hard disc drive for the purpose of storing incident events as separate data files. The DVR should cycle through the incident event storage locations on a basis of first in / first out. A minimum storage capacity of 250 minutes image recording is recommended to prevent the accidental erasure of incident events by multiple operations of the event trigger.

3.10 Digital video recorder enclosure / housing

3.10.1 The DVR should be fixed to the rail vehicle and housed in a secure robust enclosure designed to prevent damage from vandalism. The DVR and its enclosure should be positioned within the rail vehicle body so that it is protected in the event of a collision. The enclosure should be sealed to IP65 to prevent the ingress of liquid.

3.10.2 To avoid having to install video or data cables between rail vehicles it is recommended that the FFCCTV camera system DVR should be located on the same vehicle as the FFCCTV camera.

3.10.3 The DVR enclosure should incorporate a power on / fault indicator. This should be visible to train crew or maintenance staff during train preparation to monitor the operational status of the FFCCTV camera system. This should be visible without the need to open the DVR equipment enclosure. If the DVR enclosure is not mounted in the cab then an additional remote indicator should be provided. This should not be positioned in the driver's line of sight or cause any distraction to the driver, for example through reflections on the cab window.

3.10.4 The DVR enclosure should be provided with a high security lock to protect against entry by unauthorised personnel. The DVR enclosure should permit easy removal, replacement and maintenance of the DVR and its hard disc drive modules / caddies by authorised personnel.

3.10.5 To protect FFCCTV recorded image data in the event of a collision or a fire, consideration should be given for the DVR enclosure to include crash proof memory capable of storing at least two hours of recorded video data. The crash proof memory should comply with the requirements set out in GM/RT2472 or IEEE 1482.1-1999.

3.11 Use of removable hard disc drives

3.11.1 The DVR should incorporate removable hard disc drives. To provide protection for the hard disc drives they should be mounted in modules / caddies. The design of the modules / caddies should allow them to be docked, undocked and secured to the DVR and handled by authorised personnel.

3.11.2 Hard disc drives that have been removed from the DVR should be playable in a different machine and not electronically tied to the original recorder. Consideration should be given to the provision of spare modules / caddies so that any hard disc drives can be replaced after an incident thus enabling the DVR to continue functioning.

3.12 Provision of hard disc drive transit cases

3.12.1 Transit cases should be provided for transporting the hard disc drive modules / caddies. The transit case should be capable of holding sufficient quantities of hard disc drives to replace those in the DVRs for the FFCCTV camera systems at the front and rear of the train formation.

3.12.2 The transit case should be capable of withstanding multiple one metre drops onto a concrete floor from any angle without sustaining damage or loss of the integrity of the data to the hard disc drives within or the integrity of the transit case.

3.13 Viewing and data downloading facility

3.13.1 The FFCCTV camera system should be capable of downloading CCTV camera data by connection of an external device. The FFCCTV camera system should also be capable of immediate playback on the rail vehicle by authorised personnel through the use of an external device. The DVR should be capable of a full or partial download of data to the external device. The downloading of images should not affect the integrity of the recorded data on the DVR.

3.13.2 A connection port should be provided to permit downloading or viewing of the data on the DVR by authorised users. The connection port should be clearly marked, require a security access key, code or software to prevent unauthorised use or access to the FFCCTV camera systems data.

3.13.3 The connection port should be sited for convenience of the connection of a personal digital assistant (PDA) or notebook PC near a flat surface with a local 230V AC power point if this is available on the rail vehicle. The connection port could be incorporated into the DVR enclosure or provided at a separate location. If a separate location is provided for the connection port then it may be beneficial to also incorporate the DVR power on / fault indicator.

3.13.4 The connection port should allow the use of standard industry interface cables connect to a PDA or notebook PC, for example an Ethernet RJ45 socket or a USB A socket.

3.13.5 Consideration should be given to the provision of a monitor on the rail vehicle to enable immediate review of recorded data on the DVR by authorised users. The monitor should be secure and require a security access key, code or software, to prevent unauthorised use or access to the FFCCTV camera systems data. Immediate review of the recorded data will facilitate quicker decision making at the incident scene and reduce disruptions to train services.

Part 4 FFCCTV System Interfaces

4.1 Introduction

4.1.1 The design of the FFCCTV camera system should ensure that any connection to the existing train wires does not cause interference, disruption or degradation of the performance of the existing railway vehicle systems. For example, the emergency brake is a train safety critical system, to avoid any potential risk to the operation of the emergency brake the FFCCTV camera system should not be connected directly to the existing circuits of the emergency brake system.

4.2 FFCCTV camera system power supplies

4.2.1 The FFCCTV camera system power supplies should be compatible with the railway vehicles' power supplies and transient conditions. These should be derived from the rail vehicle's auxiliary power supplies. The FFCCTV camera system should also incorporate a circuit breaker to protect the power supply. The majority of suburban and interurban DMU rail vehicles operate with power supplies at a nominal 24V dc. High speed DMUs, EMUs, locomotives and coaches with driving cabs generally utilise 96V dc. power supplies.

4.2.2 If the FFCCTV camera system is to be connected to the essential and emergency load then the power consumption should be assessed to ensure that it does not compromise the ability to supply the other essential and emergency loads from the batteries.

4.2.3 Railway undertakings that operate mixed fleets of rail vehicles should consider having FFCCTV camera system equipment that can be configured to operate from different auxiliary power supplies. This could be beneficial where the FFCCTV camera system equipment requires exchanging for data retrieval purposes or for the rectification of faults.

4.2.4 To avoid the need for additional power supplies it is recommended that the FFCCTV camera system obtains its power from the DVR, for example CCTV cameras are capable of obtaining power over Ethernet utilising the RJ45 connectors.

4.3 Vehicle coding input

4.3.1 The identity of the vehicle should be automatically recorded and configured as set out in 3.6. When the DVR is installed or replaced, this could be achieved using a coding plug or dongle that incorporates the vehicle's details. Systems requiring a technician to re-configure the DVR with a tool or PC are not recommended.

4.4 Active and coupled cab input

4.4.1 The FFCCTV camera systems on the train should switch on automatically whenever a driver enables a driving cab and that cab is made active. The systems should remain active while the cab is enabled.

4.4.2 When multiple units are operating in coupled formations consideration should be given for the FFCCTV camera system to be capable of suspending the recording of images at the coupled ends. Interfaces with the rail vehicle's control systems will need to be provided so that the FFCCTV camera system can determine if it is located at a coupled cab location.

4.5 Time and location input

4.5.1 The date and time should be automatically recorded as set out in 3.6. This could be provided from an existing train system or from a dedicated GPS installation. The FFCCTV camera system should be able to continue to record the date and time during those periods where there is a temporary loss of GPS reception.

4.5.2 GPS antennas require line of sight to the satellite, generally these systems have the antenna mounted on the roof. An alternative location for a dedicated GPS system could be to include the GPS antenna in the FFCCTV camera enclosure.

4.6 Speed input

4.6.1 A movement / speed input should be provided so that the DVR can switch between different image recording rates, for example 12 fps, 20 fps or 25 fps as set out in 3.7. This could be provided from GPS data that detects train movement and vehicle speed.

4.6.2 Alternatively the stationary to movement trigger could be generated from existing train systems that generate a low speed output, which typically operates at 5 km/h.

4.7 Incident event inputs

4.7.1 Where a FFCCTV camera system has the facility to switch from lower image recording rates to higher image recording rates during incidents, suitable input triggers should be considered as part of the FFCCTV camera system installation. Train systems and driver actions that could be used as incident inputs could include:

a) Emergency brake:

i) Operation of the emergency brake whilst the train is moving (initiated by the driver or train borne systems such as AWS, TPWS or ETCS) could be used as an appropriate trigger for incident recording.

ii) The FFCCTV camera system should be capable of differentiating from emergency brake applications that occur when the train is moving and ignore those that occur whilst the train is stationary, for example when carrying out brake tests.

b) Warning horn:

i) Prolonged use of the warning horn by the driver could signify an incident situation such as trespassers or track staff failing to acknowledge a warning.

ii) The FFCCTV camera system should be capable of differentiating between the normal operation of the horn, which should be ignored and the prolonged sounding of the warning horn as an alarm.

c) Driver ‘FFCCTV camera system incident event’ button:

i) The incident event button, operated by the driver, could be used to trigger the FFCCTV camera system to switch to incident mode and begin recording at the higher recording rates.

ii) An indicator should be provided to give feed back to the driver to show when the recorder is operating in incident mode.

iii) The effects on driver workload should be considered where an incident event button is provided.

d) Pantograph automatic dropping device (ADD):

i) Operation of the ADD equipment potentially indicates a disturbance of the pantograph to overhead line equipment (OLE) interface. The FFCCTV camera system may capture the circumstances leading up to and after the operation of the ADD.

4.7.2 The ability to instigate an incident / alarm input is beneficial at the leading end of the railway vehicle. The FFCCTV camera system at the rear of the railway vehicle does not need to respond to the incident / alarm triggers generated at the leading end of the railway vehicle. This avoids the need to provide command links between the FFCCTV camera systems.

4.8 Survey mode input

4.8.1 The selection of survey mode and the associated highest image recording rate could be achieved by a manual switch within the DVR enclosure, or an external switch operated by a security key. This action should be carried out by authorised personnel.

Part 5 Off-Train Equipment

5.1 Portable access device

5.1.1 A portable access device is required to facilitate the viewing of the FFCCTV camera system recorded data whilst the DVR is mounted on the rail vehicle. This could be, for example a PDA or notebook PC that is issued to authorised personnel.

5.1.2 The FFCCTV camera system portable access device viewing software should have the following features and functions:

a) Authorised personnel should be able to connect to the DVR and view recorded images from the hard disc drive or the live images being fed to the DVR from the cameras.

b) The portable access device software should allow easy identification of specific video sequences for example event date, time and location of information.

c) On-screen controls should be simple and intuitive for example play, fast forward, rewind, pause, frame by frame steps and real time when the video sequences of interest have been identified. The portable access device should permit time lapsed functionality, whereby recorded images are capable of being played back faster than the real time recording.

d) The time display should originate from the DVR rather than the embedded clock within the notebook computer.

5.1.3 Where a notebook PC is used as the FFCCTV camera system portable access device it should be password and user ID protected to limit access to authorised personnel only. The notebook computer when configured as a portable access device should not be capable of accessing any of the system settings on the DVR or capable of editing, deleting or downloading data from the DVR.

5.1.4 It is likely that when an incident occurs, the portable access device may be offered to attending British Transport Police officers or Network Rail authorised personnel for review of the recorded images. It should be assumed that these individuals have not received any training on the use of the portable access device or the downloading of the FFCCTV camera system data or its controls.

5.1.5 Railway undertakings should consider whether staff from other authorised organisations, for example the British Transport Police or Network Rail are to be permitted viewing access to the FFCCTV camera system using their own portable access devices (PDA) or notebook PCs. The railway undertakings should provide minimum hardware specifications and software requirements or licensed copies of the FFCCTV camera system portable access device viewing software for these devices where they are issued by the authorised organisations.

5.2 Mobile download unit

5.2.1 A mobile download unit (MDU) is required to facilitate the downloading of the FFCCTV system recorded data whilst the DVR is mounted on the rail vehicle. This could be, for example a notebook PC that is issued to authorised personnel.

5.2.2 The MDU should have the following features and functions:

a) Authorised personnel should be able to connect the MDU to the DVR and view the images from the hard disc drive or live images being fed to the DVR from the cameras.

b) The MDU should be user ID and password protected.

c) The MDU should allow easy identification of specific recorded data sequences from event, date, time or location information. The MDU should permit time lapsed functionality, whereby recorded images are capable of being played back faster than the real time recording.

d) When connected to the DVR the MDU time display should originate from the DVR rather than the embedded clock in the notebook PC.

e) Authorised personnel should be able to download the video sequence directly to the hard drive of the MDU once the relevant part of recorded video has been identified.

f) The downloaded data transferred to the MDU should include the date, time, source, and location information of the recorded image to preserve the evidential integrity of the FFCCTV camera system recorded data sequences.

g) The ID of the authorised person undertaking the download along with the date and time of the download should be recorded with the downloaded data.

h) The MDU should not be capable of editing or deleting data from the DVR.

i) It should be possible to connect to the FFCCTV camera system to carry out maintenance or diagnostic checks or amend configuration details of the FFCCTV camera system.

j) The MDU and any transit case should be capable of withstanding multiple 2 m drops onto concrete from any angle without sustaining damage, loss of data integrity to the equipment in or to the integrity of the case.

5.3 Data reading station

5.3.1 The data reading station (DRS) is the base station for the FFCCTV camera system and should be at locations selected to suit the operational requirements of the railway undertaking. These could be, for example at control centres, maintenance depots or principal stations. Railway undertakings should make available the location of any data reading stations to the British Transport Police.

5.3.2 The DRS should have the following features and functions:

a) The DRS should support recorded data playback of the FFCCTV camera system images extracted using the MDU or via the hard disc caddy / module.

b) A colour viewing screen should be provided which is compatible with the recorded data, for example if HD CCTV cameras are used the resolution of the screen should be a minimum of 1920 x 1080p.

c) The DRS should be user ID and password protected.

d) The DRS should maintain a record file of all actions carried out and include a reference to the user name, date and time, for example logging in / out, insertion / extraction of hard disc drives or downloads, file saves, extractions, prints, edits and deletions.

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e) The DRS should accept extracted digital recordings by means of:

   i) Plugging in extracted hard disc drive caddies / modules.

   ii) Connecting the MDU to the DRS.

   iii) Reading DVD / CDs burned by an MDU.

f) The hard disc drive caddies / modules should be capable of being 'hot' inserted / extracted without damage, corruption or lock-up of the DRS or hard drives.

g) The time clock of the DRS should:

   i) Be used for time stamping any logged actions.

   ii) Synchronised to an accurate time reference that ensures an accuracy of ±1 second at all times.

h) When viewing the recorded data, the date, time, source and location information of the images should be visible at all times for example camera number, vehicle number, unit / set number, GPS location and the time and date provided by the on-train system.

i) It should be possible to view images from a complete train in time synchronisation using tiled windows. (This allows the images from the rear FFCCTV camera to be displayed at the same time as the front FFCCTV camera.) The DRS should permit time lapsed functionality, whereby recorded images are capable of being played back faster than the real time recording.

j) It should be possible to view and print single images, full screen and to zoom into the image to the point of pixelisation.

k) The printout of the images should include the date, time, source and location information. (The zoomed and normal images may be output to files to be burnt on a CD and protected against tampering.)

l) The DRS should be capable of providing an extract from the recorded data files that can be burned onto DVDs. The preferred solution is to export the data in digital format, retaining full resolution including the date, time, source and location information in a unique format together with the relevant 'player software' that can be operated on a standard computer. Alternatively standard formats such as .AVI or .JPG could be used to enable playback and viewing on a standard computer or notebook PC.

m) The DRS should include a file management system that secures / archives the recorded data pending use as evidential information, and includes a search facility to locate any stored recordings by date, time, event or geographic parameters. (For example, to identify any recording that exists on the 11th June 2009, between 14:00 and 15:00, within 1 km of a particular railway station.)

n) The file management system may include a means to advise authorised personnel when recorded images stored on the DRS system that are not archived as criminal evidence, are older than a predetermined age and could be deleted.

Part 6 Management of Data

6.1 Introduction

6.1.1 Authorised personnel likely to require viewing access to the FFCCTV camera system recorded data either on the rail vehicle or after the data has been downloaded include, for example:

a) Railway undertaking designated staff.

b) Network Rail designated staff.

c) British Transport Police personnel.

d) ORR designated staff.

e) RAIB designated staff.

f) Health and safety representatives.

6.1.2 Railway undertakings should develop operational procedures in conjunction with Network Rail, British Transport Police and other relevant bodies to permit viewing access of the FFCCTV camera system data by their authorised personnel.

6.1.3 Should a major incident occur, the British Transport Police may request the railway undertaking to provide authorised personnel to assist in the mass download of FFCCTV camera system data.

6.1.4 In the event of a terrorist, chemical or biological incident it is unlikely that railway undertaking authorised persons will be permitted access unless appropriate training has been undertaken. British Transport Police technicians (Digital CCTV Retrieval Team) have received training to allow them to attend major incidents. It is suggested that railway undertakings provide training for the British Transport Police technicians on their FFCCTV camera systems.

6.1.5 The FFCCTV system should have the ability to set different access rights to authorised users, for example certain authorised users should only have viewing rights whilst other authorised users would have the ability to view and download data from the DVR.

6.2 On-train access

6.2.1 The FFCCTV camera system should include provision to enable immediate on-train reviewing of the recorded data by authorised personnel. This on-train access to FFCCTV camera system incident data should reduce delays associated with the reviewing of downloaded FFCCTV camera system data off-train.

6.2.2 Instances where there is a safety impact or performance issue that requires immediate access could include:

a) Major incidents, for example terrorist / chemical attack.

b) Signal aspect monitoring – for reconciling SPAD events.

c) Resolution of signalling irregularities.

d) Fatalities – identifying whether suicide or otherwise.

6.2.3 Immediate access to FFCCTV camera system incident data may subsequently need transferring to the MDU or DRS for analysis off-train.

6.3 Post-incident access

6.3.1 The incident data recorded by the FFCCTV camera system would normally be transferred for off-train analysis where there is no immediate impact to operational performance, but an investigation is required. Examples of such investigations could include:

a) Safety issues:

i) Public trespass on the railway.

ii) Level crossing incidents.

iii) Near misses or staff incidents, for example track workers failing to clear the line adequately or acknowledge the driver.

b) Accidents:

i) Derailments.

ii) Collisions.

c) Infrastructure investigations:

i) Observing the condition of track and OLE.

ii) Monitoring flooding after heavy rainfall / snow.

d) Rolling stock incidents:

i) Observing the condition of passing trains.

e) Criminal activity:

i) Cable theft.

ii) Vandalism.

f) Platform incidents:

i) Observing activity on platforms during station pass through.

6.4 Non-urgent access to recorded data for engineering, maintenance and training purposes

6.4.1 Railway undertakings could use the data recorded by the FFCCTV camera system for:

a) Use in cab simulators.

b) Route knowledge training.

6.4.2 Infrastructure managers could use the data recorded by the FFCCTV camera system for surveying specific areas of infrastructure such as observing the condition of the track and OLE.

6.5 Police evidential requirements

6.5.1 The data recorded by the FFCCTV camera system should meet the following British Transport Police requirements:

a) Recording:

i) The FFCCTV camera system recorded images should include the date, time, source and location information when the recording occurred, see 3.6.

ii) The FFCCTV camera system should have the capacity to retain the recorded data for a minimum of 31 days, see 3.4.

b) Routine export of FFCCTV camera system recorded data:

i) FFCCTV camera system images should be exported in their native file format and include the date, time, source and location information when the recording occurred, see 5.2.2 and 5.3.2.

ii) If a FFCCTV system is capable of exporting data in an open file format for example .AVI or .JPG then this should be an additional function and not as a substitute for the native file format, see 5.3.2.

c) Mass Export:

i) FFCCTV camera systems should be capable of having their entire storage media removed without the need to remove the FFCCTV data recorders themselves for example removable hard drives, see 3.11.

ii) Hard drives that have been removed from a DVR should be playable in a different machine and not electronically tied to the original recorder, see 3.11.

6.5.2 Downloaded and exported data should include the data in digital format, retaining full resolution, together with the relevant 'player software' that can be operated on a standard computer or notebook PC. The playback software should be capable of running from the disc containing the recorded images and should permit:

a) Variable speed control, including fast forward, rewind, frame by frame forward and reverse viewing using simple and intuitive on-screen controls.

b) Searching of the recorded data by date, time, source and location information or any other recorded attributes.

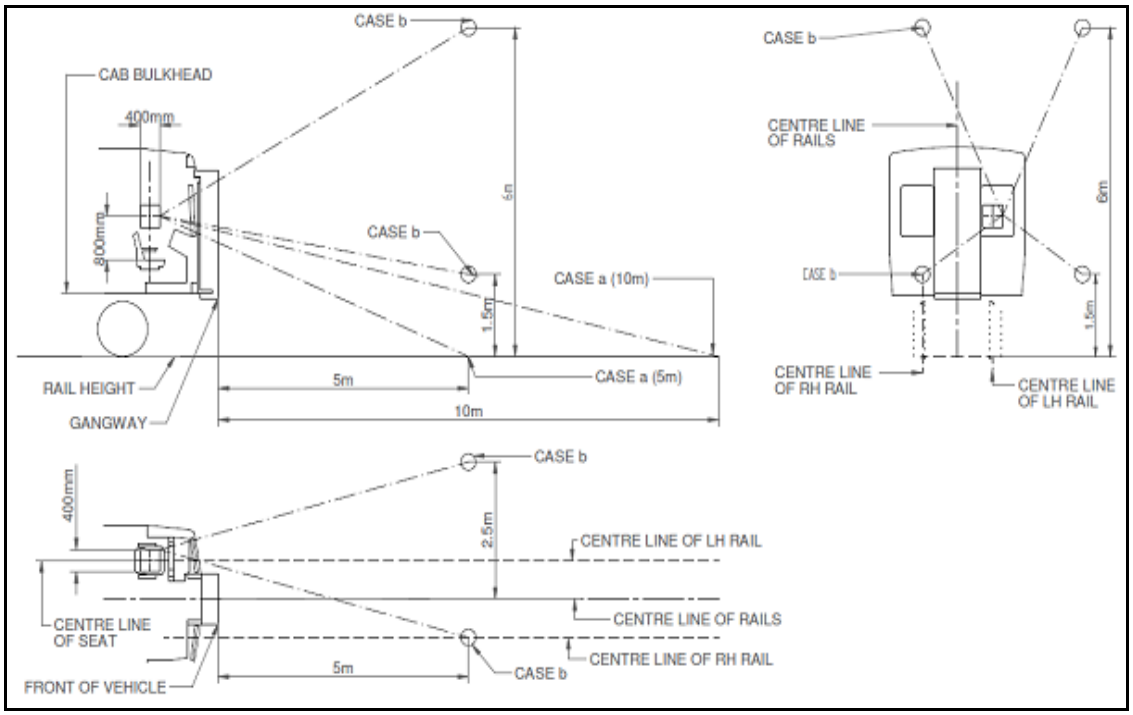
c) Displaying single and multiple camera images whilst maintaining their aspect ratio, for example the same relative height and width.

d) Images to be viewed at full resolution.

e) Printing and saving of individual images with date, time, source and location information. The British Transport Police prefer to present evidence in the form of still images rather than playing video footage.

f) The user to be able to view all the information contained in the image and the associated data.

Appendix A Viewing envelope derived from GM/RT2161 issue one



Note:

Case (a): Coupling Requirements

A view of the track (at rail height) at 5 m beyond the coupling plane for vehicles subject to frequent coupling and uncoupling activities. For other vehicles, the viewing distance shall be 10 m beyond the coupling plane.

Case (b): Signal Visibility Requirements

A view of signals positioned 5 m beyond the coupling plane at all heights between 1.5 m and 6.0 m above rail level and at all lateral positions between the right-hand rail through to 2.5 m to the left of track centreline. This view together with the view in Case (a) shall be visible from the same point within the reference cube.

Note: It is recommended that where vehicles are not fitted with a central gangway the lateral view should be 2.5 m both sides of the track centreline.

Definitions

Blooming

The defocusing of regions of a picture where the brightness is at an excessive level. In a camera, sensor element saturation and excess which causes widening of the spatial representation of a spot light source.

Blurring

The softening of the focus of selected pixels of an image. This can be caused by various factors, for example wrong focus, diffraction or camera vibration.

Caddies

Containers for storing equipment or a group of items not in use.

Image scanning (interlaced)

A method for capturing moving images in which the system alternates between transferring all the odd lines of the image and then all the even lines of the image, for example, an 8 line interlaced image the sequence would be lines 1, 3, 5, 7, then 2, 4, 6, 8 then repeat.

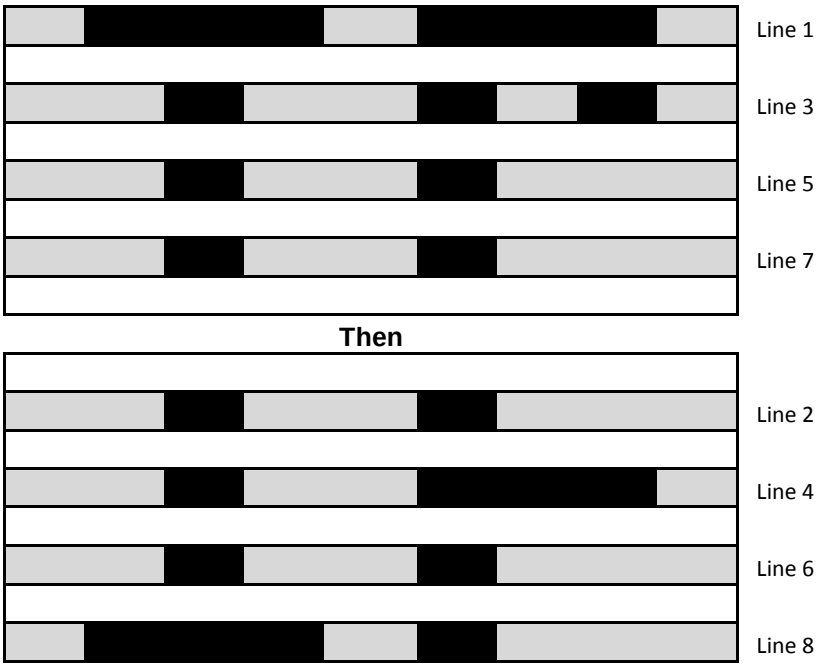
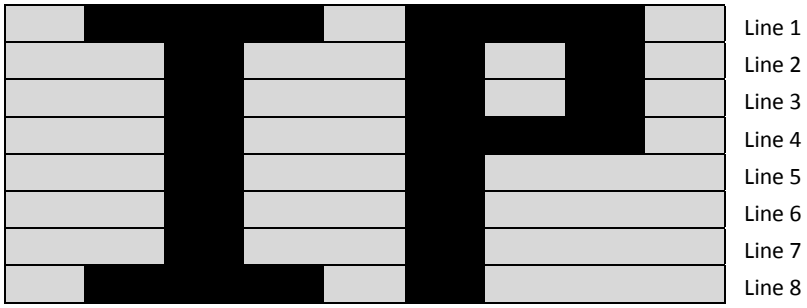


Image scanning (progressive)

A method for capturing moving images in which the system transfers all the lines of each image in sequence, for example, an 8 line progressive image the sequence would be lines 1, 2, 3, 4, 5, 6, 7, 8 then repeat.



IP '65 / 66'

IP stands for Ingress Protection (ingress means entrance or access):

a) The rating's first digit relates to the ingress protection against dust (6 means dust tight).

b) The rating's second digit relates to the ingress protection against liquids (5 means protected against low pressure jets and 6 means protected against high pressure jets).

Lux

Is equal to one lumen per square metre (lm/m^2).

Motion JPEG (MJPEG)

MJPEG, is an adaptation of the Joint Pictures Expert Group (JPEG-based codec) system for compressing images for implementation as a video codec.

Moving Picture Experts Group Compression Standard Version 4 (MPEG4) / H264

MPEG4 / H264 is a technology for compressing video and related control data and is one of the MPEG (Moving Picture Experts Group) international standards.

Open Network Video Interface Forum (ONVIF)

A membership organization devoted to the development of a standard interface for the network video market.

Personal digital assistant (PDA)

A personal digital assistant (PDA) is a handheld computer also known as small or palmtop computer.

Resolution

The degree of detail visible in the camera image.

Rolling Stock

For the purpose of this document rail vehicles are designed and intended to operate signalling and control systems and operate outside a possession.

RJ45 connector

RJ-45 is a connector used for Ethernet cabling for data transmission.

References

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by RSSB. This information is also available from www.rgsonline.co.uk.

Documents referenced in the text

RGSC 03	The Railway Group Standards Code
Railway Group Standards	
GM/RT2161	Requirements for Driving Cabs of Railway Vehicles
GM/RT2472	Data Recorders on Trains - Design Requirements
Other references	
IEEE 1482.1-1999	Standard for Rail Transit Vehicle Event Recorders – Description