



Balfour Beatty

Reading Green Park Station

Station Information and Security
Systems (SISS) Detailed Design
GRIP-5 Report

158989-ARP-RG-ST-RP-Y-000012

C02 | 8 June 2021

Extracts for CCTV (VSS) design

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 260708-40

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Drawing No / Doc No	Drawing Name / Document Name	Rev
158989-ARP-RG-BD-DR-Y-002018	CIS Typical Mounting Details – Station Building Internal	C02
158989-ARP-RG-PL-DR-Y-002019	CIS Typical Mounting Details - Platforms	C02
158989-ARP-RG-PL-DR-Y-002010	AFIL Typical Mounting Details	C02
158989-ARP-RG-ST-SH-Y-000016	SISS/Telecoms Cable Schedule	C02
158989-ARP-RG-ST-BQ-Y-000013	SISS/Telecoms Bill of Materials	C02
158989-ARP-RG-XX-RE-Z-000001	Combined CDM & CSM Hazards Record	C02
158989-ARP-RG-ST-RP-Y-000012	SISS/Telecoms GRIP-5 Report	C02

4 Description of Proposed Works

4.1 General

As stated in section 1.3.1, to provide railway passenger services between Reading West station and Mortimer station, the following works shall be undertaken at Reading Green Park station:

- Construction of two new platforms, 150.4 m in length each, with integral station canopies;
- Construction of new Footbridge and Station Building.

In this section we outline the SISS Telecommunication systems that shall be provided at the new RGP station.

Reading Green Park Station is a Category C2 station.

The scope of the SISS telecommunications work in association with station building is as follows:

- Provision of IP-based VSS system to achieve coverage at both platforms, footbridge, bicycle rack, stairway, lifts and inside the station building, as per NR and BTP (British Transport Police) requirements;
- Provision of Passengers Awareness Monitors (PAM) inside station building, at paid and unpaid side of gatelines;
- Provision of CIS system at both platforms and the station building;
- Provision of PHP system at both platforms and inside the station building, including EVC for PRM;
- Provision of LLPA coverage at both platforms and inside the station building, including AFILs (Audio Frequency Induction Loops);
- Provision of a Station LAN to connect all VSS equipment on the station. The Station LAN will connect to the GWR provided LAN for connectivity to Train Operating Company (TOC) GWR control centre at Swindon to enable remote monitoring and control;
- Provision of Data outlets at different locations inside station building;

- Provision of indoor Telecommunications equipment cabinets distributed at strategic locations to house the station SISS headend hardware;
- Provision of Ticket Vending Machines (TVM) and Smart Card Platforms Validators (PVAL) inside and outside station building.

The design criteria, constraints and assumptions applicable to this design considered for the above-mentioned SISS/Telecom systems have been outlined in the subsequent sections.

This detailed design is based on the below listed AiP:

- UA008320-11-ETL-FOA-ARC-1501_A01- RGP SISS GRIP-4 – Platforms (by Arcadis);

-139787-ARP-RG-BD-RP-Y-000012_A01 - Reading Green Park Phase 3 Station Building SISS AiP GRIP-4 Report (by Arup).

All designs comply with applicable Network Rail standards and meet the requirements of the Technical Specification for Interoperability for Persons with Reduced Mobility (TSI-PRM).

The construction of Reading Green Park station will include the following:

- Two platforms with integral canopies, 150.4m long each;
- Footbridge with covered stairways;
- Bicycle rack and surface car parking;
- Station building, incorporating a ticket hall / ticket enquiries office/staff room, waiting room, toilets, staff facilities and two small plant rooms. A canopy will be also provided for weather protection to the station building entrance.

4.1.1 Cable routes

Platform-1:

- Platform lighting, CIS cables, PA cables, CCTV cables will run through a 6-way multi-duct along the length of the back of the platform. When this cable route reaches the station building the station cables will be incorporated into the building design, using internal containment systems. Existing Lineside cables will remain in a ducted route with suitable manhole/chamber access. Proposed future S&T cables will run in a separate ducted route.

Platform-2:

- Platform lighting, CIS cables, PA cables, CCTV cables will run along a cable tray attached to the rear of the platform (this is adjacent to a maintenance access walkway). This route will continue at the rear of the platform along the length of the canopy, except for cable services suspended beneath the canopy. These cables will be routed into a cable tray attached to the canopy.

4.2 VSS system

4.2.1.1 General

A new Internet Protocol (IP) based High Definition (HD) Video Surveillance System (VSS) will be deployed at the new RGP station. The IP VSS system will consist of 50 Nos. IP HD dome cameras located at strategic places around the RGP station as follows:

- Platform 1 – 12 cameras – drawings 158989-ARP-RG-PL-DR-Y-002004, 002005 and 002006;
- Platform 2 – 14 cameras - drawings 158989-ARP-RG-PL-DR-Y-002004, 002005 and 002006;
- Footbridge – 4 cameras - drawing 158989-ARP-RG-FB-DR-Y-002014;
- Lifts – 4 cameras - drawing 158989-ARP-RG-FB-DR-Y-002014;
- Bicycle Rack – 2 cameras - drawing 158989-ARP-RG-PL-DR-Y-002006;
- Station Building – 14 cameras - drawing 158989-ARP-RG-BD-DR-Y-000010.

IP HD cameras will be connected to the local Network Video Recorders (NVRs) by several dedicated Layer-3 Ethernet Switches. Due to the long length of platforms (150.4m) in order to mitigate the 90m limit of Ethernet cables, there will be Ethernet Switches at 3 locations. The Ethernet Switches will support PoE / PoE+ standard to supply with electrical power the VSS cameras and will be housed inside SISS / Telecoms cabinets at below listed locations:

- VSS Headend cabinet (VSS-CAB-001) inside Communications Room underneath Platform-1 footbridge stairways;
- VSS cabinet (VSS-CAB-002) inside Store-1 underneath Platform-2 footbridge stairways;
- VSS cabinet (VSS-CAB-003) inside Station Building Plant Room.

The above listed PoE Ethernet Switches will be interconnected via a separate duct grade Fibre Optic (FO) cable. They will be dedicated to the VSS system only and will form the VSS LAN. The NVRs will be housed in the main VSS cabinet CAB-01 in the Communications Room and will provide local recording and storage for all RGP station IP cameras. Local monitoring of RGP station cameras will be available at the Ticket Office (TO) by a desktop VSS Workstation (a PC). Remote monitoring of RGP VSS cameras will also be available from GWR control centre at Swindon and will be via the GWR Information Technology (IT) WAN. WAN Router will be provided for this purpose by GWR IT department and will be connected to VSS LAN. The GWR WAN router will be located at LAN-CAB-001 inside Platform-1 Communications Room.

The new IP HD VSS cameras will ensure the safety and security of the station and will comply with the following standards:

- NR/GN/TEL/50017 - “CCTV for stations – functional, technical and operational requirements”;
- NR/L2/TEL/30135-Technical Requirements for Security CCTV Systems on Network Rail Infrastructure;
- BTP CCTV Output requirements version 1.6, June 2017;
- The provision of IP HD VSS cameras for this proposed design has been provided in line with the standard NR/L2/TEL/30135, issue-5 Technical Requirements for Security CCTV systems on Network Rail Infrastructure, that specifies the requirements for an IP-based CCTV system.

The following information describes indicative levels of coverage. Please note, the % of the screen height has been adjusted to suit the image quality of a high definition (1080P) HD IP camera; see Table 2 for details.

- **Monitor** = A figure occupies at least 5% of the screen height, from this level of detail an observer can determine the number, direction and speed of movement of people across a wide area, providing their presence is known to them, for example, they do not have to be searched for;
- **Detection** = A figure occupies at least 10% of the screen height, following an alert an observer will search the display screens and ascertain with a high degree of certainty whether a person is visible in the images displayed or not;
- **Observe** = A figure occupies 25-30% of the screen, some characteristics that an observer can search and ascertain with a greater degree of certainty whether or not a person is present;
- **Recognition** = When a figure occupies 50% of the screen height, viewers can say with a high degree of certainty whether or not the individual shown is the same as someone they have seen before;
- **Identification** = When a figure occupies at least 100% of the screen, picture quality and detail shall be sufficient to enable the identity of a subject to be established beyond reasonable doubt.

The minimum record rate relates to the number of fps (frames per second) that are recorded for each camera. These are identified as two different categories by GWR:

- High = 15 fps;
- Standard = 6 fps;

The requirements for the necessary CCTV coverage levels of the different station areas shall be in accordance with the table 1.

Camera View	Rotakin [%R]	Area of Floor Covered, %	Image Quality	Minimum frames per second (fps)
Booking/Revenue Office Windows	50	n/a	Recognise	Medium
At risk office doors	100	n/a	Identify	High
Boundary Walls / Approach Roads	10	90	Detect	Medium
Booking Hall Overview	10	95	Detect	Medium
Passenger Assistance / Alarm Points	50	n/a	Recognise	Medium
Platforms Overview	10	90	Detect	Medium
Station Frontage / Forecourt	10	95	Detect	Medium
Station Piazza / Concourse Overview	10	95	Detect	Medium
Public Toilet Entrances	50	n/a	Recognise	Medium
Station Entrance / Exit	100	n/a	Identify	High
Ticket Machines / ATMs	50	n/a	Recognize	Medium
Travel Information Bureaux Overview	10	95	Detect	Medium
Ticket Barriers-both sides	100	n/a	Identify	High
Waiting Rooms / Shelters	50	95	Recognise	Medium
Cycle Racks, Bins and bulk waste	50	100	Recognize	Medium
Taxi Ranks	10-30	95	Detect/Observe	Medium

Table 1 – extract from NR standard NR/L2/TEL/30135

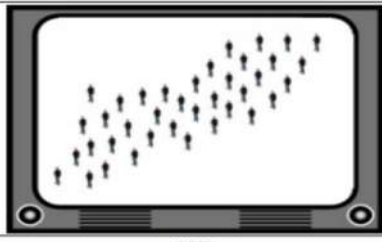
Detect  10%	Observe  25%
Recognise  50%	Identify  100%

Figure 4 - Example for % of screen height occupation by the monitored object

The Enquiry desk windows VSS coverage system is compliant with the Booking/Revenue office windows. The area outside the Enquiry desk is compliant with the Travel Information Bureaux Overview.

It should also be noted at this point that when these guidelines were first developed, all the CCTV systems were made by low resolution analogue cameras and used the common PAL standard for video capture and display. Hence general observation standard categories were developed to be valid for all CCTV monitoring equipment. Since the influx of digital systems to the CCTV market, there is now variability in the capture, recording and display resolution. The digital CCD matrix-based CCTV cameras which are used now have High Definition. New High-Resolution LCD based screens were introduced also, supporting HD playback.

Therefore, a 'Recognise' requirement can no longer be simply equated to a 50% screen height. For instance, using an HD megapixel camera and high-resolution LCD displays it is now possible to provide the same image resolution as before by using a much smaller physical percentage of the screen which the object occupies. Conversion tables have therefore been developed to show how the traditional percentage screen height criteria for a PAL system will look under a range of non-PAL resolutions. Table 1 shows the resolutions commonly encountered and Table 2 shows the equivalent screen heights needed to maintain the required resolution. The required minimal resolution to measure the different image qualities can be measured in pixels per meter.

In accordance with Home Office Guidelines (HOSDB-28-09 CCTV Operational Requirements Manual) – the equivalent percentage screen heights occupied by the monitored object for an Analogue PAL CCTV camera and an IP 1080p CCTV camera for the respective Image Quality are as summarised in Table-2:

Image Quality	Analogue Camera – PAL	IP camera – 1080p	Required resolution equivalent, pix/m
Identify	100%	38%	>200
Recognise	50%	19%	125
Observe	25%	10%	50
Detect	10%	4%	25
Monitor	5%	2%	5

Table 2 – Equivalent % screen heights and image quality in pix/m

4.2.1.2 VSS headend equipment

The new VSS system headend at RGP station will comprise of the below listed equipment and hardware:

- 3 No. 24-port PoE Ethernet switches;
- 3 No. 24-port FO patch panels suitable for 19" Telecoms cabinet installation;
- 3 No. 24-port Cat-6 RJ-45 modular patch panels suitable for 19" Telecoms cabinet installation;
- Cat-6 horizontal cabling Structural Cabling System (SCS) and Cat-6 STP patch cables;
- Weatherproof inline RJ-45 Female-to-Female couplers for Cat-6 cable termination;
- 1 No. desktop Personal Computer (PC) with VSS software, keyboard, mouse and 2 Nos. desktop monitors (called further VSS workstation);
- 2 No. 64 IP video Channels NVRs (XRN-6410DB4) with built-in RAID-5/6 Hard Disk Drives (HDD) storage of up to 160 TB (Tera Bytes) – 2 x 8 SATA slots;
- 1 No. rack mount UPS unit with 4 No. external battery packs;
- 1 No. rack mount Keyboard, Video and Mouse (KVM) unit.

The VSS headend hardware shall be housed within 19" floor standing and wall mounted Telecom cabinet. The hardware for the VSS workstation will be provided by GWR but the cost will be covered by the project.

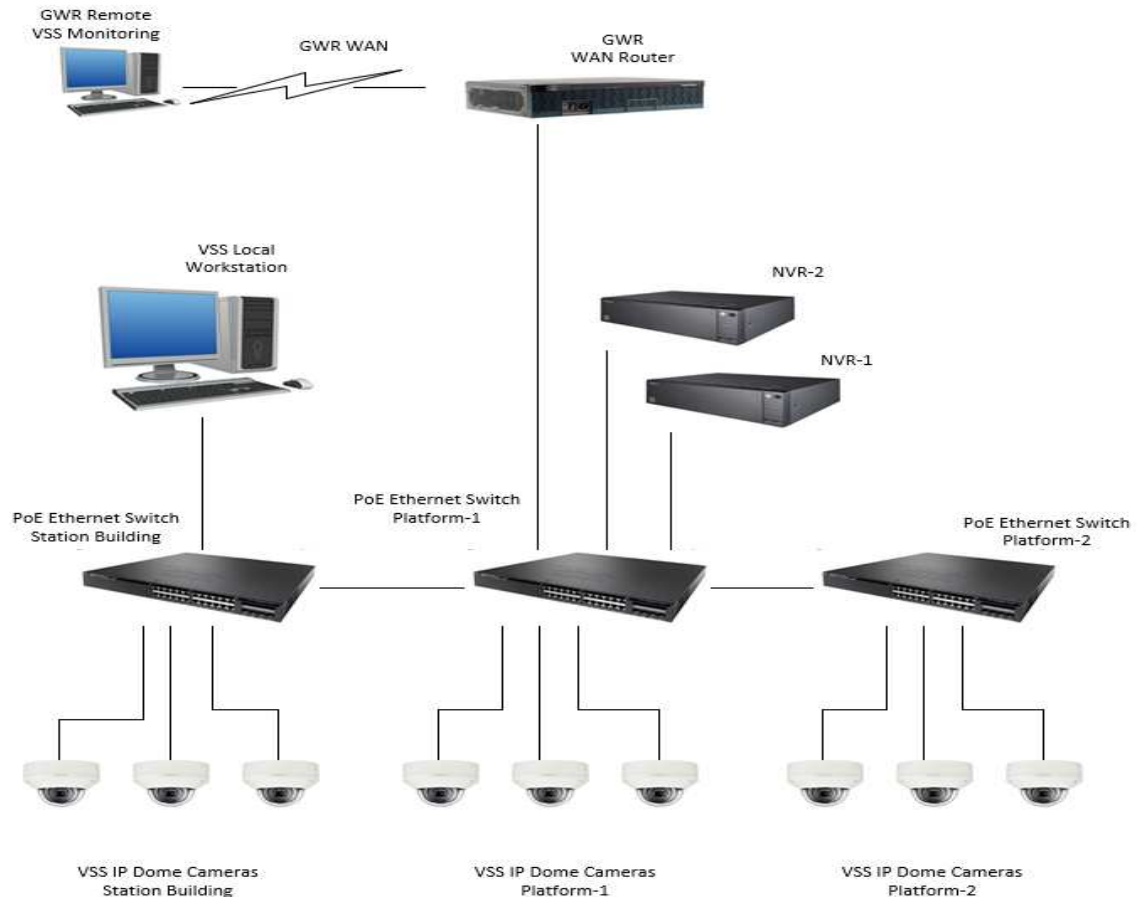


Figure 5 - VSS System Block Diagram

4.2.1.3 VSS cameras

Proposed is 50 Nos. (fifty) VSS cameras to be installed at Platforms, foot bridge, lifts, bicycle rack and station building, which shall provide security coverage of RGP station, including Platform-1, Platform-2, stairway to footbridge, footbridge, lifts, bicycle rack, station building areas such as booking hall, waiting room, gate-lines, passenger help points, ticket office & secure doors, station entrance/exit points and Events Gate.

The new cameras will be HD IP-based colour, suitable for outdoor installation (IP-67 grade) anti-vandal dome type and will support PoE. Proposed model is Hanwha-Techwin XNV-6081Z. This model is equipped with HDR (high dynamic range) of over 150dB which reduces blur effects, quality degradation or silhouettes when parts of the covered area are in direct sunshine and other parts have very low illumination (dark). The support of built-in video analytics functions of this camera model is an option which may be used at a later stage by GWR. XNV-6081Z can stream 2MP or 5 MP video stream and supports Pan, Tilt, Rotation and Zoom (PTRZ). The proposed camera model has NR PADS approval.

All IP CCTV cameras are Open Network Video Interface Forum (ONVIF) compatible and utilise minimum H.264 video compression.

Due to the high image quality and built-in video analytics, a range of different events may be configured in each camera which can be reported to a remote

server over Simple Network Management Protocol (SNMP) or trigger different dry contact alarms which may be used later as an input to an automation system should this be required in future. Date, Time and camera number stamp will be configured for each camera, as well as brief descriptions identifying the station and area monitored by each camera. The time and date will be synchronised with NR approved time source and will be over Network Time Protocol (NTP).

During AiP preliminary design for RGP Platforms (by Arcadis) a higher quantity of VSS cameras with 720p resolution had been proposed. This quantity has been reduced significantly during the detailed design development after VSS modelling, as all the 720p cameras have been changed to 1080p resolution cameras which provide higher image quality.

Station building area	Manufacturer	Model	Lens Model / Spec	Image
Platform-1 Platform-2 Footbridge Bicycle Rack Station Building	Hanwha-Techwin	XNV-6081Z 2MP/5MP IP HD VR PTRZ fixed dome camera	2.8 – 12 mm Built-in	
Lift Cars	Hanwha-Techwin	XNV-6012 2MP IP HD VR fixed discrete corner mini-dome camera	0.1-2.4 mm Built-in	

Table 3 – IP CCTV camera types

4.2.1.4 VSS coverage

The below table provides a summary of the new VSS cameras and coverage proposed for the scheme based on NR/L2/TEL/30135 standard, issue-5, Technical and Operational Requirements. Camera lenses are varifocal and can be adjusted in the range shown at Table-3 above. The values stated in the “Focal Length” column in the tables below are derived from the CCTV modelling and show the correct settings for each camera lens in order to provide the required view. This shall be adjusted during the commissioning stage as per NR standard: NR/L2/TEL/30136 – Testing Requirements - Security CCTV. Table-4 below shows information about coverage area and image quality captured by each camera. This information is being obtained from the IP CCTV video modelling tool JVSG. The image quality metric shown in the last column is valid for the test object (Rotakin) placed at the end of the coverage zone, i.e. worst scenario. All objects placed closer to a camera will appear on the screen with higher resolution. For more details refer to 158989-ARP-RG-ST-CS-Y-000010 – VSS Cameras View- Platforms & Station Building.

Camera ID	Camera Location	Focal Length, mm	View area	Image resolution, pix/m
RGP-VSS-CAM-001	Station Building Canopy	6.6	Station Building front	139
RGP-VSS-CAM-002	Station Building Canopy	3.3	Events Gate External Ticket Vending Machine	141
RGP-VSS-CAM-003	Ticket Hall	2.7	Booking Hall – Non-Paid & Retail	127
RGP-VSS-CAM-004	Ticket Desk	3.2	Ticket Desk, Booking Hall – Non-Paid & Retail	181
RGP-VSS-CAM-005	Ticket Hall	3.0	Station Building Main Entrance – Entrance	212
RGP-VSS-CAM-006	Ticket Hall	5.0	Gate-line - Exit	225
RGP-VSS-CAM-007	Waiting Hall	2.6	Waiting Hall paid side - secure doors to offices and plant rooms, Toilets entrance	143
RGP-VSS-CAM-008	Waiting Hall	5.0	Gate-line - Entrance	233
RGP-VSS-CAM-009	South side of Station building	2.7	Waiting Hall paid side - secure doors to offices and plant rooms, Toilets entrance	200
RGP-VSS-CAM-010	Station Building external wall	5.0	Plant Room access	219
RGP-VSS-CAM-011	Station Building external wall	6.9	Station Building front	124
RGP-VSS-CAM-012	Station Building Canopy	7.7	Station building front	168
RGP-VSS-CAM-013	Station Building Canopy	5.0	Station Building Main Entrance	215

Table 4 – Summary of VSS cameras and coverage at Station Building

Camera ID	Camera Location	Focal Length, mm	View area	Image quality, pix/m
RGP-VSS-CAM-014	Platform-1- South End, Pole Mount	6.5	Platform-1 – South End	126
RGP-VSS-CAM-015	Platform-1- South End, Pole Mount	12	Platform-1 – South End	99
RGP-VSS-CAM-016	Platform-1- South End, Pole Mount	12	Platform-1-Waiting shelter	131
RGP-VSS-CAM-017	Platform-1 - Canopy	11.8	Platform-1-South End	157
RGP-VSS-CAM-018	Platform-1 - Canopy	5.8	Platform-1-PHP	230
RGP-VSS-CAM-019	Platform-1 - Canopy	12	Platform-1-Central	128
RGP-VSS-CAM-020	Station Building external wall - North	7	Platform-1 stairway to Footbridge	217
RGP-VSS-CAM-021	Platform-1 - Canopy	6.2	Event / Out of Hours Entrance	167
RGP-VSS-CAM-022	Platform-1 - Canopy	10.2	Platform-1-Central	107
RGP-VSS-CAM-023	Platform-1 - Canopy	11.8	Platform-1 – North End	155
RGP-VSS-CAM-024	Platform-1 - Canopy	12	Platform-1 – North End	129
RGP-VSS-CAM-025	Platform-1 - Canopy	2.8	Platform-1 – Lift waiting area	117

Table 5 - Summary of CCTV cameras and coverage at Platform-1

Camera ID	Camera Location	Focal Length, mm	View area	Image quality, pix/m
RGP-VSS-CAM-026	Platform-2 – South End, Pole Mount	4.9	Platform-2- South End-EVC-001	235
RGP-VSS-CAM-027	Platform-2 – South End, Pole Mount	10.5	Platform-2-South End	149
RGP-VSS-CAM-028	Platform-2 – South End, Pole Mount	10.5	Platform-2-Waiting Shelter	79
RGP-VSS-CAM-029	Platform-2 – South End, Pole Mount	12	Platform-2-South End	159
RGP-VSS-CAM-030	Platform-2 - Canopy	12	Platform-2-Central	120
RGP-VSS-CAM-031	Platform-2 - Canopy	10.8	Platform-2-PHP	189
RGP-VSS-CAM-032	Platform-2 - Canopy	9.5	Platform-2 stairway to Footbridge	228
RGP-VSS-CAM-033	Platform-2 - Canopy	12	Platform-2-North End	159
RGP-VSS-CAM-034	Platform-2 – Footbridge Walkway external wall	11.8	Platform-2 Escape Route	162
RGP-VSS-CAM-035	Platform-2 - Canopy	12	Platform-2-Lift Waiting Area	156
RGP-VSS-CAM-036	Platform-2 – Footbridge Walkway external wall	12	Platform-2 Escape Route	112
RGP-VSS-CAM-037	Platform-2 – North End, Pole Mount	3.3	Platform-2 – Lift waiting area	120
RGP-VSS-CAM-038	Platform-2 - Canopy	11.8	Platform-2-North End	136
RGP-VSS-CAM-039	Platform-2 – North End, Pole Mount	7.8	Platform-2-North End-EVC-002	309

Table 6 – Summary of CCTV cameras and coverage at Platform-2

Camera ID	Camera Location	Focal Length, mm	View area	Image quality, pix/m
RGP-VSS-CAM-040	Footbridge	5.8	Footbridge – Lift-1 waiting area	250
RGP-VSS-CAM-041	Footbridge	4.2	Footbridge – Platform 1 Stairway and walkway	98
RGP-VSS-CAM-042	Footbridge	2.8	Footbridge– Lift-2 waiting area	106
RGP-VSS-CAM-043	Footbridge	4.2	Footbridge – Platform 2 Stairway and walkway	97
RGP-VSS-CAM-044	Lift Car-1	0.1	Lift Car-1	118
RGP-VSS-CAM-045	Lift Car-1	0.1	Lift Car-1	116
RGP-VSS-CAM-046	Lift Car-2	0.1	Lift Car-2	131
RGP-VSS-CAM-047	Lift Car-2	0.1	Lift Car-2	123
RGP-VSS-CAM-048	Bicycle Rack-1	4.1	Bicycle Racks	125
RGP-VSS-CAM-049	Bicycle Rack-2	3.7	Bicycle Racks	124
RGP-VSS-CAM-050	Station Building Canopy	12	Walkway to Bicycle Racks	135

Table 7– Summary of CCTV cameras and coverage at Lifts, foot bridge and bicycle rack

To assure that each lift car floor is covered at 95% min, and all objects with height above 1.5m are captured with Recognize level of image quality, 2 Nos of CCTV mini-dome corner cameras are proposed for lift cars. Entries and Exit points to Emergency Escape route at Platform-2 are covered by RGP VSS, the escape route itself is not covered since it falls outside the leased territory of RGP station.

To cover the bicycle racks with “identify” quality, two dedicated VSS cameras will be installed underneath bicycle rack canopies.

The IP address plan for RGP VSS system will be provided by GWR CCTV team as per the GWR Guidance for IP CCTV cameras configuration, issue 02 from July 2019. The IP address plan will have to be requested by the SISS contractor prior to commissioning stage, as per the GWR instructions. Configuration of IP addresses of all VSS devices shall also comply with NR standard NR/L2/TEL/30182 - Specification for Secure Configuration and Management of Network Rail Telecom Internet Protocol (IP) Networks, Systems and Devices.

For more details about the VSS coverage study and proposed cameras views on RGP Platforms, Footbridge and Station Building refer to the following drawings and documents listed in Appendix-A:

- 158989-ARP-RG-ST-CS-Y-000010;
- 158989-ARP-RG-PL-DR-Y-002011;
- 158989-ARP-RG-BD-DR-Y-000011;
- 158989-ARP-RG-FB-DR-Y-002020.

For Exact location of all VSS cameras at RGP Platforms, Footbridge and Station Building refer GA Layout drawings: 158989-ARP-RG-PL-DR-Y-002004, 002005, 002006, 158989-ARP-RG-FB-DR-Y-002014, 158989-ARP-RG-BD-DR-Y-000010.

For connectivity refer drawings: 158989-ARP-RG-ST-DR-Y-000002, 158989-ARP-RG-PL-DR-Y-000031, 158989-ARP-RG-PL-DR-Y-000032 and 158989-ARP-RG-BD-DR-Y-000033.

Above mentioned cameras are part of RGP VSS and will provide coverage of RGP Station only. This includes Platform-1, Platform-2, Footbridge, Station Building, Ticket Office and Bicycle rack.

The VSS coverage for the Taxi Rank, Car Park and Interchange areas will be provided by others as part of the interchange work contract. These areas fall outside the GWR leased area hence they are not covered by the RGP VSS system. The coverage of RGP VSS is limited only to the GWR leased area.

VSS camera coverage shall be setup as detailed in the Appendix F: Proposed VSS Camera Views. Final camera views shall be adjusted during commissioning to maximise camera coverage.

The VSS system shall be configured in accordance with GWR documents listed below:

- GWR.CCTV.CONFIG.NVR.PRN-4011 – CCTV Configuration for HT PRN-4011 NVR;
- GWR.CCTV.CONFIG.CAMERA.IP – CCTV Configuration for HT IP Cameras;
- GWR.SISS.CCTV.CONF.CHECKLIST.EXT – GWR CCTV Commissioning Checklist (External)

A copy of these documents is available in Appendix-H.

4.2.1.5 VSS cabling and routing

The new CCTV cameras will use internal and duct grade (external) Cat-6 structured cabling system (SCS) to connect back physically to the VSS and SISS Telecoms cabinets. Cables routes are designed in a way that individual cable runs shall not exceed the 90m limit of ethernet cables.

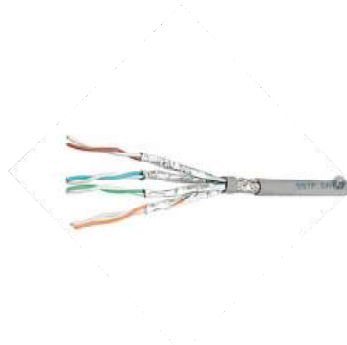


Figure 6 – Category-6 duct grade LSZH STP cable

The Cat-6 SCS cabling shall be terminated at one end at rack mount RJ-45 Cat-6 modular patch panels located inside the VSS and SISS/Telecoms cabinets. Cat-6 patch cables shall be used to cross-connect each camera to a port of the relevant PoE ethernet switch. Electrical power for the cameras will be supplied by the ethernet switch ports over the PoE.

Each cable run will be labelled at both ends in accordance with the Telecoms Cable Schedule.

All network cabling shall be installed and tested to TIA/EIA 568 standard. Cable testing report shall be supplied at the end of the work and submitted to GWR IT Network and security manager on completion. Patch cabling inside VSS cabinets shall adhere to the below listed colours for clarity:

- Blue - Camera
- Yellow - NVR
- Red - UPS
- Grey – Local Management PC
- Green – WAN

All VSS dedicated patch panels and patching shall be arranged as per GWR.CCTV.CONFIG.SWITCH.LAYOUT – CCTV Switch & Patch Panel Standard layout, issue June 2020.

The network installation/termination diagrams 158989-ARP-RG-ST-DR-Y-000006 and 158989-ARP-RG-ST-DR-Y-000007 shall be updated after all installations are completed and shall be fixed close to patch panels.

The Cat-6 SCS cabling shall be terminated at Weatherproof Cat-6 Female-to Female RJ-45 couplers, located inside the dome camera mounting rings.



Figure 7 – 24 ports RJ-45 patch panel for Cat-6 STP cable

Cat-6 patch cables shall be used to connect the cameras to the RJ-45 inline coupler. These patch cables shall be installed in a rigid or flexible conduit.

Connectivity between VSS Ethernet Switches and SISS LAN will be via Cat-6 STP patch cables.



Figure 8 - Cat-6 STP Patch Cable



Figure 9 - Waterproof RJ-45 Female-to-Female Cat-6 inline coupler

The cable routes have been designed in accordance with below listed NR standards:

- NR/GN/TEL/30138 – Buried cable route and cable route through station Platforms;
- NR/GN/TEL/30139 – The Survey and Design of Telecoms cable and Routes;
- NR/GN/TEL/30140 – Telecommunications Cable Routes and Installation;
- NR/L2/TEL/30151 – Design and installation of station cabling and guidance notes.

Telecom and Electrical cables will be segregated by:

- a distance, not less than 50mm; or
- a divider meeting the requirements of BS 7671.

All cable routes will be easily accessible for maintaining the cabling systems. All cable containment will be securely mounted to the proposed structures. All primary cable containment will conform to NR standards.

All telecoms cables will be encased in containment to provide end to end protection for the cable. Cable containment types include the following:

- Trunking – metallic trunking is preferred if running in close proximity to power cabling or other sources of Electromagnetic Interference (EMI);
- Metal tube solid wall conduit – galvanised, stainless steel or other corrosion resistant covering;
- Flexible conduit (Kopex) – corrosion resistant. Used only for short runs usually between trunking and gland on equipment housing.

The cabling and Cable Management System (CMS) will comply with relevant standards with respect to electromagnetic interference, with separate cable routes for signal & power cables if a shared containment is applicable. Where communications cabling run in close proximity to power cabling or share common cable route a physical metallic barrier will be installed (cables encased in metal trunking).

Any metallic cable containment will be installed and earthed as detailed in the MEP Building Services Form 003. Cable containment will be installed by qualified competent installation engineers.

All cables will be tested prior to installation and the test results provided for inspection. All cables once installed will be fully tested and test results provided for inspection to the nominated NR electrical / Telecoms engineer.

The primary cable containment and cable routing design is provided by the

M&E designer and is done with close liaison between the Telecoms and Civils to ensure that all requirements are captured, and potential conflicts / clashes eliminated.

Between the cable containment and each piece of deployed equipment, cables will be run internally within equipment brackets / housings where practicable. Where this cannot be achieved cables will be installed in flexible conduits. The flexible conduit will be tidily run and secured at appropriate points. A single flexible conduit run from the primary cable route to deployed equipment shall not exceed 3 metres in length.

Cable entries to all external housings will be via a weatherproof gland and to internal housings via a dustproof gland.

All new CMS will be designed with a 25% minimum spare capacity for future expansion. The exact routing, size and type of the CMS is detailed in the MEP Building Services Form 003.

For cable routing refer drawings 158989-ARP-RG-ST-DR-Y-003004, 003005 and 003006.

4.2.1.6 VSS Recording and Viewing Control System

Every VSS camera's IP video stream shall be recorded and stored locally at the RGP station by one of the proposed NVRs. Recording storage is calculated using a generic formula, based on the following input parameters:

- IP camera with HD resolution of 1920 x 1080, i.e. 2 Megapixel;
- IP Video stream bitrate 2,048 Kbit/s;
- MPEG-4 video codec;
- H.264 Video Compression;
- Recording quality at 10 frames per second;
- Required period for storage of video recordings of 31 days;
- Motion all time (worst case scenario);
- Day mode all time (worst case scenario).

Therefore, to allow for 31 days of recording to be retained for 50 No. of IP cameras, a total of 42.85 Terabytes (TB) of storage space will be required, using the generic formula which does not consider any compression. Storage calculation depends on multiple factors, but most important are compression type, frames per second, resolution and motion.

Storage, TB = ((bitrate/8) * 3600 * 24 * cam * days)10⁻¹², where:

Storage = Amount of space in TB (Terabytes)

bitrate = Camera bandwidth (Kbit/s) – 2,048 as per manufacturer

8 = to convert from bits to Bytes

3600 = (number of seconds in one hour)

24 = to convert from hour to day

cam = Total number of cameras (50 in this case)

days = Total number of days (31 days as per NR and GWR requirement)

1TB = Divide by 1 Tera (1,000,000,000,000) to convert from Kilobytes to Terabytes

Storage = $((2,560/8)*3600*24*50*31)/1,000,000,000,000 = 42.85$ Terabytes

The results from Samsung tool for CCTV Bandwidth and NVR Storage calculation, taking into account H.264 compression and middle scene activity are shown on figures 13 and 14 below.

The screenshot displays the 'Bandwidth Calculator v4.34.0_20170120' software interface. The main configuration area includes a 'New Project' tab, a 'Model' dropdown set to 'XNV-6080', and a 'Quantity' of '50'. The 'Name' is 'RGP CCTV' and 'Scene Activity' is 'MIDDLE'. Below these are settings for 'Streaming Purpose', 'Video Codec' (H.264), 'Resolution' (1920x1080), 'Bitrate control' (VBR), 'Framerate' (15), 'Compression', 'Bitrate' (2560 kbps), and 'GOV' (30). A table lists three streaming configurations: Streaming01 (Live, REC, N/W), Streaming02 (Live, REC, N/W), and Streaming03 (Live, REC, N/W). The 'REC Duration' is set to 31 days. A summary table shows the following data:

Model	Quantity	Live	REC	N/W Transferring	Total Bandwidth	Total Storage	Action
XNV-6080	50	86.80 Mbit/s	86.80 Mbit/s	86.80 Mbit/s	86.80 Mbit/s	29.06 TB	
XNV-6080	50	86.80 Mbit/s	61.25 Mbit/s	86.80 Mbit/s	148.05 Mbit/s	20.51 TB	

A 'Summary' row shows: 100, 173.60 Mbit/s, 148.05 Mbit/s, 173.60 Mbit/s, 234.85 Mbit/s, and 49.57 TB. Below this are tabs for 'Recordable Time', 'NVR Calculation', and 'SSM Calculation'. The 'NVR Calculation' tab is active, showing 'NVR model' as 'PRN-4011', 'RAID Type' as 'RAID 5', and 'HDD Size' as '4 TB'. A table shows the NVR calculation results:

NVR model	REC	NVR Quantity	HDD Quantity	Total Storage
PRN-4011	148.05 Mbit/s	2	20	49.57 TB

A 'View Detailed Report' button is located at the bottom right of the NVR Calculation section.

Figure 10 - CCTV bandwidth and NVR Storage calculation



Figure 11 - CCTV bandwidth and NVR Storage calculation- detailed report

There will be two separate profiles configured for each camera - HD and SD, as per GWR guide GWR.CCTV.CONFIG.CAMERA.IP - CCTV configuration for HT IP cameras, July 2019. Respectively two parallel IP video streams will be recorded by the NVR from each camera, as per GWR.CCTV.CONFIG.NVR.PRN-4011 - CCTV configuration for HT PRN-4011 NVR, July 2019. The recording for the HD profile will be set to 15 frames per second (fps) and 6 fps for the SD profile.

29.06 TB storage capacity will be required for the HD profile and respectively **20.51 TB** will be required for the SD profile as per the Samsung NVR storage and CCTV bandwidth calculation tool, or **49.57 TB** in total, configured in RAID-5.

The NR requirement for 10% spare storage capacity shall be taken into consideration. A total of **55 TB** HDD space will be necessary to retain for 31 days the recording of all RGP station cameras. This shall be distributed between two NVRs for redundancy, and storage inside NVRs will be configured as a RAID-5 array to prevent loss of information in case of single HDD failure. Thus, a 28 TB storage space will be necessary per NVR, which will be achieved by 10 No. of 4 TB HDDs inside each of the NVRs.

Samsung XRN-6410DB4 NVR is proposed based on GWR preferences. Both NVRs will be located in the main VSS cabinet VSS-CAB-001 inside Communications Room (underneath Platform-1 stairway). Proposed HDD to be used for the NVRs built-in storage are Western Digital, 4TB.

Video source identification (camera titles) shall be added to all camera images, for easier identification of camera view, for display and recording review purposes.

Samsung XRN-6410DB4 NVRs can record up to 64 No. IP video streams. They have built-in storage with maximum of 16 No. SATA HDDs (up to 160 TB in total) configurable as 2 No. RAID-5 or RAID-6 arrays. NVRs will be capable of storing all recording for up to 31 days at a recording rate of 15 fps for the HD profile and 6 fps for the SD profile, with the ability to increase the recording rate to 25 fps in the event of alarm or emergency as per NR standard, NR/L2/TEL/30135, issue-5 Technical Requirements for Security CCTV Systems on Network Rail Infrastructure. NVR-1 will record the footage from the first 25 cameras and NVR-2 will record the footage of the remaining 25 cameras.



Figure 12 – Hanwha-Techwin (Samsung) XRN-6410DB4 NVR



Figure 13 - 19" Rack Shelf

In the event of total power loss, the proposed NVRs will not lose any historical recordings. Upon power restoration the NVRs will start up and resume recording automatically without a necessity of any manual intervention.

A local 19" 1U KVM (keyboard, video, mouse) unit will be installed inside the main VSS cabinet for easy access of the NVRs during commissioning and for maintenance and trouble-shooting purposes.

Export of video from NVRs will be possible locally and remotely, on a standard video file format and will be able to view on any MS Windows based video player without a necessity of any special software tool for conversion from proprietary standards.

camera	profile	fps rate	NVR	NVR Port No
RGP-VSS-CAM-001	HD	15	RGP-VSS-NVR-001	1
RGP-VSS-CAM-001	SD	6	RGP-VSS-NVR-001	33
RGP-VSS-CAM-002	HD	15	RGP-VSS-NVR-001	2
RGP-VSS-CAM-002	SD	6	RGP-VSS-NVR-001	34
RGP-VSS-CAM-003	HD	15	RGP-VSS-NVR-001	3
RGP-VSS-CAM-003	SD	6	RGP-VSS-NVR-001	35
RGP-VSS-CAM-004	HD	15	RGP-VSS-NVR-001	4
RGP-VSS-CAM-004	SD	6	RGP-VSS-NVR-001	36
RGP-VSS-CAM-005	HD	15	RGP-VSS-NVR-001	5
RGP-VSS-CAM-005	SD	6	RGP-VSS-NVR-001	37
RGP-VSS-CAM-006	HD	15	RGP-VSS-NVR-001	6
RGP-VSS-CAM-006	SD	6	RGP-VSS-NVR-001	38
RGP-VSS-CAM-007	HD	15	RGP-VSS-NVR-001	7
RGP-VSS-CAM-007	SD	6	RGP-VSS-NVR-001	39
RGP-VSS-CAM-008	HD	15	RGP-VSS-NVR-001	8
RGP-VSS-CAM-008	SD	6	RGP-VSS-NVR-001	40
RGP-VSS-CAM-009	HD	15	RGP-VSS-NVR-001	9
RGP-VSS-CAM-009	SD	6	RGP-VSS-NVR-001	41
RGP-VSS-CAM-010	HD	15	RGP-VSS-NVR-001	10
RGP-VSS-CAM-010	SD	6	RGP-VSS-NVR-001	42
RGP-VSS-CAM-011	HD	15	RGP-VSS-NVR-001	11
RGP-VSS-CAM-011	SD	6	RGP-VSS-NVR-001	43
RGP-VSS-CAM-012	HD	15	RGP-VSS-NVR-001	12
RGP-VSS-CAM-012	SD	6	RGP-VSS-NVR-001	44
RGP-VSS-CAM-013	HD	15	RGP-VSS-NVR-001	13
RGP-VSS-CAM-013	SD	6	RGP-VSS-NVR-001	45
RGP-VSS-CAM-014	HD	15	RGP-VSS-NVR-001	14
RGP-VSS-CAM-014	SD	6	RGP-VSS-NVR-001	46
RGP-VSS-CAM-015	HD	15	RGP-VSS-NVR-001	15
RGP-VSS-CAM-015	SD	6	RGP-VSS-NVR-001	47
RGP-VSS-CAM-016	HD	15	RGP-VSS-NVR-001	16
RGP-VSS-CAM-016	SD	6	RGP-VSS-NVR-001	48
RGP-VSS-CAM-017	HD	15	RGP-VSS-NVR-001	17
RGP-VSS-CAM-017	SD	6	RGP-VSS-NVR-001	49
RGP-VSS-CAM-018	HD	15	RGP-VSS-NVR-001	18
RGP-VSS-CAM-018	SD	6	RGP-VSS-NVR-001	50
RGP-VSS-CAM-019	HD	15	RGP-VSS-NVR-001	19
RGP-VSS-CAM-019	SD	6	RGP-VSS-NVR-001	51
RGP-VSS-CAM-020	HD	15	RGP-VSS-NVR-001	20
RGP-VSS-CAM-020	SD	6	RGP-VSS-NVR-001	52
RGP-VSS-CAM-021	HD	15	RGP-VSS-NVR-001	21
RGP-VSS-CAM-021	SD	6	RGP-VSS-NVR-001	53
RGP-VSS-CAM-022	HD	15	RGP-VSS-NVR-001	22
RGP-VSS-CAM-022	SD	6	RGP-VSS-NVR-001	54

camera	profile	fps rate	NVR	NVR Port No
RGP-VSS-CAM-023	HD	15	RGP-VSS-NVR-001	23
RGP-VSS-CAM-023	SD	6	RGP-VSS-NVR-001	55
RGP-VSS-CAM-024	HD	15	RGP-VSS-NVR-001	24
RGP-VSS-CAM-024	SD	6	RGP-VSS-NVR-001	56
RGP-VSS-CAM-025	HD	15	RGP-VSS-NVR-001	25
RGP-VSS-CAM-025	SD	6	RGP-VSS-NVR-001	57
SPARE			RGP-VSS-NVR-001	26
SPARE			RGP-VSS-NVR-001	58
SPARE			RGP-VSS-NVR-001	27
SPARE			RGP-VSS-NVR-001	59
SPARE			RGP-VSS-NVR-001	28
SPARE			RGP-VSS-NVR-001	60
SPARE			RGP-VSS-NVR-001	29
SPARE			RGP-VSS-NVR-001	61
SPARE			RGP-VSS-NVR-001	30
SPARE			RGP-VSS-NVR-001	62
SPARE			RGP-VSS-NVR-001	31
SPARE			RGP-VSS-NVR-001	63
SPARE			RGP-VSS-NVR-001	32
SPARE			RGP-VSS-NVR-001	64
RGP-VSS-CAM-026	HD	15	RGP-VSS-NVR-002	1
RGP-VSS-CAM-026	SD	6	RGP-VSS-NVR-002	33
RGP-VSS-CAM-027	HD	15	RGP-VSS-NVR-002	2
RGP-VSS-CAM-027	SD	6	RGP-VSS-NVR-002	34
RGP-VSS-CAM-028	HD	15	RGP-VSS-NVR-002	3
RGP-VSS-CAM-028	SD	6	RGP-VSS-NVR-002	35
RGP-VSS-CAM-029	HD	15	RGP-VSS-NVR-002	4
RGP-VSS-CAM-029	SD	6	RGP-VSS-NVR-002	36
RGP-VSS-CAM-030	HD	15	RGP-VSS-NVR-002	5
RGP-VSS-CAM-030	SD	6	RGP-VSS-NVR-002	37
RGP-VSS-CAM-031	HD	15	RGP-VSS-NVR-002	6
RGP-VSS-CAM-031	SD	6	RGP-VSS-NVR-002	38
RGP-VSS-CAM-032	HD	15	RGP-VSS-NVR-002	7
RGP-VSS-CAM-032	SD	6	RGP-VSS-NVR-002	39
RGP-VSS-CAM-033	HD	15	RGP-VSS-NVR-002	8
RGP-VSS-CAM-033	SD	6	RGP-VSS-NVR-002	40
RGP-VSS-CAM-034	HD	15	RGP-VSS-NVR-002	9
RGP-VSS-CAM-034	SD	6	RGP-VSS-NVR-002	41
RGP-VSS-CAM-035	HD	15	RGP-VSS-NVR-002	10
RGP-VSS-CAM-035	SD	6	RGP-VSS-NVR-002	42
RGP-VSS-CAM-036	HD	15	RGP-VSS-NVR-002	11
RGP-VSS-CAM-036	SD	6	RGP-VSS-NVR-002	43
RGP-VSS-CAM-037	HD	15	RGP-VSS-NVR-002	12

camera	profile	fps rate	NVR	NVR Port No
RGP-VSS-CAM-037	SD	6	RGP-VSS-NVR-002	44
RGP-VSS-CAM-038	HD	15	RGP-VSS-NVR-002	13
RGP-VSS-CAM-038	SD	6	RGP-VSS-NVR-002	45
RGP-VSS-CAM-039	HD	15	RGP-VSS-NVR-002	14
RGP-VSS-CAM-039	SD	6	RGP-VSS-NVR-002	46
RGP-VSS-CAM-040	HD	15	RGP-VSS-NVR-002	15
RGP-VSS-CAM-040	SD	6	RGP-VSS-NVR-002	47
RGP-VSS-CAM-041	HD	15	RGP-VSS-NVR-002	16
RGP-VSS-CAM-041	SD	6	RGP-VSS-NVR-002	48
RGP-VSS-CAM-042	HD	15	RGP-VSS-NVR-002	17
RGP-VSS-CAM-042	SD	6	RGP-VSS-NVR-002	49
RGP-VSS-CAM-043	HD	15	RGP-VSS-NVR-002	18
RGP-VSS-CAM-043	SD	6	RGP-VSS-NVR-002	50
RGP-VSS-CAM-044	HD	15	RGP-VSS-NVR-002	19
RGP-VSS-CAM-044	SD	6	RGP-VSS-NVR-002	51
RGP-VSS-CAM-045	HD	15	RGP-VSS-NVR-002	20
RGP-VSS-CAM-045	SD	6	RGP-VSS-NVR-002	52
RGP-VSS-CAM-046	HD	15	RGP-VSS-NVR-002	21
RGP-VSS-CAM-046	SD	6	RGP-VSS-NVR-002	53
RGP-VSS-CAM-047	HD	15	RGP-VSS-NVR-002	22
RGP-VSS-CAM-047	SD	6	RGP-VSS-NVR-002	54
RGP-VSS-CAM-048	HD	15	RGP-VSS-NVR-002	23
RGP-VSS-CAM-048	SD	6	RGP-VSS-NVR-002	55
RGP-VSS-CAM-049	HD	15	RGP-VSS-NVR-002	24
RGP-VSS-CAM-049	SD	6	RGP-VSS-NVR-002	56
RGP-VSS-CAM-050	HD	15	RGP-VSS-NVR-002	25
RGP-VSS-CAM-050	SD	6	RGP-VSS-NVR-002	57
SPARE			RGP-VSS-NVR-002	26
SPARE			RGP-VSS-NVR-002	58
SPARE			RGP-VSS-NVR-002	27
SPARE			RGP-VSS-NVR-002	59
SPARE			RGP-VSS-NVR-002	28
SPARE			RGP-VSS-NVR-002	60
SPARE			RGP-VSS-NVR-002	29
SPARE			RGP-VSS-NVR-002	61
SPARE			RGP-VSS-NVR-002	30
SPARE			RGP-VSS-NVR-002	62
SPARE			RGP-VSS-NVR-002	31
SPARE			RGP-VSS-NVR-002	63
SPARE			RGP-VSS-NVR-002	32
SPARE			RGP-VSS-NVR-002	64

Table 8 - VSS cameras to NVR ports allocation

To enable VSS cameras local viewing at the station building by staff, a VSS workstation will be provided inside secure office that shall consist of:

- 1 No. desktop PC;
- 2 No. 22” HD CCTV monitors – quad split-screen view and full screen viewing;
- 1 No. keyboard;
- 1 No. mouse;
- VSS software – ‘Samsung Smart Viewer & Security Manager’ to be free issued by ‘Samsung’.

The VSS workstation will need to meet Samsung / Hanwha-Techwin minimum performance specifications. It will be supplied with electrical power by the VSS UPS (Un-Interruptible Power Supply). The VSS workstation hardware will be provided by GWR.

Proposed are CISCO Catalyst 3650 L2/L3 Ethernet Switches supports full PoE and redundant Power Supply Modules (PSU), hence their high reliability and very high Mean Time Between Failures (MTBF). They support remote access and management. VSS Ethernet switches will be connected in a “Star” topology, as detailed in the LAN and SCS schematic: 158989-ARP-RG-ST-DR-Y-000010. To comply with the minimal Cyber Security requirements and IEC-62443-3-3:2013-Industrial Communication Networks – Network and System Security – Level 2, all used ports of ethernet switches will be secured, and all unused ports will be disabled. Both console and remote access to ethernet switches will be encrypted and password protected by the commissioning contractor.



Figure 14 – 24 ports CISCO Catalyst 3650 PoE Ethernet switches

Each Cisco 3650 24-port switch will have two fully redundant AC power supply modules, each of them energized by the VSS UPS. This configuration can deliver up to 435W worth of DC power for the provision of PoE (802.3af) and / or PoE+ (802.3at). This results in an average of approx. 18W per RJ45 Ethernet port. If one of the power supply modules fails, then the other one can fully support the connected load to all switch access ports. The switch itself at full processing load will consume a maximum of 87W.

To calculate the PoE budget for the network cameras the following has been considered:

- The manufacturer listed maximal power consumption of the IP CCTV camera XNV-6081Z is 11W for PoE, class-3 as per IEEE 802.3af;
- The manufacturer listed maximal power consumption of IP CCTV camera XNV-6012 is 6.5W for PoE, class-3 as per IEEE 802.3af;

Access port occupation of ethernet switches will be as follows:

- VSS-ESW-001 - 24 ports occupied, 0 spare ports;
- VSS-ESW-002 - 18 ports occupied, 6 spare ports;
- VSS-ESW-003 - 15 ports occupied, 9 spare ports.

In total, there will be 57 access ports occupied and 15 spare ports. Thus, 20% overall access ports spare capacity are provided for the VSS LAN.

No special requirements for Human Factors (HF) have been advised by the TOC-GWR for the VSS workstation or for the operation of the SISS / Telecoms systems. GWR will advise the VSS workstation specifications during the construction stage. Viewing of camera recordings will be password protected and accessed either remotely or locally by GWR, from inside VSS workstation located at Secure office. The remote access for BTP will be arranged by GWR. Accessing of all recordings for view or export will also be possible from the KVM located inside VSS cabinet at Communications Room. The main purpose of the KVM is for maintenance and troubleshooting as there is no desk available within the Communications Room where a PC can be installed.

The proposed model of Hanwha-Techwin IP CCTV cameras support also local internal video recording and storage. This option can be used in the future should the TOC decide that this is necessary. This option has not been taken into account presently.

The table below shows a basic bandwidth calculation for VSS LAN network with following assumptions:

- Single camera video downlink stream size – 2.560 Mbit/s (this is worst case scenario, with 100% of the time motion and day mode);
- VSS Workstation at Ticket Office will have two monitors which will view simultaneously 4 cameras each, i.e. 8 No. additional downlink IP video streams in total;
- The remote VSS Workstation in GWR control centre in Swindon will need 12 simultaneous video streams at a moment of time, i.e. 12 No. of uplink IP streams.

The generic formula for the IP CCTV camera bandwidth calculation is used:

$$\text{Bandwidth (Mbit/s)} = (\text{FrameSize (Kb)}) * 1024 * 8 * \text{FPS} \cdot 10^{-6}$$

VSS node	No of IP video cameras	No of other IP video devices	single camera IP video stream, Mbit/s	downlink bandwidth, Mbit/s	uplink bandwidth, Mbit/s	notes
VSS-CAB-001 (headend)	18	2 (NVR)	2.560	174.08	133.12	50 video streams to NVRs x 2.560 Mbit/s 12 video streams to Swindon x 2.560 Mbit/s 18 video streams from IP cam. x 2.560 Mbit/s 32 video streams from IP cam. x 2.560 Mbit/s (from CAB-002 and CAB-003)
SIS-CAB-002 (access)	18	0	2.560	46.08	46.08	18 Video Streams from IP cam. x 2.560 Mbit/s
VSS-CAB-003 (access)	14	1 (workstation)	2.560	56.32	56.32	8 video streams to VSS WS x 2.560 Mbit/s 14 video streams from IP cam. x 2.560 Mbit/s

Table 9 - VSS LAN bandwidth calculation

4.2.1.7 VSS cameras mounting

All VSS cameras will be mounted at a minimum height of 2.5m Above Finished Floor Level (AFFL). There will be several types of mounting- wall mounted, pole mounted, and surface mounted on ceiling / bulkheads/soffits. Cameras will be mounted with headroom and lateral clearances in accordance with RIS-7700-INS – Rail Industry Standard for Station Infrastructure.

The following will apply to all pole-mounted cameras:

The tilt-down poles will be located at a distance of 3.184m from the platform edge and will be in line with the lighting poles. Refer to civils drawing: 158989-ARP-RG-PL-DR-C-100010 for more details. The tilt-down poles direction of fall will be parallel to the platforms, hence will not affect the safety of the railway and public on platforms.

Dome cameras installed outside RGP station will either be wall mounted (directly or by hanging support) or surface mounted (underneath entrance canopy). The purpose of these cameras is to monitor all Public and Plant entrances to RGP station rather than any private objects, not related to station security.

VSS dome cameras installed inside the station building will be surface mounted and fixed to the suspended ceiling.

All dome cameras will be directly mounted using surface mounting rings and following the installation instructions from the supplier manual. The weatherproof RJ-45 Cat-6 inline coupler will be located inside the surface mounting ring and will provide a suitable Network Test Point (NTP) for maintenance. The connection from the inline coupler to camera RJ45 interface will be via a factory made 5m Cat-6 STP patch cord.

VSS dome cameras at platforms will be surface mounted under the integral canopies and pole mounted at tilt-down SISS/Telecom poles. In an official response to a technical query (TQ), the TOC and RAM has advised that the

lighting poles at platforms shall not be used for VSS camera mounting hence dedicated SISS/Telecoms poles will be deployed across the station.

VSS dome cameras on the footbridge will be surface mounted under the bridge canopies. Bicycle rack VSS dome cameras will be surface mounted, underneath bicycle rack canopies.

VSS dome cameras inside and outside the Station Building will be surface mounted (ceiling) using surface mounting rings and appropriate fixing accessories from the camera manufacturer Hanwha-Techwin. Datasheets are available in Appendix-D. For more details about VSS camera mounting refer drawing: 158989-ARP-RG-PL-DR-Y-002002 in Appendix-A.

Proposed tilt-down poles to be used at Platforms are Altron, AW-4460/3 (4.5m long) - 6 Nos. as shown at figure-25, and Abacus T058 RLH/FL, 2 Nos. as shown at figure-26. Both types of tilt-over poles will be supplied with anti-climb protection for vandalism prevention.



Figure 15 – Altron AW4460/3 4.5m tilt-down SISS /Telecoms pole with anti-climb protection



Figure 16 - Abacus T058 RLH/FL Tilt-Down Pole

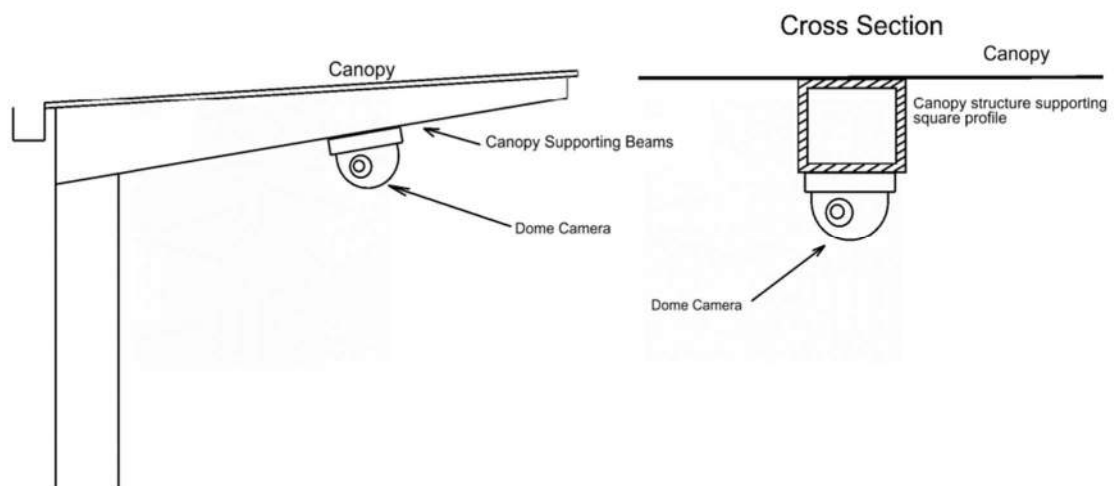
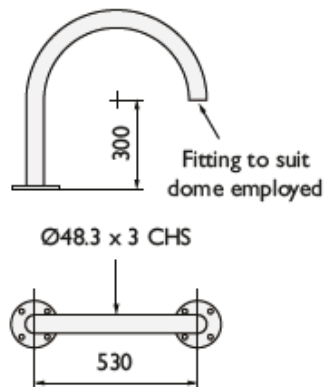


Figure 17 - Canopy mounted VSS dome camera



● **AWI699/F**
Single



AWI699/TF
Twin

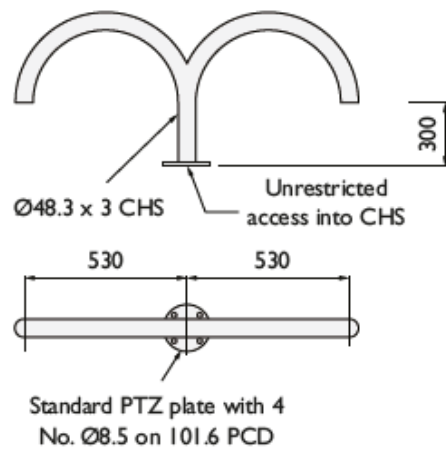


Figure 18 – Installation accessories for surface, wall and pole mounting by Hanwha-Techwin and Altron

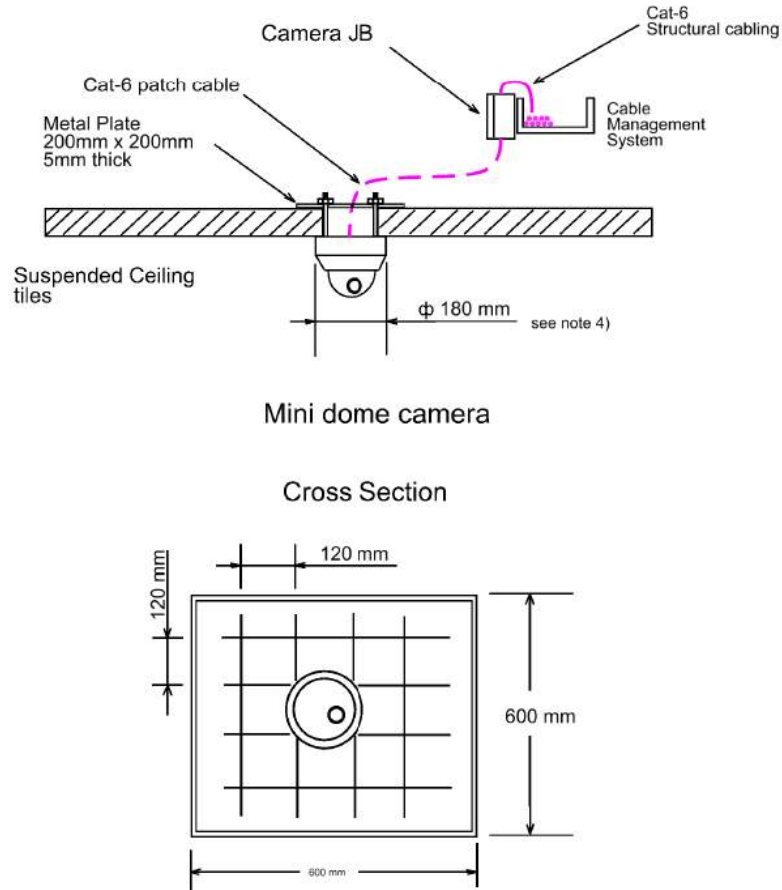


Figure 19 - Ceiling mounted VSS dome cameras

4.2.1.8 VSS system power requirements

The VSS cameras will be connected to the PoE ethernet switch ports, using Cat-6 Shielded Twisted Pair (STP) cable that will provide IP video signal and electrical power for each camera.

The station VSS system will be energized by a local dedicated UPS in order to provide a minimum of 1 hour 230 VAC / 50Hz back-up power supply and will comply with the NR standards NR/GN/TEL/31109- Telecoms back-up power selection guidance and NR/L2/TEL/30025- Standby Power Supply Requirements for Telecommunications Equipment.

AEG Protect C-3000-R, 19" rack mount type UPS is proposed, with 4 no. of external 19" rack mount battery packs. The UPS will be located in the main VSS cabinet VSS-CAB-001 inside the Communications Room underneath platform-1 stairway.

In the event of mains electrical power loss greater than 1hr, the NVR equipment will be capable of receiving an alarm signal from the UPS when a "battery low" event arises, in order to perform a controlled shut down of the NVR and prevent any data loss (stored camera recordings) or RAID array damage. NVRs and Ethernet Switches will be capable of cold restart after electrical power is restored without any necessity of manual intervention. The proposed UPS is capable of automatic shut-down in the event of long-term mains power loss in order to protect the back-up batteries from very high depth of discharge. Upon mains

power supply restoration, the system will start-up automatically and support the load without any manual intervention.



Figure 20 – AEG C-3000R, 19” rack mount UPS with one external battery expansion

Cabinets SIS-CAB-002, located at Platform-2 and VSS-CAB-003, located inside ticket office, will be provided with 230 VAC UPS power from the main VSS cabinet VSS-CAB-001.

UPS size is calculated, taking into consideration the power requirements for the whole VSS system as shown below:

- 3 Nos. 24 ports Full PoE Ethernet Switches (CISCO Catalyst 3650), 640W each (with full PoE load);
- 2 Nos. NVR Samsung XRN6410DB4, 250W each (with 10 Nos HDD fitted).

Thus, total maximal power, 1,420W will be necessary for the VSS headend equipment. The proposed AEG Protect-C-3000 R/S type UPS can provide up to 3,000 kVa (equivalent to 2,100 W) electrical power for 15 min autonomy time with one external battery pack at full load. Hence in order to provide a minimum back-up time of 1hr at full load, 4 (four) external battery units will be supplied and connected to the UPS. The UPS will be version “S”, which includes increased battery charging capacity for charging of external battery packs.

Item	Description	Quantity	Item power consumption (Watts)	Total power consumption (Watts)
WS-C3650-24PS	24 Port PoE Cisco Ethernet Switch with RPS	3	640	1,920
PRN-4011	Samsung 64 IP Video Streams NVR	2	250	500
Total (Watts):				1,420

Table 10 - UPS Load Calculation

The selected UPS is compatible with the Hanwha range of NVRs for automatic controlled shutdown and auto power up upon mains power restore. To enable the controlled shutdown of the NVRs, the UPS in the Communications Room will be equipped with a network adapter card and with CompuWatch shutdown and UPS management software package.

The UPS system is to incorporate controlled shutdown of the NVRs, initiated approx. 15 minutes prior to the UPS system batteries maximum allowed discharge. To provide this shutdown facility, AEG have the CompuWatch software package for installation on a PC.

Required:

- SNMP Pro Adapter;
- CompuWatch software (UPSMAN and RCCMD module);
- Hanwha NVR – PRN-4011P installed with latest firmware*.

*The correct firmware is required on the PRN-4011 which includes the shutdown operation via RCCMD.

The AEG software package consists of an application called UPSMAN which manages the UPS and RCCMD server and is the application used to control the shutdown of client PC's, i.e. XRN-6410DB4. The CompuWatch software is to be installed on the console PC (SSM-02) so that any alarms are indicated within the secure office for staff attention.

Due to the heavy weight of UPS and Back-Up battery units, Rack Rails shall be used. To avoid the hazard of potential injuries from heavy lifting, the UPS and Back-Up Battery units shall be installed at the first bottom positions of VSS headend cabinet.

For more details about connection and initial setup refer Equipment Datasheets and Installation Manual in Appendix-D.

4.2.2 VSS Cabinets

19" standard Telecoms cabinets will be supplied and installed at RGP to house the VSS headend equipment at following locations:

- VSS-CAB-001 – Communications Room under Platform-1 stairway – a 19" standard 39U floor standing telecoms rack;
- VSS-CAB-002 – Store-1 at Platform-2 - a 19" standard 12U wall mounted telecoms rack;
- VSS-CAB-003 – Station Building Plant- wall mounted enclosure, dedicated for the VSS system only.

All 19" cabinets will be supplied with all required cabinet mounting brackets and fixings. Cabinets shall be suitable for indoor installation, with a min. IP45 rating. To restrict the access to the VSS headend and recording equipment to authorised personnel, the access to all the cabinets will be restricted by 221 lock at the doors and tamper switches will be connected to VSS headend equipment to report remotely an alarm when the cabinet door is open. The access doors of Communications room at Platform-1 and Store-1 at Platform-2 shall be fitted with BRW lock (cylinder rim lock or padlock).

The 19" standard racks shall consist of below listed components suitable for the installation of rack-mounted equipment:

- 19" equipment mounting struts- front and back;
- 19" cable management panel (brush type);

- Cabinet earthing kit;
- Door alarm kit (to transmit alarms for the fan tray and cabinet doors to the station CCTV workstation for display of alarm to station staff);
- Glazed front door;
- 3 Nos. 6-way Power Distribution Units (PDU);
- 3 Nos. 24 port FO Patch Panels;
- 3 Nos. 24 port Cat-6 RJ-45 modular Patch Panels.



Figure 21– 19" 12U indoor wall mounted telecoms cabinet



Figure 22 - 19" Rack Top Mount Hot Air Extract Fan unit



Figure 23-19" Rack Base Plinth, 600mm x 600mm



Figure 24 – 19" standard 39U indoor floor standing telecoms cabinet

SIS-CAB-002 will be wall mounted and positioned in a way that there is space greater than 760mm for access at both sides and front of the cabinets for maintenance purposes. The cabinet will be with bottom cable entries, via cable glands. For exact location refer Communications Rooms GA Layout drawing 158989-ARP-RG-PL-DR-Y-002017. For cabinet GA refer drawing: 158989-ARP-RG-PL-DR-Y-000008.

VSS-CAB-003 will consist of Schneider enclosure NSYS3D6630 with dimensions H=600mm, W=600mm, D=300mm and 19" standard 4U equipment mounting frame fitted inside, as shown at figures 28 and 29 below. The enclosure will be with bottom cable entries, via cable glands. For details refer GA Layout drawing: 158989-ARP-RG-BD-DR-Y-000010 in Appendix-A. For cabinet GA refer drawing: 158989-ARP-RG-BD-DR-Y-000013



Figure 25 - Schneider Enclosure NSYS3D6630



StarTech.com

Figure 26 - 4U 19" Vertical Wall Mount Equipment Rack Bracket

The equipment cabinets shall be fit to house and accommodate all required communications system equipment and include additional spare capacity (25%) for further future expansions.

The preferred RAL colour of cabinets will be advised by the TOC prior to purchase and delivery to site. The locations where cabinets will be located will meet the environmental requirement of equipment manufacturers.

For Details about cabinets GA refer drawings: 158989-ARP-RG-PL-DR-Y-000006, 158989-ARP-RG-PL-DR-Y-000009 and 158989-ARP-RG-BD-DR-Y-000013 at Appendix-A.

For Details about VSS connectivity refer drawings: 158989-ARP-RG-ST-DR-Y-000002, 158989-ARP-RG-PL-DR-Y-000031, 158989-ARP-RG-PL-DR-Y-000032 and 158989-ARP-RG-BD-DR-Y-000033 at Appendix-A.

4.2.2.1 VSS interfaces

The VSS cameras will allow remote monitoring remotely at the GWR control centre, located in Swindon.

GWR shall be responsible for the provision of an IT WAN router and connectivity link from the station to the control centre.

The IP addresses for the entire VSS shall be allocated by the GWR. This shall be requested officially by the SISS/Telecoms contractor prior to commissioning stage by email at: cctv@gwr.com , as per GWR.CCTV.CONFIG.CAMERA.IP – CCTV Configuration for HT IP Cameras.

The VSS system shall be configured in accordance with GWR documents in Appendix-H as it is listed in details in section 4.2.1.4.

Any configurations or software upgrades required for telecoms assets at the GWR control centre to enable additional VSS viewing from RGP station i.e. VSS control hardware, software or additional video monitors shall be the responsibility of GWR. Such upgrades and Commissioning tests shall be carried by the VSS system maintenance contractor at the GWR control centre and will comply with the NR directive for process for managing telecoms software/hardware changes - NR/L3/TEL/31104.

RGP VSS will cover only the station and access to the station from all sides. The VSS coverage of RGP car park and Taxi Rank are not subject to this design. In order to avoid any potential gaps between VSS coverage of RGP station and car park / taxi rank, two additional cameras have been added at Station Building, covering the walkway to Taxi Rank, Car Park and Interchange. Reading Borough Council shall ensure that the designer working on the VSS coverage of RGP car park and taxi rank station consider the VSS coverage of RGP station in order to avoid any coverage gap.