

**MOKOLO AND CROCODILE  
WATER AUGMENTATION PROJECT  
PHASE 2 (MCWAP-2)**

**TENDER NO 054/2024/PMID/MCWAP2/RFB**

**PART C3.1  
SPECIFICATION**

**SECTION 44**

**SECURITY – PLANT AND INSTALLATION**

PART C3.1

SPECIFICATION

SECTION 44

SECURITY -

PLANT AND INSTALLATION

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## SECTION 44

### SECURITY PLANT AND INSTALLATION

#### 44.1 SCOPE

This Section shall be read in conjunction with Section 43 – Security General.

It describes the Employer's requirements with regard to the Plant and Installation of the security system.

#### 44.2 DEFINITIONS AND REFERENCES

##### 44.2.1 Definitions and Abbreviations

For definitions refer to Section 43.

The following abbreviations shall have the meanings given:

mA	:	Milliamp
DC	:	Direct Current
EPP/ECP	:	Enhanced Parallel Port
DB	:	Decibel
nm	:	Nano meter
deg/s	:	Degrees per second
SVGA	:	Super Video Graphics Array
AGP	:	Accelerated Graphics Port
ANSI	:	American National Standards Institute
ATM	:	Asynchronous Transfer Mode
BNC	:	Bayonet Neill – Concelman Connector
CAD	:	Computer Aided Design
CCIR (PAL)	:	International Radio Consultative Committee
CCTV	:	Closed Circuit Television
CE	:	Council of Europe
CPU	:	Central Processing Unit
CSIR	:	Council for Scientific and Industrial Research
CST	:	Computer Simulated Technology or Council for Science and Technology
CSV	:	Comma Separated Values
DDE	:	Dynamic Data Exchange
DDR	:	Double Data Rate
DIP	:	Dual Inline Pin
DVD	:	Digital Video Disk
DVR	:	Digital Video Recorder
DWA	:	Department of Water Affairs
DVI	:	Digital Visual Interface

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EPROM	:	Erasable Programmable Read Only Memory
LAN	:	Local Area Network
FEP	:	Front End Processor
FSB	:	Front Side Bus
GPRS	:	General Packet Radio Service
GSM	:	Global System for Mobile Communications
GUI	:	Graphical User Interface
Hz	:	Hertz
ICASA	:	Independent Communications Authority of South Africa
IP	:	Internet Protocol
ISO	:	International Organization for Standardization
LED	:	Light Emitting Diode
MAC	:	Machine Access Code
MBPS	:	Mega bits per second
OLE	:	Object Linking and Embedding
PPP	:	Point to Point Protocol
PLC	:	Programmable Logic Controller
PCI	:	Peripheral Component Interconnect
PIR	:	Passive Infra Red detectors
PTZ	:	Pan Tilt and Zoom
RAM	:	Random Access Memory
RJ	:	Registered Jack
ROM	:	Read Only Memory
SANS	:	South African National Standards
SDRAM	:	Synchronous Dynamic Random Access Memory
SIRA	:	Private Security Authority
SMS	:	Short Message Service
SP	:	Service Pack
SQL	:	Structured Query Language
SVGA	:	Super Video Graphics Array
TCP/IP	:	Transmission Control Protocol / Internet Protocol
UPS	:	Uninterruptible Power Supply
USB	:	Universal Serial Bus
V	:	Volt
VDU	:	Visual Display Unit
WAN	:	Wide Area Network

#### 44.2.2 References

When reference is made to a Code of Practice, Specification or Standard, the reference shall be taken to mean the latest edition or replacement at time of tender of the Code, Specification or Standard; including addenda, supplements, modifications and revisions thereto. Where a previous version is intentionally used, it will be indicated as such. Where reference is made to a Code, Specification or Standard that has subsequently been withdrawn and not replaced, the intended content will remain relevant unless confirmed otherwise in writing by the Engineer.

## 44.3 ACCESS CONTROL SYSTEM

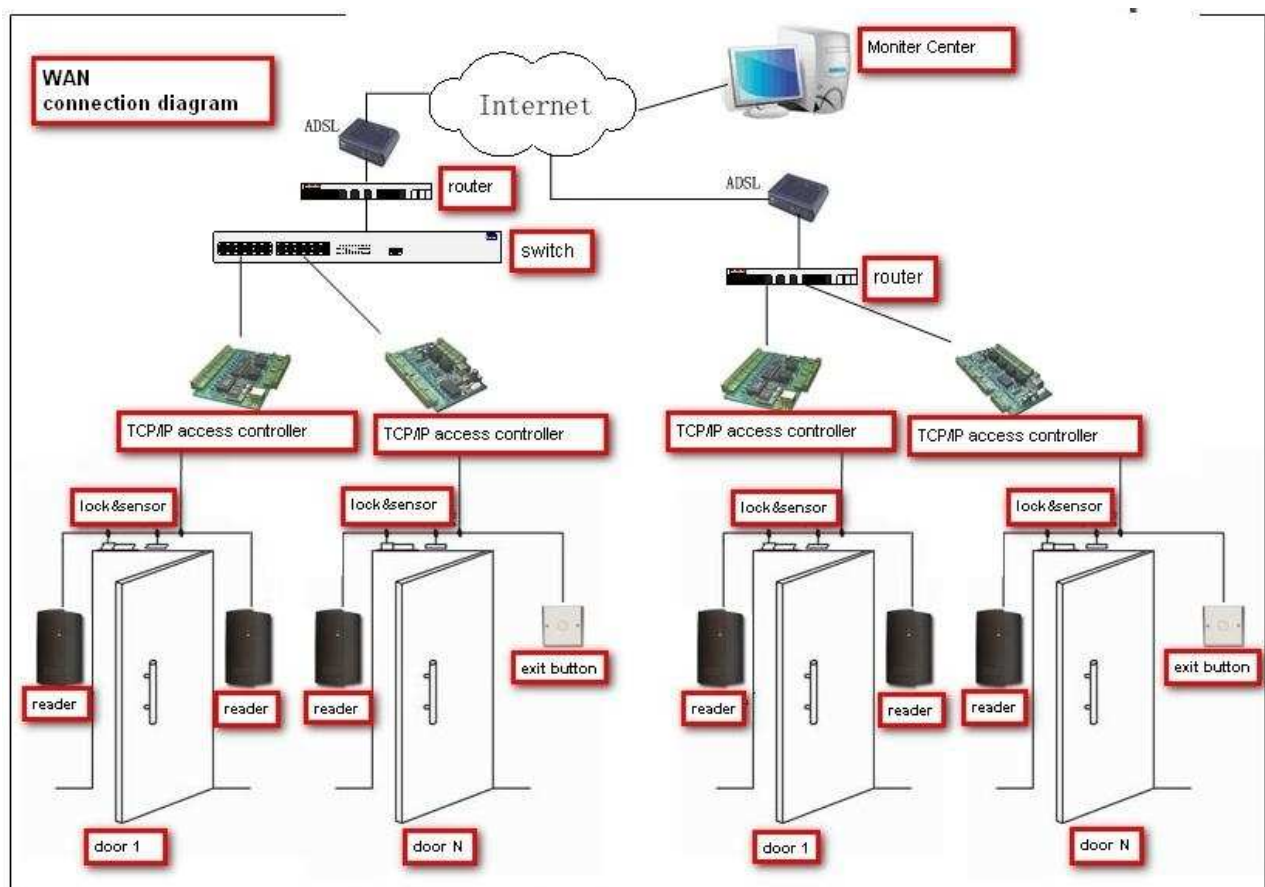
### 44.3.1 General

The requirements are for a biometric system that utilises fingerprint scanners that combine industry leading multispectral imaging sensors with advanced security features. The biometric readers shall have a high-performance multispectral imaging (MSI) sensor. The biometric readers shall be able to read data from both the surface and subsurface levels of a fingerprint. This will ensure fingerprint can be read even when features are hard to distinguish due to factors such as dirt, moisture and damage.

The biometric readers shall have advanced encryption for data transmission. The biometric readers shall be highly accurate, and the processor shall produce a quality image to reliably allow the matching of up to 50,000 (10,000 as standard) fingerprint templates. The biometric reader unit itself shall not store any user data, thus providing an additional level of protection.

The biometric readers shall have an IP65 rating with built-in environmental controls for harsh weather conditions. The biometric readers shall support proximity detection. The biometric readers shall have clear LED and audio indications.

### 44.3.2 Access Control Typical System Hardware Layout



**44.3.3 Biometric Access Card Readers**

There shall be two types of biometric access card readers. The one shall be for outdoor and the other one for indoor.

The outdoor type biometric card readers shall be of a rugged design and shall be vandal proof, and as defined in the following specifications:

- a) SSL on TCP/IP network;
- b) Cryptographic key management;
- c) Secure screws with anti-theft, anti-tamper switches;
- d) International certifications like PIV-IQS, FIPS 201;
- e) Compliant with international standards CE, UL;
- f) Power over Ethernet capable;
- g) Multi-factor authentication ability;
- h) Supply Voltage DC 12V or 24V;
- i) Sensor Optical Sensor;
- j) LED Display 3-Colour LED;
- k) Smart Card enabled;
- l) Log Capacity 10,000;
- m) Communication Protocols Bluetooth, RS485, Wiegand out;
- n) IP65 rated for harsh environmental deployment;
- o) Multispectral imaging sensor;
- p) Data transmission AES (128 bit) encryption;
- q) LED and audio indications;
- r) Anti-tamper and vandal resistant;
- s) Seamless integration with large number of existing access control systems;
- t) Built in environmental controls;
- u) Heater and humidity sensor; and
- v) Spoof detection functionality.

The indoor type of biometric access card readers shall be as defined in the following specifications:

- a) Supply Voltage DC 12 V or 24 V;
- b) Sensor Optical Sensor;
- c) LED Display 3-Colour LED;
- d) Smart Card enabled;
- e) Log Capacity 5,000;
- f) Communication Protocols Bluetooth, RS485, Wiegand out;
- g) International certifications like IP 53;
- h) Compliant with international standards CE, UL;
- i) Secure screws with anti-theft, anti-tamper switches; and
- j) Option of Multi-factor authentication.

#### **44.3.4 Power Supply for Access Control Plant**

All Plant offered shall be equipped to operate from 230 VAC.

The Contractor shall ensure that Plant / cards installed can work from the existing supply of 230 VAC. For Plant that operates at a lower voltage and current, the Contractor shall ensure that he provides the step-down circuitry for this.

The power supplies used for the Access Control Plant shall be fitted with lightning and surge protection that can be easily accessible for maintenance purposes.

All 230 V power points shall be supplied by the Contractor within a metre of final camera positions. Power points shall be enclosed inside mast poles, with weather-proof and vandal resistant covers.

#### **44.4 SECURITY GENERAL REQUIREMENTS**

All software packages shall be 100% locally supported and shall be suitable for the system installed.

It shall not be possible for the operator of any station to accidentally or intentionally destroy the database by entering faulty or erroneous instructions or messages.

The software shall be fully supported by easily understandable user manuals and documentation.

The Contractor shall be responsible for the provision of all security scan software, including all software required to provide a complete, operational data acquisition and recording and control system.

##### **44.4.1 UPS Requirements**

On-line Un-interruptible Power Supply (UPS) systems with a standby capacity of at least 2 hours each shall also be required.

The UPS systems shall provide power to all the security electronic Plant.

A bypass switch shall be provided on the UPS in case of failure to the UPS. The security Plant shall then be fed directly from the main 230 V supply.

Batteries used in UPS systems shall be of the high-quality maintenance free, sealed cells with life expectancy of a minimum five (5) years. The use of automotive type storage batteries will not be accepted. The chargers shall be suitable for float / boost charging to the requirements of the batteries' manufacturer to ensure minimum maintenance and an extended working life.

The following minimum specification shall apply to the UPS systems:

- a) Input voltage 230 VAC  $\pm$  20%, 50  $\pm$  3 Hz;
- b) Output voltage 230 VAC  $\pm$  3%, 50  $\pm$  0.5 Hz;
- c) Harmonic distortion better than 5%;
- d) Power rating not less than 130% of maximum Monitoring Station requirements;
- e) Load regulation: - transient condition :  $\pm$  10% after 100 ms :  $\pm$  3%;
- f) Output overshoot (cold start, full load) < 17%;



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- g) Charger output voltage - adjustable between 2.20 - 2.45 Volts per cell (pre-set to the requirements of the batteries manufacturer);
- h) Inverter surge capacity: 200% rated output for 1 second; and
- i) Audible noise < 40 dBA (one metre from unit).

**44.4.2 Lightning and Surge Protection**

The connection between the mains supply and Plant shall be equipped with adequate surge protection to prevent damage to the Plant caused by switching transients and static discharges.

The following shall be a minimum requirement:

- Fine protection: type VM 280 Dehn blitsductor or similar.

Coarse protection should already be provided by the Isolation Transformer inside the UPS.

**44.4.3 UPS Plant Housing**

An approved type of battery cabinet shall be supplied if this is not housed inside the UPS cabinet.

The UPS cabinet and battery cabinet shall be identical in size, colour and design.

The UPS cabinet, together with the battery cabinet, shall be supplied complete with an appropriately designed stand which will be 200 mm in height. This means that the UPS cabinet and battery cabinet shall be 200 mm off the floor.

All details for cabinets, stands and tables are to be accepted at Tender stage.

**44.4.4 Installation**

The Contractor shall ensure that the quality of the electronic Plant and the installation thereof is of the highest quality, suitable for the environment in which it is installed.

Wires (signal and power), cables and connectors shall not be visible in their installed positions; neither shall they be accessible to unauthorised persons. All cables shall be installed in galvanized conduit, split trunking systems or below raised flooring for security reasons.

The Contractor shall supply such benches and brackets to ensure that all viewing screens and peripherals are easily accessible to the operator.

**44.5 SURGE PROTECTION**

The Contractor shall make provision for and install surge protection Plant on all system input / output circuits, power supply input (dc, mains) circuits, and for the installation of the necessary earth mats and earth connections.

**The following Plant shall be included as an absolute minimum required:**

On all analogue / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings.

On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent.

On all telephone lines - Telkom-approved protection network, containing gas arrestors, inductance's, transorb type arrestors and 600 ohm / 600 ohm isolating transformers. Loop and ringing current circuits shall be optically isolated.

The Engineer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative Plant.

The Contractor shall implement additional measures deemed necessary to achieve the required protection level on all connections between the main supply and Plant.

## **44.6 INSTALLATION AND SPARES**

Each security installation shall be installed complete with all cabling, accessories and Plant required providing a functional and fully operational installation as per the layouts and as specified.

The Contractor shall ensure that the quality of the outstation Plant and the installation thereof is of the highest quality suitable for the environment in which it is installed.

Wires (signal and power), cables and connectors shall not be visible in their installed positions neither shall they be accessible to unauthorized persons. All cables shall be installed in bosal conduit or behind concrete walls for security reasons. Cabling between the camera and the power supply shall be protected.

The Contractor shall supply and install any other test equipment and instruments that, in his opinion, shall be required by maintenance personnel, to keep the Security and Control System in a fully operational status.

All interfacing and linking cables to perform the required maintenance shall be supplied by the Contractor.

## **44.7 CCTV SYSTEM**

### **44.7.1 General Requirements**

Video surveillance has to deliver images with a minimum resolution of 960 lines per image per camera in order to guarantee that persons and objects can be identified properly in the live images.

The camera images need to be recorded with at least 960 image lines in order to guarantee that persons and objects can be identified properly in the stored images. The system has to allow for simultaneous display and storage of the live images as well as the display of the stored images and video sequences without the risk of losing data.

The system needs to be able to record at least 20 smooth video streams simultaneously on one standard computer. The recorded video streams need to contain at least 10 images per second. If reducing costs is a requirement, the system should not require additional power lines for the camera's power supply. Instead, power should be supplied via the network cabling (e.g. Power-over-Ethernet). The system needs to be able to operate in outdoor applications at temperatures between -30° to + 60°C (-22°F to 140°F) without any additional heating in the surveillance cameras. This will reduce power consumption to a minimum, thus providing for cost-efficient protection of the whole system using uninterruptible power supplies.

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The cameras should not have to rely on any moving parts such as auto iris, mechanical filters, motors, fans or similar. This ensures that the complete system is highly reliable and maintenance-free. The surveillance cameras need to be able to bridge at least a one-minute failure of the data connection or the storage device without losing any storage data, images or video sequences. The surveillance cameras need to be able to output voice messages and to react to sounds in the camera perimeter and to trigger alarms accordingly. The system needs to play back and store the audio signals in a lip-synchronous manner.

The cameras need to employ wide-angle lenses with an image angle of 90 degrees or more so that the monitored areas are covered as efficiently as possible. The housing and the materials have to be chosen in such a way that the cameras have a life expectancy of at least fifteen years.

Reliable and complete protection of end-to-end video security systems is a requirement. An intelligent video system is required. Some requirements are:

- a) The password can only be reset on server;
- b) Extra-long password characters required;
- c) Display of password quality level;
- d) The web server recognizes and blocks the execution of external scripts;
- e) Protection against malicious attacks by hackers;
- f) The scanning of network addresses is prevented by individually assigning port numbers;
- g) Cameras allow access only to defined IP addresses;
- h) 128-bit data encryption;
- i) Camera firmware for prevention of malware;
- j) Camera access logged on the web server; and
- k) Free firmware updates.

#### **44.7.2 Video Management System**

A Video Management, System (VMS) shall have tools for both video analysis and device control capabilities. The VMS shall be state of the art, powerful, and intuitive. The VMS shall conform to the ONVIF industry standard. This ensures that all vendor types can be supported.

#### **44.7.3 Camera Types**

- (a) Bullet camera – range 30 m (Lens size between 3 mm to 9 mm)**



Shall conform to the following specifications:

- a) Motorized Vari-Focal Lens with Auto Focus;
- b) Auto-iris function;
- c) Remote zoom and focus functionality;
- d) Additional power support (PoE/DC12 V/AC24 V);

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- e) Integrated IR LED's (distance up to 30 m);
- f) Minimum IP protection level of IP66 and IK10;
- g) Max temperature range of 65°C;
- h) CMOS sensor support with 4 MP Resolution;
- i) Multiple Codec types like H.264, MJPEG, etc.;
- j) Low latency streaming;
- k) True day / night functionality;
- l) Noise reduction; and
- m) MicroSD (SDHC/SDXC) card slot.

**(b) Bullet camera – range 40 m (Lens size between 9 mm to 22 mm)**



Shall conform to the following specifications:

- a) Motorized zoom lens with Auto Focus;
- b) Auto-iris function;
- c) Remote zoom and focus functionality;
- d) Additional power support (PoE/DC12 V/AC24 V);
- e) Integrated IR LED's (distance up to 40 m);
- f) Minimum IP protection level of IP66 and IK10;
- g) Max temperature range of 60°C;
- h) CMOS sensor support with 4MP Resolution;
- i) Multiple Codec types like H.264, MJPEG, etc.;
- j) Low latency streaming;
- k) True day / night functionality;
- l) Noise reduction; and
- m) MicroSD (SDHC/SDXC) card slot.

**(c) Digital camera - Outdoor dome type**



Shall conform to the following specifications:

- a) High-performance dual lens type with two flexible adjustable sensor modules;
- b) Switchable between day and night (6 MP color or B/W Sensor);
- c) Interchangeable w.r.t lens type (e.g. 180° panoramic lens type @12 MP, 180° fisheye lens type, 8° super telescope lens type, etc.);

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- d) Energy efficient - power consumption < 7 W using PoE;
- e) Low maintenance and weatherproof IP66 rated;
- f) Operate between -30 and +60°C;
- g) Image sensor with individual exposure zones;
- h) Internal DVR – minimum 4 GB (microSD);
- i) Microphone / speaker, passive infrared sensor (PIR) and temperature sensor;
- j) Shock detector (for detection of tampering);
- k) Ethernet interface - Ethernet 100BaseT;
- l) Wall, ceiling and pole mountable;
- m) MTBF greater than 80,000 hours;
- n) Conform to the protocols: IPv4, IPv6, HTTP, HTTPS, FTP, RTP, UDP, SNMP, SMTP, DHCP (client and server), NTP (client and server), SIP (client and server) G.711 (PCMA and PCMU) and G.722;
- o) Conform to the following video codecs: MxPEG, MJPEG MxPEG, MJPEG MxPEG, MJPEG;
- p) Digital zoom and pan functionality;
- q) Snapshot recording functionality (pre / post-alarm images);
- r) Record with audio functionality;
- s) Programmable for weekly schedules of recordings and actions;
- t) Event video and image transfer via FTP and email functionality; and
- u) Master / Slave functionality.

**(d) Digital camera – Indoor vandal proof type**



Shall conform to the following specifications:

- a) Completely protected and professionally fitted;
- b) Varying options w.r.t lens types (e.g. fields of view between 15° and 103°) available in both 6 MP day sensor and 6MP night sensor types;
- c) Integrated microphone and speaker;
- d) Vandal proof for increased camera protection - stainless steel frame and reinforced dome;
- e) Multiple inputs and outputs (MIMO);
- f) Internal DVR with MicroSD card (4 GB minimum);
- g) Option of installation in ceiling or on wall, adjustable lens tilt angle of between 0° and 90°;
- h) Additional manipulation protection;
- i) Video analysis tools as standard;
- j) Integrated vibration and temperature sensors;
- k) IP rating of IP20, temperature range between 0 and 40°C;

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- l) Image sensor with individual exposure zones;
- m) MTBF greater than 80,000 hours;
- n) Conform to the following certifications: EN55032:2012; EN55022:2010; EN55024:2010; EN50121-4:2015; EN61000-6-1:2007; EN 61000-6-2:2005 EN61000-6-3:2007+A1:2011; EN61000-6-4:2007 +A1:2011; AS/NZS CISPR22:2009+A1:2010; EN55032:2012;
- o) Conform to the following protocols: IPv4, IPv6, HTTP, HTTPS, FTP, FTPS, RTP, RTSP, UDP, SNMP, SMTP, DHCP (client and server), NTP (client and server), SIP (client and server) G.711 (PCMA and PCMU) and G.722;
- p) Conform to the following video codecs: MxPEG/MJPEG/H.264, MxPEG/MJPEG/H.264, MxPEG/MJPEG/H.264;
- q) Conform to the following image formats: format 4:3, 8:3, 16:9, format 2592 x 1944 (5MP), format 2048 x 1536 (QXGA), format 1920 x 1080 (Full-HD), format 1280 x 960 (MEGA);
- r) Multi-streaming, multicast streaming via RSTP;
- s) Continuous recording with audio functionality, snapshot recording functionality (pre / post-alarm images);
- t) Programmable for weekly schedules of recordings and actions;
- u) Event video and image transfer via FTP and email functionality;
- v) Master / Slave functionality;
- w) Customized voice messages;
- x) Analytics that show heatmaps, counting corridors, etc.;
- y) Video management software; and
- z) Mobile App function.

**(e) Digital camera - Vandal proof outdoor type**



Shall conform to the following specifications:

- a) Robust in design and fitment and able to withstand toughest attack;
- b) Housing made from stainless high-grade steel, thickness between 3 to 5 mm;
- c) Completely protected and professionally fitted;
- d) Varying options w.r.t lens types (e.g. fields of view between 15° and 103°) available in both 6 MP day sensor and 6 MP night sensor types;
- e) Integrated microphone and speaker;
- f) Vandal proof for increased camera protection - stainless steel frame and reinforced dome;
- g) Multiple inputs and outputs (MIMO);
- h) DVR - Record on an internal MicroSD card (4 GB minimum);
- i) Option of installation in ceiling or on wall and adjustable lens tilt angle of between 0° and 90°;
- j) Additional manipulation / tampering protection and video analysis tools as standard;
- k) Integrated vibration and temperature sensors, IP20 rated and operate between temperature range -40°C to +60°C;
- l) Image sensor with individual exposure zones and MTBF greater than 80,000 hours;

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- m) Conform to the following certifications: EN55032:2012; EN55022:2010; EN55024:2010; EN50121-4:2015; EN61000-6-1:2007; EN 61000-6-2:2005 EN61000-6-3:2007+A1:2011; EN61000-6-4:2007 +A1:2011; AS/NZS CISPR22:2009+A1:2010; EN55032:2012;
- n) Conform to the following protocols: IPv4, IPv6, HTTP, HTTPS, FTP, FTPS, RTP, RTSP, UDP, SNMP, SMTP, DHCP (client and server), NTP (client and server), SIP (client and server) G.711 (PCMA and PCMU) and G.722;
- o) Conform to the following video codecs: MxPEG/MJPEG/H.264, MxPEG/MJPEG/H.264, MxPEG/MJPEG/H.264;
- p) Conform to the following image formats: format 4:3, 8:3, 16:9, format 2592 x 1944 (5 MP), format 2048 x 1536 (QXGA), format 1920 x 1080 (Full-HD), format 1280 x 960 (MEGA);
- q) Multi-streaming and multicast streaming via RSTP;
- r) Continuous recording with audio functionality and snapshot recording functionality (pre / post-alarm images);
- s) Night video motion detection, programmable for weekly schedules of recordings and actions;
- t) Event video and image transfer via FTP and email functionality;
- u) Master / Slave functionality, customized voice messages;
- v) Analytics that show heatmaps, counting corridors, etc. and video management software;
- w) Programmable from a mobile App function;
- x) Pre-alarm and post-alarm images, failure reporting for camera and data security;
- y) User and group management, IP-based access control, digital image signature; and
- z) Programmable exposure zones, digital zoom and pan functionality.

**(f) Digital cameras - Thermal type cameras**



Thermal imaging cameras measure the heat signatures of organic and inorganic material. They are used to detect excessive heat / cold signatures which can lead to damage to person and/or property. These cameras shall be used to trigger an event based on the temperature increasing above or decreasing below an individually set trigger level. When these trigger levels are activated, then a signal shall be generated through a camera alarm, network message, activation of a signal output etc.

Thermal imaging technology is a contactless imaging procedure that makes it possible to see the thermal radiation from an object or body otherwise invisible to the human eye (mid-wavelength infrared). Thermal radiation is electromagnetic radiation emitted by a body based on its temperature. It is caused by thermal motion within a body's molecules. This is the result of accelerated charges that emit radiation in accordance with the laws of electrodynamics. Thermal imaging technology captures and displays temperature distribution across surfaces and objects. Thermographic cameras usually display heat intensity information in artificial colours (blue for cooler, red for warmer). In terms of the number of pixels, the resolution is considerably lower than that for cameras capturing the visible spectral range.

Unlike cameras with optical image sensors, one of the decisive quality criteria for a thermal camera is the camera's ability to capture the slightest differences in temperature and to produce an image

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that displays these differences in colours. The NETD, or Noise Equivalent Temperature Difference, is used to measure the sensitivity of a thermal sensor and is expressed in millikelvin.

The detected thermal profile of a thermal camera shows no identifiable details for identification of persons and can therefore guarantee privacy. When an object is moving into the relevant surveillance area, the camera can automatically switch from thermal sensor to the optical sensor, producing visible high-resolution video. The camera combines two aspects, respecting the privacy aspect and at the same time optimal video surveillance.

Multiple different temperature triggers can be defined at the same time within the Thermal Radiometry windows. Additionally, the whole sensor image can be used over a typical temperature range of between -40 to +550 °C. In this way critical situations can be analysed in the control room in order to plan the next steps for effective fire prevention. Critical assets like emergency generators, wind turbines or radio stations can be cost-effectively maintained and tested remotely.

Shall conform to the following specifications:

- a) Operate in total darkness;
- b) Intelligent video system with powerful analytics;
- c) High-performance thermal imaging sensor;
- d) Thermal overlay functionality;
- e) Thermal and optical analytics to pinpoint exact location of hotspots;
- f) Thermal image sensor shall be calibrated;
- g) Varying thermal field of views (45°, 25° or 17°);
- h) Option for additional image sensor modules;
- i) DVR recording on an internal MicroSD card (4GB minimum);
- j) Power consumption of < 10 W PoE and temperature operating range: -40 to +60°C;
- k) Microphone or speaker functionality and passive infrared sensor (PIR);
- l) Temperature sensor, Shock detector (tamper detection);
- m) Interfaces Ethernet 100BaseT, USB, RJ45, RS232 and mounting options for wall, pole or ceiling;
- n) MTBF greater than 80,000 hours;
- o) Conform to certifications: EN55032:2012; EN55022:2010; EN55024:2010; EN61000-6-1:2007; EN 61000-6-2:2005 EN61000-6-3:2007+A1:2011 EN61000-6-4:2007+A1:2011 AS/NZS; CISPR22:2009+A1:2010; CFR47 FCC part15B;
- p) Conform to Protocols: IPv4, IPv6, HTTP, HTTPS, FTP, FTPS, RTP, RTSP, UDP, SNMP, SMTP, DHCP (client and server), NTP (client and server), SIP (client and server) G.711 (PCMA and PCMU) and G.722;
- q) Conform to video codecs: MxPEG/MJPEG/H.264;
- r) Conform to image formats: 4:3, 8:3, 16:9, 2592 x 1944 (5 MP), 2048 x 1536 (QXGA), 1920 x 1080 (Full-HD), 1280 x 960 (MEGA);
- s) Multi-streaming and Multicast streaming via RTSP;
- t) Digital pan and zoom functionality and programmable exposure zones;
- u) Snapshot recording, event recording with audio and continuous recording with audio;
- v) Event video and image transfer via FTP and email with Master / Slave functionality;



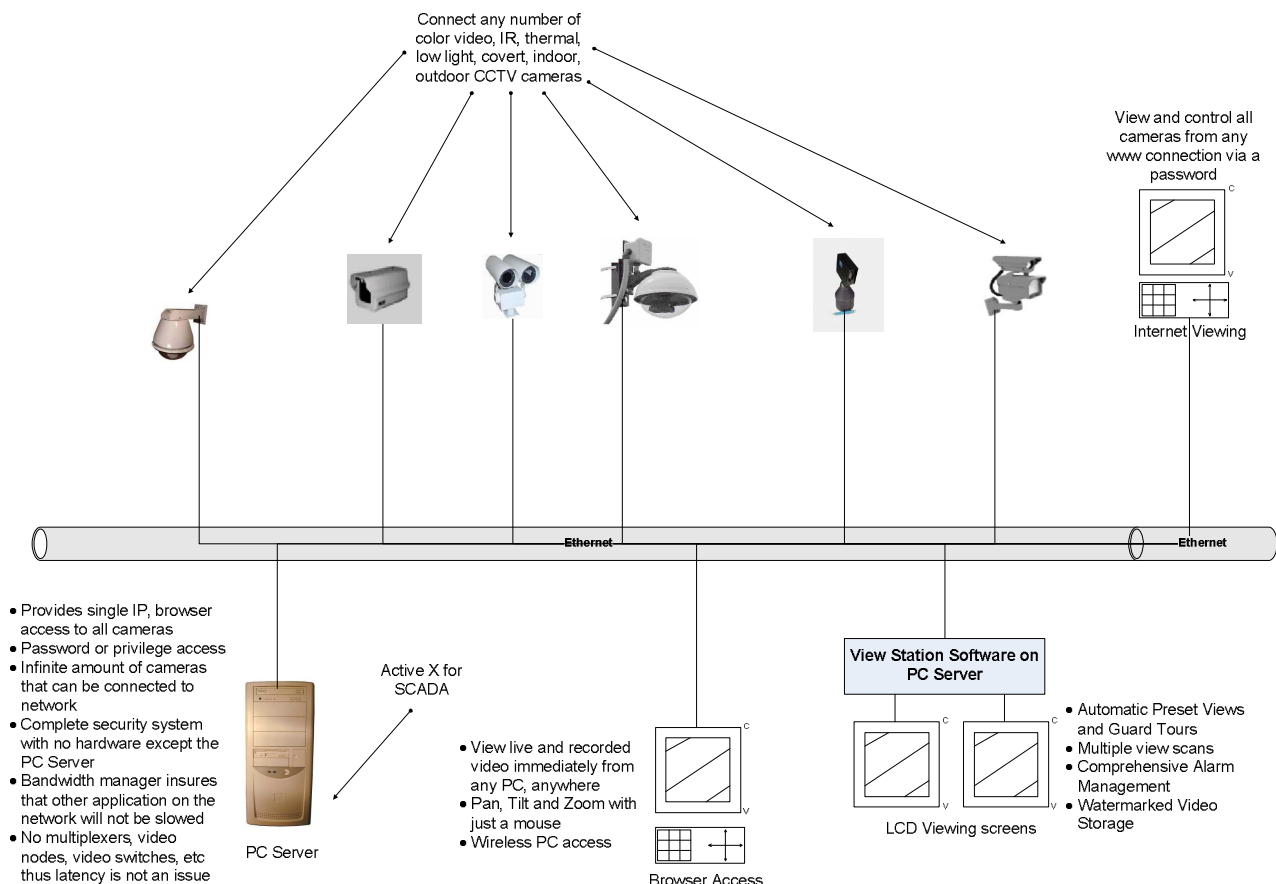
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- w) IP-based access control functionality and digital image signature;
- x) Video Analysis M16B Day M16B Night M16B Day; and
- y) Night Video motion detector.



#### 44.7.4 CCTV System General Layout

Below is a typical layout diagram of an IP based CCTV network:



**FIGURE 44/1: LAYOUT DIAGRAM OF A TYPICAL IP-BASED CCTV NETWORK**

Below is a diagram of a conventional CCTV layout using Video Switches, Multiplexers, etc.

##### 44.7.4.1 Communication General

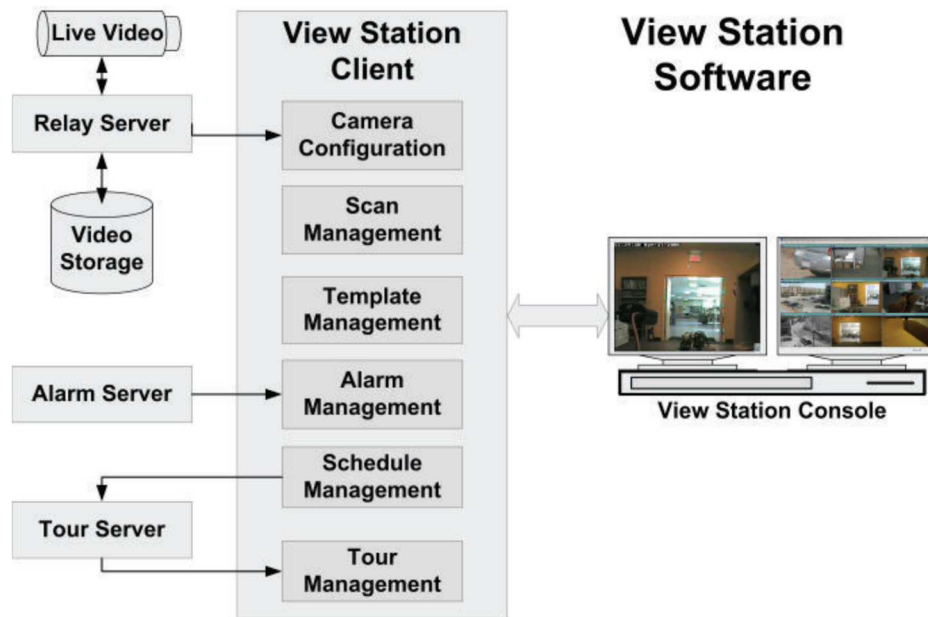
Cameras shall communicate via appropriate gateway, electrical receiver / transmitters and copper-to-fibre converters.

All images shall be communicated via high speed, weatherproof optical fibre cables.

## PART C3.1 - SPECIFICATION

All cameras shall either have an IP address that can be addressed using DIP or rotary switches on the back of the camera or via software.

The flow of data communication shall be as is displayed in Figure 44/2.



**FIGURE 44/2: FLOW OF DATA COMMUNICATION**

Figure 44/2 above shows a typical layout of how the data interchange shall be dealt with in the CCTV system. The CCTV server shall have a full duplex communication channel to both the IP based cameras and to the video storage area on the server.

The CCTV server shall have a simplex communication channel to the view station client software installed on any chosen computer. The view station client software allows for different camera configurations, scan times management, template management, and alarm management, schedule management and tour management.

The view station client software shall receive alarms from the alarm server. The view station console shall view the CCTV footage and extract recorded video footage on demand when requested.

There shall be no license fees required for browser-based video viewers and there shall be no limit to the number of viewers that can access the network when ample bandwidth is available.

It shall be possible to view and control any of the cameras by entering the IP address for applicable relay server and then selecting the desired camera from a list.

No special software or license shall be required at the view station. The video footage shall be viewed and controlled using only a browser on the PC. No proprietary software shall be allowed. Access shall be restricted through the use of Passwords or by User Authentication.

Access to video and camera control shall be achieved from anywhere on the LAN network.

#### **44.7.4.2 Housing of Outdoor CCTV Cameras**

The Contractor shall supply Plant that fits neatly and professionally into enclosures.

PART C3.1 - SPECIFICATION

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All cable (fibre optic / dc power, etc.) entries to enclosures shall be via suitable cable glands or enclosure - mount connectors, etc., and emphasis shall be placed on installing all wiring inside enclosures neatly and professionally.

Enclosures shall be rated IP 66 or better. The cable glands and connections shall not void the specific IP rating of the Enclosure of IP 66 or better.

Enclosures shall protect the camera Plant from heat, dust, moisture, rain, hail, frost and strong winds, by consisting of a heat sink type of shape to ensure that camera Plant will not fail due to extensive heat.

The Enclosure for the power supply and signal cable shall be separate from the camera Plant.

Where pole mounted cameras are specified, enclosures shall be mounted on the support poles in such a way that they are out of reach of intruders at a height of 4 metres above the ground.

#### **44.7.4.3 Ancillary Plant**

Cameras shall be complete and operational including all interconnections required between the Network Video Recorder (NVR) Plant and the power supply Plant.

#### **44.7.4.4 Surge Protection**

The Contractor shall take all necessary steps to protect the Camera Plant against surge (lightning) damage.

#### **44.7.4.5 Power Supply for CCTV Plant**

All Plant offered shall be equipped to operate from 230 VAC.

The Contractor shall ensure that Plant / cards installed can work from the existing supply of 230 VAC. For Plant that operates at a lower voltage and current, the Contractor shall ensure that he provides the step-down circuitry for this.

The power supplies used for the CCTV Plant shall be fitted with lightning and surge protection that can be easily accessible for maintenance purposes.

Where cameras are to be pole mounted, all 230 V power points shall be supplied by the Contractor within a metre of final camera positions. Power points shall be enclosed inside mast poles, with weatherproof and vandal resistant covers.

### **44.8 SECURITY STANDARD**

Any service provider rendering a security service to the Department must be screened.

In terms of the Private Security Regulatory Act, Act no 56 of 2001, security service providers are required to be registered with the regulatory authority, in this instance the Private Security Regulatory Authority (SIRA).

All software packages shall be 100% locally supported and shall be fully equipped for this purpose.

PART C3.1 - SPECIFICATION

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It shall not be possible for the operator of any station to accidentally or intentionally destroy the database by entering faulty or erroneous instructions or messages.

The software shall be fully supplemented by easily understandable user manuals and documentation.

The C&I contractor shall be responsible for the provision of all security scan software, including all software required to make up a complete, operational data acquisition and control system.

#### **44.9 OPTICAL FIBRE COMMUNICATION CABLE**

The same single mode fibre optic cable shall be used for both SCADA and security data communication between sites. Dedicated fibres shall be made available for security Local Area Networks (LAN's). Refer to Section 40 - Control and Instrumentation General.

The LAN's at each site shall utilize 50  $\mu$ m / 850 nm multimode fibre optic cable to connect the cameras to the CCTV network switch via an optic fibre patch panel. Multimode fibre optic is used for distances under 2 km. For shorter distances under 100 m, Cat5e / Cat6 Ethernet Twisted Pair cable can be used provide the following is done:

- a) The type of Cat5e / Cat6 Ethernet cable selected shall be of the overall screened and individually insulated type;
- b) The Cat5e / Cat6 Ethernet cable shall not be placed in cable trays where electrical cables are running. The minimum allowable distance between Cat5e / Cat6 Ethernet cabling and electrical cables shall be 300 mm for parallel runs; and
- c) All crossings between Cat5e / Cat6 Ethernet cabling and electrical cabling shall be at 90 degrees with a minimum of 300 mm distance at the crossing point.

##### **44.9.1.1 Transmission Standards for Ethernet**

Both Fast Ethernet (100Base-SX/ZX) and Gigabit Ethernet (1000Base-SX/ZX) over single mode fibre and multimode fibre shall be utilized.

##### **44.9.1.2 CCTV Multimode Optic Fibre Technical Design Requirements**

The design of the CCTV multimode Fibre Optic network shall include, amongst others the following minimum design requirements:

- a) Detailed optical power budget calculations;
- b) Transceiver SFP details;
- c) Fibre link lengths;
- d) dB losses per each patch cord / lead used;
- e) Any Mid-couplers used;
- f) Type of Patch panels installed (8-way, 16-way, etc.);
- g) Type of connectors used (LC, ST, etc.); and
- h) Number of splicing joints made.

The design of the CCTV multimode Fibre Optic network shall conform, amongst other international standards to the following international standard: ITU-T G.651.1 specification. No splicing of Fibre

## PART C3.1 - SPECIFICATION

Optic cable joints shall be allowed, except for termination of the CCTV Fibre Optic cables in the patch panels at all the respective sites. The design shall include, amongst others the technical details specified below.

Type of SFP transceivers selected - Shall include the following design details:

- a) Optical Power Budget (PB);
- b) Minimum Optical Power transmission values (dBm); and
- c) Minimum Receiver sensitivity values (dBm).

The dB Losses as per design – Shall include the dB losses of the following:

- a) dB losses from connectors;
- b) dB losses from patch cords;
- c) dB losses from patch panels;
- d) dB losses from mid-couplers;
- e) dB losses from pig-tails; and
- f) dB loss/km for each specific Fibre Optic link (@ 850 nm wavelength).

#### **44.9.1.3 Express / Emergency Joints**

Each CCTV Fibre Optic link shall be installed without the need for any splicing joints in-between sites. Only splicing at the patch panels on either side (between camera and patch panel) is expected. Express or Emergency splicing joints shall only be allowed when a Fibre Optic cable has been damaged and needs to be temporarily repaired to restore service.

Before commencing with any such endeavours, the Contractor shall firstly request permission from the Engineer if the need to make an Express or Emergency splicing joint arises. The Engineer reserves the right to decline such a request from the Contractor. An express joint shall always be a temporary measure only and the repaired cable shall be replaced as soon as possible (the Contractor shall communicate the time frame on the replacement of the affecting Fibre Optic link to the Engineer).

For Information: The overall design of the Fibre Optic network shall ensure the optimal Optical Power Budget (PB) shall remain after installation, to cater for any such temporary Express or Emergency splicing joints, without affecting the overall Quality of Service (QoS) relevant to the Fibre Optic Link affected.

#### **44.9.1.4 Multimode Optic Fibre Optical Characteristics**

The multimode Fibre Optic cable shall be manufactured according to international standards, including but not withstanding the ITU-T G.651.1 specification. In addition, the multimode Fibre Optic cable shall conform to the following Optical properties and characteristics:

- a) 12 or 24 cores;
- b) Typical Core Diameter - 50  $\mu\text{m}$ ;
- c) Cladding Diameter - 125.0  $\pm$  1  $\mu\text{m}$ ;
- d) Primary Buffer >250  $\mu\text{m}$ ;
- e) Secondary Buffer >900 nm;

## PART C3.1 - SPECIFICATION

- f) Bandwidth at 850 nm – 1000 MHz/km;
- g) Cable Fibre Attenuation – <5 dB/km @ 850 nm, <3 dB/km @ 1300 nm;
- h) Each Optical Fibre shall consist of a doped silica core surrounded by a concentric silica cladding;
- i) The Fibre shall be a matched clad design; and
- j) The coating shall be dual layered and UV-cured acrylate.

**44.9.1.5 Multimode Optic Fibre Mechanical Properties**

The multimode Fibre Optic cable shall be manufactured according to international standards, including but not withstanding the ITU-T G.651.1 specification. In addition, the multimode Fibre Optic cable shall conform to the following Mechanical properties and characteristics:

- a) The cable shall consist of a dielectric, glass reinforced plastic (GRP) rod to prevent bucking of the cable;
- b) Water-blocking technology shall be used to impede migration of water through the cable core;
- c) Fillers shall be included in the cable core to aid in symmetry of the cable cross-section if needed;
- d) A water blocking tape shall be applied longitudinally around the outside of the stranded tubes or fillers;
- e) The water blocking tape shall be non-nutritive to fungus, electrically non-conductive and homogenous. It shall also be free from dirt and any foreign matter;
- f) High tensile strength dielectric yarns shall be helically stranded evenly around the cable core to improve tensile strength;
- g) Ripcords shall be provided in the cables for easy sheath removal;
- h) The armoured cables shall contain two ripcords under the steel armour;
- i) The armoured cable shall contain corrugated steel tape / steel wire, plastic coated on both sides for corrosion resistance;
- j) It shall be applied around the outside of the water blocking tape over the dielectric tensile strength members;
- k) This shall be done with an overlapping seam with all the corrugations in line;
- l) The outer jacket shall be applied over the corrugated steel tape / steel wire armour;
- m) The outer jacket / sheath shall be HDPE;
- n) The minimal outer jacket thickness shall be 2.0 mm;
- o) The cable jacket on the armoured cables shall contain no metal elements and shall be of a consistent thickness;
- p) The shipping, storage, and operating temperature range of the cable shall be -40°C to +70°C;
- q) The installation temperature range of the cable shall be -30°C to +70°C;
- r) Cable Sheath Marking - All cables shall have sequential length markings along the cable sheath;
- s) The height of the marking shall be approximately 2.5 mm; and
- t) As required by Section 350 G of the NESC, ANSI C2-1993, all cables shall have a visual identifier to identify them as telecommunications / data-communications cables.

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**44.9.1.6 Multimode Optic Fibre Cable Installation Requirements**

The CCTV Fibre Optic cable shall be installed in 50 mm cable ducts. The requirements for the cable duct shall be as follows:

- a) Direct burial type of duct;
- b) 50 mm outside diameter;
- c) UV rated;
- d) Pre-installed pull tape;
- e) Silicone lined for reduction in friction;
- f) Manufactured according to SABS ISO 9001;
- g) Jointing of duct only via high compression couplings;
- h) Ducts shall have a pressure rating > 9 Bar;
- i) Where the cable route changes direction (termination of fibre links into buildings, change of direction due to services and infrastructure, etc.), manholes / handholes shall be constructed or installed if of the pre-cast / polyethylene type; and
- j) The minimum dimensions shall be 600 mm wide x 600 mm wide x 1200 mm high.

The CCTV Contractor shall be required to survey the route prior to the commencement of the installation of the multimode Fibre Optic cables to determine the following:

- a) The length of the route that requires the Fibre Optic cable;
- b) The terrain conditions and terrain accessibility;
- c) Crossings including existing services, streams, rivers, pipelines, etc.;
- d) Location and condition of existing manholes (where applicable);
- e) Distances between existing manholes (where applicable);
- f) Distances between planned new manholes;
- g) Accessibility of the terrain, if the use of mechanical hauling equipment is preferred;
- h) However, the pulling in of multimode Fibre Optic cables by hand is preferred;
- i) Identification and allocation of correct spare pipe to be utilised if available; and
- j) Once the above has been verified, a proper hauling schedule shall be compiled.

- Optic Fibre Cables are normally available in full drum lengths from the cable supplier and it is essential to make optimum use of the available lengths; and
- Confirm the available lengths from cable supplier before the hauling schedule is compiled.

Ensure that the cables are drummed correctly to suit the direction of pull.

Drums shall be unloaded from its transport vehicle using a JCB or fork-lift truck.

NOTE - Under no circumstances shall the drums be dropped from the transport vehicle onto the ground.

Small drums can be rolled carefully to the installation point. Drums shall never be allowed to roll freely down a slope. In most instances a drum trailer or similar arrangement shall be used. Battens shall only be removed when ready for installation. When deploying cable from a rotating drum into a trench or duct, it shall be ensured that the drum stand or trailer is firmly located and that rotation of the drum during installation shall not cause any problem.

PART C3.1 - SPECIFICATION

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The Contractor shall ensure that the drum does not lie flat during installation and that coils are pulled off thus causing corkscrew twists. This shall be avoided at all cost as this will cause cable damage and installation problems, the replacement costs for the cable of which shall be for the Contractor's account.

To minimise problems which may arise due to water / moisture contamination, the following guidelines shall be adhered to:

- a) Do not cut or break into cables until it is absolutely necessary;
- b) Before cutting into or breaking, pump out any standing water in the manhole or trench if applicable;
- c) Before cutting or breaking cable, check weather conditions and if applicable cover the manhole / trench with a tent or waterproof covering (Rain, Thundershowers, Hail, etc.);
- d) When Splicing always arrange the cable working position 'above ground' so as not to allow the cables to lie on the ground or in water;
- e) If a cable end has to be created by cutting through a continuous cable, fit a waterproof sealing end cap until such time is required to open the end of the cable for termination or splicing; and
- f) If cut cables have to be left for a considerable period of time like overnight or longer, then the cable shall have to be sealed to prevent water ingress.

Where patch panel are installed, the patch panels shall be earth bonded to earthing bars.

The Contractor may need to adjust trench depths to accommodate bedding where required. The padding and bedding materials shall be sieved to a maximum allowable size, approved by the Engineer. Large objects shall not be dumped into the trench. Removal of rubble shall be the responsibility of the Contractor.

Note: All trench depth measurements shall be made to the top of the cable / duct / sleeve when laid, ready for backfill. The installation depth from the top of the trench (level with surrounding virgin soil) till the top of the cable / duct / sleeve shall be to a minimum depth of 550 mm.

All ducts and pipes shall be well sealed at entry / exit points of manholes / handholes. General Backfill shall consist of the material excavated from the trench, provided that:

- a) The material is easily workable and compactable;
- b) The material is free from organic material (roots, grass etc.) rubbish, clay lumps and aggregates larger than 50 mm stones in diameter; and
- c) The material has suitable moisture content and is not too dry.

If the site materials cannot meet these requirements, then suitable material shall be imported. Compaction of suitable bedding material of thickness 100 mm shall be achieved by passes over the whole trench bed, preferably using a Power Vibrating Rammer or a 5 kg hand rammer as an alternative. The cable / duct / sleeve shall then be laid on the prepared bed. For any variations to this procedure, approval shall firstly be required from the Engineer.

An appropriate amount of slack shall be looped and retained where splices are to be made (at all designated sites). Self-expanding polystyrene type foam shall be injected into the communication tube openings after the cable has been pulled in to seal the ends of the tubes and to stop the ingress of sand, rodents, etc. at these manholes.



PART C3.1 - SPECIFICATION

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All trenches shall be backfilled with suitable material that is easily workable and compactable. The backfill material shall be free from grass and roots. If the backfill material is too dry, it shall be moistened prior to placing and compacting.

Each layer of 150 mm thick compacted backfill shall be tested to the following requirements using the standard 5 kg DCP test method or an appropriately SABS recognised Density Test Method:

- a) Road Trenches: Minimum of 5 blows per 100 mm penetration;
- b) Sidewalk, driveways and median trenches: minimum of 3 blows per 100 mm penetration; and
- c) Verge trenches: minimum of 2 blows per 100 mm penetration.

Trenches in the verge (unhardened areas) may be backfilled and compacted in 300 mm loose layers. All test results shall be recorded and handed to the Engineer. The Engineer reserves the right to carry out their own DCP testing and should minimum requirements not be achieved on completed work, the Contractor shall be required to remove and redo the operation to ensure compliance.

The procedure to deal with existing services shall be as follows:

- a) Where required trenches have been identified in areas by the Contractor, and where infrastructure are/may be prevalent, pilot holes shall be dug at intervals along that run.

These pilot holes shall be dug either as per one or a combination of the following:

- a)  $\leq 20$  m for trenches less than equal to 200 m;
- b)  $\leq 25$  m for trenches greater than 200 m; and
- c) Or as per the site requirements and/or site instruction.

Pilot holes shall be dug at points where the new trench crosses known existing services, according to way leave plans and/or other drawings and including verbal communication from the client's site personnel.

The pilot holes shall be at least 150 mm deeper and wider than the proposed excavation so as to reveal the presence of any services belonging to other administrations.

These Pilot holes shall be dug by hand, and with the utmost of care.

All excavation work shall be performed under the supervision of a responsible and competent person who shall be competent to exercise such supervision.

Failure to abide by any of the above instructions, may/can lead to damages to existing services. The Contractor shall be liable for all damages to existing services, and the subsequent repairs shall be carried out by the Contractor without any delay.

The trench shall be laid out in such a position that the cables / ducts / sleeves shall be laid at least 300 mm from power cables. Where this is not possible with services that are in the way of the cable / duct / sleeve and if there is insufficient space for the 300 mm separation, then the cable / duct / sleeve shall be tunnelled 300 mm underneath the other services. Storm water gutters and drains shall not be obstructed.

Where it is not possible to get the minimum required depth, the cables / ducts / sleeves must be boxed in concrete to a required thickness of 50 mm and strength of 20 MPa. Trenching for cables shall be excavated in straight lines in accordance with the servitude / way leave plan, except where obstruction or other conditions occur. These areas shall be pointed out to the Engineer for his approval on any route diversions.

PART C3.1 - SPECIFICATION

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The width of trenches shall be in accordance with the following:

- a) Trench widths for one and/or two 50 mm sleeves – 450 mm;
- b) Trench widths for three 50 mm sleeves – 625 mm; and
- c) Trench widths for four 50 mm sleeves – 800 mm.

Before commencing with cable / duct / sleeve-laying operations in an excavated trench the Contractor shall suitably prepare the trench floor to provide firm support for the cable / duct / sleeve over their full length. To this end he must ensure that the trench floor is free from all loose and or unsuitable material, including soil saturated with water, evenly levelled and at the proper depth required for the cable / duct / sleeve.

The Contractor must undercut trench floors below the required final level by the amount and under the conditions indicated hereunder and refill this space with compacted bedding material. The bedding must be compacted over its whole area by means of a compactor. The compaction factor shall be 90% mod AASHTO.

The Contractor shall exercise due care in trimming and/or undercutting trench floors to ensure that only the necessary amount of ground is removed. Should the Contractor remove, either by neglect or bad workmanship more ground than is necessary, he shall at his own cost fill such excess excavation with compacted bedding material.

**Bedding:** This shall refer to the material constituting the even floor of an excavated trench onto which a duct or a bank of ducts is laid (+/-100 mm).

**Padding:** This shall refer to the material installed around and/or between ducts up to a level of at least 150 mm above the duct or bank of ducts.

**Backfilling:** This shall refer to the material installed above the padding material layer to complete the refilling of an excavated trench.

The 3 layers of material in the backfilled trench shall be classified as bedding, padding, and main backfill. The bedding and padding material shall not be too fine and shall be free of large stones (it shall be evenly graded between 0,6 mm and 19 mm). Clay type material shall not be acceptable (the PI shall not exceed 12 and the compaction factor shall not exceed 0.4).

Imported material can be used for bedding, padding and backfilling in the trench, if so required. The material excavated from the trench shall be used as main backfill if it is free from stones.

The Contractor shall pay particular attention to the proper compaction of bedding, padding and backfilling material. The approved type of marker tape, orange in colour and a minimum width of 150 mm (warning tape with inscription: “**Warning - Fibre Optic Cable Below**”) shall be laid 300 mm above the cable / duct / sleeve over the entire length of the cable / duct / sleeve run. A high standard of compaction effort shall be incited upon in all cases where fine materials are approved as bedding and padding.

The compaction of padding immediately adjacent and between the cable / duct / sleeve shall only be executed manually using a suitable tamping tool. Manual compaction shall continue until a layer of padding 150 mm thick and 300 mm backfill covers the cable / duct / sleeve.

The compaction of backfill shall be by means of a compactor and must be compacted to a density higher than that or at least similar to that of the virgin soil parallel to that specific trench. These comparative tests shall not be taken more than 0.5 metre from the compacted trench. The above shall be applicable to all roadway crossings and normal trenching.

PART C3.1 - SPECIFICATION

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Compaction tests shall be done by means of a Dynamic Cone Penetrometer (DCP) or similar. Tests shall be done on backfilling where trenches and dugouts were done. These test results shall be recorded and provided to form part of the Project Completion File.

The Contractor shall supply tamping tools for the manual compaction of padding material immediately adjacent to and between the cable / duct / sleeve. A suitable tamping tool shall be provided similar to the following:

- A tamping foot made up of a 37 mm diameter steel rod 300 mm long securely attached to a vertical handle made up of 20 mm steel rod 1.35 meters long.

During the compaction of padding and backfill material the Contractor must exercise due care to ensure that cable / ducts / sleeves are not disturbed or damaged in any way. The use of non-cohesive, single size, graded sand or crusher sand for bedding, surround blankets and backfilling of trenches shall not be permitted.

#### **44.9.1.7 Concrete Cable Slabs**

Where cables cross other services such as water pipes, sewerage pipes and other cables or where the chance exists that the cable may be damaged as a result of excavation by others, the cable shall be protected by means of reinforced concrete slabs or fibre protection covers. The slabs or covers shall protect the cable for a distance of 500 mm on either side of the crossing.

The cable slabs supplied and installed under this Contract shall be formed solidly out of concrete with steel reinforcing and shall have dimensions of 1 000 mm x 350 mm x 100 mm. Alternative block sizes will be considered. The following concrete mixture is desired:

- a) Portland cement (dry) - 1 part per volume;
- b) Clean dry river sand - 3 parts per volume; and
- c) Crushed stone (size 10 mm) - 6 parts per volume.

#### **44.9.1.8 Cable Trays and Cable Ladders**

Cable ladders and/or cable trays shall be of the heavy-duty type, equal and similar to Cabstrut. Cable ladders shall be hot dipped galvanized or as specified on the drawings the, height of the sides shall be 76 mm with the width to suit the number and size of cables to be installed.

The cable trays and ladders shall be installed neatly, level and square / parallel to walls. The cable ladders shall be secured on suitable lengths of Unistrut channel, which shall be suspended from the roof slab by means of suitable lengths 8 mm diameter threaded hot, dipped galvanized steel rods. The threaded rods shall be secured to the roof slab with suitable sized hot dipped galvanized steel rawl bolts and shall be secured to the channel sections by means of two hot dipped galvanized nuts and washers.

Cable ladders and trays against walls shall be secured to channel sections by means of two hot dipped galvanized nuts and washers, which in turn are fixed against the wall by means of suitably sized hot dipped galvanized steel rawl bolts.

Where cable ladders must be installed over clear floor areas it shall be supported on galvanised stands which are provided with a foot plate of ample size which can be bolted to the floor by means of suitably sized hot dipped galvanized steel rawl bolts. The cable ladders shall be secured to the stands by means of two hot dipped galvanized nuts and washers.

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PART C3.1 - SPECIFICATION

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Cable straps or k-clamps suitable for the specific cable shall be employed to secure the cable to the tray. The different parts of the trays and ladders must be thoroughly bonded electrically and mechanically to each other.

Outdoor cable straps shall be stainless steel and cables shall be secured on intervals not exceeding 600 mm. Cables on cable trays or ladders in outdoor environments shall be covered with removable cable tray or ladder covers of similar material.

#### **44.9.1.9 Cable Markers**

Cable ends shall be properly labelled with reference to equipment, section of plant and other requirements specified by the client at both cable ends.

Cable markers with lead labels cast into the top of the cable markers shall be supplied and installed along the cable routes under this Contract as follows:

- a) Along straight runs of the route, not further than 25 m apart;
- b) At turns - one on each side of the turning point, 900 mm from such turning points; and
- c) At each branch, 3 markers - i.e. one on each side of the branch, 900 mm from the branch.

The cable markers shall be installed deep enough to ensure that the top of the marker will protrude 50 mm above final ground level.

#### **44.9.1.10 As - Builds**

On completion of the works, but before the certificate of completion will be issued, the Contractor shall submit to the Engineer, the following in electronic format indicating in a satisfactory manner the following:

- a) The exact cable routes with reference to fixed points (X and Y coordinates);
- b) The exact lengths of fiber optic cable installed between terminating points and between joints where relevant; and (X and Y coordinates);
- c) With reference to fixed points the exact positions of cable joints / terminations (X and Y coordinates);
- d) Manhole installation positions (X and Y coordinates);
- e) Position of existing services where crossings occur (X and Y coordinates);
- f) Details of fiber optic route installations at these crossing points with existing services;
- g) Details of any other deviations to the cable route;
- h) Installation and termination layouts for the Patch Panel installation at all the sites;
- i) Fiber Optic cable route layout inside each building (for all sites connected on network); and
- j) Electronic copies of the various plans for the marking up of the information required will be supplied to the Contractor on request.

**44.9.1.11 Multimode Fibre Optic Splicing and Testing****(a) Pre - Installation Test**

Whilst on the drum and using an Optical Time Domain Reflectometer (OTDR) all fibres shall be tested for Optical Continuity in both directions.

The Optical Fibre Cable shall be tested for conformance with its Optical specification, and a report shall be prepared for the Engineer's review. The following steps shall be adhered to:

- a) The Contractor shall inform the Engineer when the drums will be opened, for verification of any type of physical damage to the cables before starting with testing.
- b) If any physical damage to the cable is observed, it shall be recorded, and corrective action shall be taken.
- c) The fibre optic cables shall be prepared and tested as described below:
  - i) Attach the fibre to a pigtail and connect to a calibrated OTDR Instrument using a suitable connector type;
  - ii) Test and note the result of each fibre link test (test to be done in both directions);
  - iii) All results shall be recorded in a Pre-installation Report;
  - iv) The average Attenuation shall not be greater than 5 dB per km at 850 nm and 3 dB per km at 1300 nm;
  - v) Each core shall be tested using a calibrated OTDR, from each side of the fibre link, both at Wavelength's of 850 nm and 1300 nm; and
  - vi) After completion of the tests the ends of the fibre-optic cable shall be sealed with end caps to prevent the ingress of moisture.

**(b) Splicing**

Only splicing at the patch panels on either side of a designated link shall be done. Express or Emergency splicing joints shall only be done when a cable is damaged and needs to be temporarily repaired to restore service. The Contractor shall request permission from the Engineer if there is a need to make an Express or Emergency splicing joint, before starting with any ROS (Restoration of Service).

The Engineer reserves the right to decline such a request from the Contractor. In the case that the Engineer approves a request from the Contractor to make an Express or Emergency splicing joint, the following procedure shall be adhered to:

- Open the Handhole / Manhole box and take the cable out from the box (where applicable). Ensure that there should be sufficient minimum Fibre Optic cable available in the box, in either direction for splicing. The outer sheath and loose tube of the cable will be stripped till sufficient bare fibre is exposed.
- The Fibre Optic cable shall be placed and tightened inside the joint enclosure. The Fibre Optic cable in the enclosure shall be sealed with a heat shrinkable sleeve. Care shall be taken not to damage the Fibre Optic cable and the enclosure during the heating process.
- The fibres shall be cleaned with either hexane or isopropanol and tissue paper shall be used to remove any moisture resistant jelly. The fibre coating and cladding shall be stripped off using a fibre stripper and the stripped portion shall be cleaned with either hexane or isopropanol.

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The Fibre Optic splicing shall be done in a dust free environment i.e. covered tent / air-conditioned vehicle. The procedure shall be as follows:

- a) Clean the fibre completely with hexane or isopropanol;
- b) Put the prepared fibre ends inside a precision cleaver;
- c) The cleaver shall be used to cut the Fibre Optic ends neatly and at exactly 90 degrees to ensure the two ends to be spliced shall line up neatly in preparation to be fusion spliced;
- d) The two ends to be spliced together shall be placed in the "V" groove of the fusion splicing machine, and subsequently fused together;
- e) If the splicing loss in dB is within the specified criteria (0.05 dB average loss,  $\leq 0.3$  dB maximum loss), then the splicing joint shall be acceptable; and
- f) If the splicing loss in dB is not within the specified criteria (0.05 dB average loss,  $\leq 0.3$  dB maximum loss), then the splicing joint shall be redone.

On completion of the Express or Emergency splicing joint, the shrinkable heat sleeve which shall have been placed on before splicing was to be started, shall be shrunk to the applicable size. This action shall further enhance the rigidity and give extra strength to the splicing joint enclosure.

All fibres shall be fusion spliced. Mechanical splice kits shall not be allowed. All Express or Emergency splicing joints shall be done in manholes / handholes (where applicable). Permission to make Express or Emergency splicing joints in trenches shall firstly have to be obtained from the Engineer. Joint boxes shall be IP68 rated to prevent the ingress of water / moisture and dust.

Note: Self-expanding polystyrene type foam shall be injected into the communication tube openings after the cable has been pulled in to seal the ends of the tubes and to stop the ingress of sand, rodents, etc. in the manholes and entrances into buildings.

### Post - Installation Test

Each core shall be tested using a calibrated OTDR, from both directions, both at Wavelength's of 850 nm and 1300 nm. A detailed OTDR test report shall be compiled, including but not withstanding the following information:

- a) Link description (from Point A to Point B);
- b) Distance of Link;
- c) Testing Wavelength (850 nm or 1300 nm);
- d) Core number / colour;
- e) Splicing losses;
- f) Attenuation loss in dB/km;
- g) Total return dB loss;
- h) Name of test technician;
- i) Signature of test technician supervisor;
- j) Client name;
- k) Date;
- l) Machine model information (must include calibration date and details); and
- m) Certificate number.

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An installation report shall also be compiled for the Multimode Fibre Optic installation. The installation report shall also include all events along the route.

The maximum allowed splice loss for any individual splice shall not exceed 0.3 dB, with the average splice loss shall be 0.05 dB on average.

The Looped fibre shall be neatly arranged in the storing tray of the splicing enclosure. After closing the joint enclosure, the same will be placed in the Handhole / Manhole box and the holes used for duct entry in handle box to be closed.

44.10      **HANDBOOKS AND INSTRUCTION MANUALS**

All documentation made available during the tests-on-completion shall be fully updated subsequent to successful Tests-on-Completion to include whatever final modifications are required to be made by the Contractor to his Plant, in order for it to gain acceptance by the Engineer for inclusion in the manual. Refer in this regard to Section 43 and Section 48.

44.11      **MEASUREMENT AND PAYMENT**

The rates tendered under this Section shall not include for the general obligations, Contractor’s Equipment and work deemed to be covered by the items provided in Section 1 – General.

44.001      **Design and documentation**

Unit : lump sum (Sum)

The rates tendered shall include for full compensation of all costs incurred in the preparation of the design and calculations, detail working drawings for all items, specifications, schematic diagrams, wiring diagrams, CCTV System layout diagrams, CCTV Network layout diagrams, GUI graphic layouts, CCTV software code, CCTV design philosophy, CCTV operational philosophy, operation and maintenance instructions, programmes of work (manufacture and on-site) and any other work as specified for the design of the complete installation. Payment will only be effected after the design and associated documentation has been approved by the Engineer.

Measurement and Payment for the preparation and submission of O&M Manuals shall be covered under Clause 48.11 of Section 48 – Tests on Completion and paid elsewhere.

44.002      **Supply and Deliver to Site**

Unit : number (No)  
or: sets (Sets)  
or: pairs (Pairs)  
or: lump sum (Sum)

The rates tendered shall include full compensation for the supply and delivery of the Plant to Site including supply of raw materials and bought-out items and associated operating Plant items; fabrication, manufacture and assembly; quality assurance and quality control; inspection and Factory Acceptance Testing (including attendance on inspections and tests witnessed by the Engineer); type and routine tests; application of finishes (painting and corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. Payment will be made per unit. Payment will only be effected after full compliance of the Plant items with this Section and associated documentation has been approved by the Engineer.

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**a) Bullet camera – range 30 m (Lens size between 3 mm to 9 mm) Unit: number (No)**

The rates shall include the complete bullet camera – range 30 m (Lens size between 3 mm to 9 mm) as per the technical data sheets, with LED's and all other material and Plant required including surge protection to ensure a fully functional Plant item.

**b) Bullet camera – range 40 m (Lens size between 9 mm to 22 mm) Unit: number (No)**

The rates shall include the complete bullet camera – range 40 m (Lens size between 9 mm to 22 mm) as per the technical data sheets and all other material and Plant required including surge protection to ensure a fully functional Plant item.

**c) Digital camera - Outdoor dome type Unit: number (No)**

The rates shall include the complete digital camera - Outdoor dome type as per the technical data sheets and all other material and Plant required including surge protection to ensure a fully functional Plant item.

**d) Digital camera – Indoor vandal proof type Unit: number (No)**

The rates shall include the complete digital camera – Indoor vandal proof type as per the technical data sheets and all other material and Plant required including surge protection to ensure a fully functional Plant item.

**e) Digital camera - Vandal proof outdoor type Unit: number (No)**

The rates shall include the complete digital camera - Vandal proof outdoor type as per the technical data sheets and all other material and Plant required including surge protection to ensure a fully functional Plant item.

**f) Digital cameras - Thermal type cameras Unit: number (No)**

The rates shall include the complete digital cameras - Thermal type cameras as per the technical data sheets and all other material and Plant required including surge protection to ensure a fully functional Plant item.

**g) View Station Software Unit: number (No)**

The rate shall include all license tag fees applicable, application software, operating system software, drivers, graphics packages, network licences, anti-virus software, read and write software, office suite software, diagnostic software and any other software required for the View Station to be a fully functional installation.

**h) Relay Server Software Unit: number (No)**

The rate shall include all license tag fees applicable, application software, operating system software, drivers, graphics packages, network licences, anti-virus software, read and write software, office suite software, diagnostic software and any other software required for the Relay Server to be a fully functional installation.



**i) Managed Ethernet Switches****Unit: number (No)**

The rate shall include the specified Industrial Switch as per the technical data sheets, including fibre (1000BaseX) and copper ports (10/100BaseTX), LC/SC/SFP/Pluggable Optics connector types, password protection, encryption, port security, galvanized steel enclosure, mounting rails and surge protection.

**j) Routers 10/100TX RJ45****Unit: number (No)**

The rate shall include the specified Router 10/100TX RJ45, including all hardware accessories.

**k) Ethernet IP Video Servers****Unit: number (No)**

The rate shall include the specified Ethernet IP Video Server as per the technical data sheets, including LCD screens and all hardware accessories.

**l) Ethernet Multimode Fibre Optic Cabling 50/125 micro metre****Unit: metre (m)**

Cable lengths are approximate lengths. Installed cable will be measured on site.

The rate shall include all clamping, strapping and cable tag marking. Trenching is priced separately.

**m) Biometric Access Readers (Outdoor Type)****Unit: number (No)**

The rates shall include the complete Biometric Access Reader as per the technical data sheets and all other material and Plant required including surge protection to ensure a fully functional Plant item.

**n) Biometric Access Readers (Indoor Type)****Unit: number (No)**

The rates shall include the complete Biometric Access Reader as per the technical data sheets and all other material and Plant required including surge protection to ensure a fully functional Plant item.

**o) Detection Beam Units****Unit: number (No)**

The rates shall include the complete detection beam unit and all other material and Plant required including surge protection to ensure a fully functional Plant item.

**p) Access Controller Units****Unit: number (No)**

The rate shall include the Access Controller Unit, inclusive of complete I/O marshalling IP65 rated cabinets, wiring, terminals, trunking, numbering systems, circuit breakers, installation of software packages, power supplies, expansion racks, mounting brackets, and all other material and Plant items required to give a fully operational Access Controller Unit including surge protection.

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**q) Access Controller Viewer****Unit: number (No)**

The rates shall include the complete Access Controller Viewer, including LCD screens and all other material and Plant required including surge protection.

**r) Peripherals, Trunking, Cabling, Terminators and Connectors****Unit: lump sum (Sum)**

The rates shall include all peripherals, trunking, cabling, terminators and connectors and all other material and Plant required to ensure a fully functional CCTV and Access Control System installation.

**s) Special Tools and Test Equipment****Unit: lump sum (Sum)**

The rates shall include all special tools and test equipment required to ensure a fully functional CCTV and Access Control System installation.

**t) Tools and Accessories****Unit: lump sum (Sum)**

The rates shall include all tools and accessories required to ensure a fully functional CCTV and Access Control System installation.

**u) GUI (Graphical User Interface)****Unit: number (No)**

The rate shall include full compensation for the specified GUI, including all accessories and Plant items required to give a fully functional and operational GUI as per the design specification.

**v) Viewing Screens****Unit: number (No)**

The rate shall include full compensation for the specified LED quiescent viewing screens, including all accessories and Plant items required to give a fully functional and operational viewing screen.

**44.003 Installation of Plant**

**Unit : number (No)**  
**or: sets (Sets)**  
**or: pairs (Pairs)**  
**or: lump sum (Sum)**

The rates tendered shall include for full compensation for the installation of the Plant on Site including the provision of all labour, transport, materials and Temporary Works necessary to install the complete works; on-site quality assurance and quality control, inspection, testing (including attendance at tests witnessed by the Engineer); the installation of all auxiliary Plant items; necessary for the operation of the installation until taken over by the Employer; the putting into service of the complete installation of the Plant; and any other work as specified.

The rate shall also include for all pre-commissioning testing and the provision of equipment therefore including all disruptions to installation caused by such testing. Payment will be made per unit. Payment will only be effected after full compliance of the Plant items with this Section and associated documentation has been approved by the Engineer.

Measurement and Payment for Test on Completion shall be covered under Clause 48.11 of Section 48 – Tests on Completion and paid elsewhere.

PART C3.1 - SPECIFICATION

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- a) Bullet camera – range 30 m (Lens size between 3 mm to 9 mm) Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the specified bullet camera – range 30 m (Lens size between 3 mm to 9 mm) as per the technical data sheets to render a complete and operational installation as specified, including surge protection.

- b) Bullet camera – range 40 m (Lens size between 9 mm to 22 mm) Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the specified bullet camera – range 40 m (Lens size between 9 mm to 22 mm) as per the technical data sheets to render a complete and operational installation as specified, including surge protection.

- c) Digital camera - Outdoor dome type Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the specified digital camera - Outdoor dome type as per the technical data sheets to render a complete and operational installation as specified, including surge protection.

- d) Digital camera – Indoor vandal proof type Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the specified digital camera – Indoor vandal proof type as per the technical data sheets to render a complete and operational installation as specified, including surge protection.

- e) Digital camera - Vandal proof outdoor type Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the specified digital camera - Vandal proof outdoor type as per the technical data sheets to render a complete and operational installation as specified, including surge protection.

- f) Digital cameras - Thermal type cameras Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the specified digital cameras - Thermal type cameras as per the technical data sheets to render a complete and operational installation as specified, including surge protection.

- g) View Station Software Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the View Station Software on the servers and view stations, inclusive of installation of all required software packages including, license fees applicable, application software, operating system software, drivers, graphics packages, network licences, anti-virus software, read and write software, office suite software, diagnostic software and all other required items needed to give a fully operational View Station.

**h) Relay Server Software****Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the Relay Server Software on the servers and view stations, inclusive of installation of all required software packages including, license fees applicable, application software, operating system software, drivers, graphics packages, network licences, anti-virus software, read and write software, office suite software, diagnostic software and all other required items needed to give a fully operational Relay Server.

**i) Managed Ethernet Switches****Unit: number (No)**

The rates shall include full compensation for the installation, testing and pre-commissioning of the specified Managed Ethernet Switch as per the technical data sheets, including fibre (1000BaseX) and copper ports (10/100BaseTX), LC/SC/SFP/Pluggable Optics connector types, password protection, encryption, port security, galvanized steel enclosure, mounting rails and surge protection.

**j) Routers 10/100TX RJ45****Unit: number (No)**

The rates shall include full compensation for the installation, testing and pre-commissioning of the specified Routers 10/100TX RJ45.

**k) Ethernet IP Video Servers****Unit: number (No)**

The rates shall include full compensation for the installation, testing and pre-commissioning of the complete Ethernet IP Video Servers inclusive of all labour, installation materials and sundries for a fully operational and serviceable installation.

**l) Ethernet Multimode Fibre Optic Cabling 50/125 micro metre****Unit: metre (m)**

The rate shall include full compensation for the installation, splicing, pre-installation OTDR tests, post-installation OTDR tests, after splicing OTDR tests in both directions and @ 850nm of the required Ethernet Multimode Fibre Optic Cabling 50/125 micro metre including all peripherals to ensure a complete and functional installation.

**m) Biometric Access Readers (Outdoor Type)****Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the biometric access readers as per the technical data sheets, inclusive of all labour, installation materials and sundries for a fully operational and serviceable installation.

**n) Biometric Access Readers (Indoor Type)****Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the biometric access readers as per the technical data sheets, inclusive of all labour, installation materials and sundries for a fully operational and serviceable installation.

**o) Detection Beam Units****Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the detection beam units, inclusive of all labour, installation materials and sundries for a fully operational and serviceable installation

**p) Access Controller Unit****Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the Access Controller Unit in the designated areas, inclusive of complete I/O marshalling IP65 rated cabinets, wiring, terminals, trunking, numbering systems, circuit breakers, installation of software packages, power supplies, expansion racks, mounting brackets, and all other material and Plant items required to give a fully operational Access Controller Unit including surge protection.

**q) Access Controller Viewer****Unit: number (No)**

The rates shall include full compensation for the installation, testing and pre-commissioning of the complete Access Controller Viewer inclusive of all labour, installation materials and sundries for a fully operational and serviceable installation.

**r) Peripherals, Trunking, Cabling, Terminators and Connectors****Unit: lump sum (Sum)**

The rates shall include full compensation for the installation, testing and pre-commissioning of each item, including the provision of all labour, equipment, transport, materials and Temporary Works necessary to install the complete peripherals, trunking, cabling, terminators and connectors.

**s) GUI (Graphical User Interface)****Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the graphical user interface (GUI) in the designated areas, inclusive of wiring, terminals, trunking, circuit breakers, installation of graphical packages and other software packages, power supplies, mounting brackets, and all other material and Plant items required to give a fully operational GUI system after loading of software and installation.

**t) LED Screens****Unit: number (No)**

The rate shall include full compensation for the installation, testing and pre-commissioning of the LED Screens, inclusive of all labour, installation materials and sundries for a fully operational and serviceable installation.

**44.004 Spares****Unit : Provisional Sum (PS)**

The cost of spares, considered to be necessary by the Contractor other than spares required by the Employer, delivered to Site and handed over will be paid as a lump sum. A Spare Part Schedule by the Employer is available in Section 48 – Test on Completion, and the BoQ. The spares identified by the Contractor are to adhere to Clause 43.16 Spare Parts Requirements.

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The actual lump sum to be paid shall be based on the unit rates priced in the Bill of Quantity for the actual spares ordered and supplied and the Employer is entitled to purchase all, some or none of the items listed. A Provisional Sum will be allocated in the Bill of Quantity for the complete list of spare parts as listed by the Contractor.

The rate tendered shall provide for the manufacture, supply, delivery to Site and handing over of the spares ordered and shall include permanent packing for long term storage. The spares shall be manufactured at the same time as the installed items.