Eskom	Specification	Generation

Title: **Kusile Power Station Additional CCTV System Specification**

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1. INTRODUCTION

CCTV systems provide surveillance capabilities used in protection of people, assets, and systems. A CCTV system serves mainly as a security force multiplier, providing surveillance for a larger area, more of the time, than would be feasible with security personnel alone. CCTV systems are often used to support comprehensive security systems by incorporating video coverage and security alarms for barriers, intrusion detection, and access control. For example, a CCTV system can provide the means to assess an alarm generated by an intrusion detection system and record the event.

The cameras installed at Kusile Power Station are not enough to cover all critical areas, the various stakeholders have identified more areas that require surveillance for protection of people, plant, systems, and monitoring of critical plants where visuals will help controllers to manage and control the plant better.

To design such an integrated system with required interfaces, a comprehensive site survey to support the development of detailed equipment specifications, installation design, and ultimately a thorough system test requires a specialised skill set. These skills and capabilities cannot be sourced within the organisation.

1.1 IDENTIFICATION

The areas will be identified for the additional CCTV cameras at Kusile Power Station. The composition of these areas will consist of a combination of cameras covering them and will be as follows:

Area (Location)	Monitoring Centre (Display)
Station Lifts	Main Control Room
Switchgear/Equipment Rooms	
Mills	
Fans (ID, FD, PA)	
Turbine Hall and Auxiliary Plants	
Submerged Scrapper Conveyors	
Four Dewatering Lines at FGD, including Head Ends	FGD Control Room
Dewatering Building	
Gypsum Transfer Houses	
Reagent/ Ball Mill Areas	
Recirculation Pumphouses	
Coal Weighbridge Offices	BOP Control Room
Coal Offloading and Weighbridge Areas	
Coal Stockyard	
Drum Reclaimers	
Buffalo Feeders	
Coal Belts and discharge points from stockyard up to units	
Terrace Ash Conveyor	
Radial Stack Conveyor	
Fuel Offloading Station	
Coal Transfer Houses	
Coarse Ash Conditioners	BOP Control Room
Top of Ash Silos	
Ash Conditioners at BOP	
Ash Emergency Stacker	
Ash Plant Transfer Houses	
Limestone Stock Yard	
Limestone Hopper Offloading Facilities	
Limestone Conveyor 3	

Table 1: Plant areas by CCTV cameras project scope

1.2 SYSTEM OVERVIEW

A Closed-Circuit Television (CCTV) system is a comprehensive and sophisticated surveillance solution designed to enhance security and monitoring capabilities for various environments and plant areas within the parameters of Kusile Power Station. This system will employ video cameras, digital video recorders (DVRs), and associated components to capture, record, and manage visual information. Supporting Clauses

AI CCTV cameras combine traditional surveillance with artificial intelligence to detect and analyse activities in real time. They can identify unusual behaviour, recognize faces, detect objects, and send instant alerts. With features like cloud integration and remote access, they enable faster response and smarter monitoring. This improves security efficiency, prevents threats, and support both public safety and business operations.

2. SCOPE

The scope of this document is limited to the additional CCTV surveillance system with Artificial Intelligent (AI) capabilities at strategic listed areas at Kusile Power Station. The design for the surveillance camera system shall consider the following:

2.1 CAMERAS

AI CCTV cameras strategically placed to cover the identified critical areas.

Table 2: Minimum specifications for cameras

Characteristics	Requirements
AGC (Automatic Gain Control)	Must automatically adjust brightness to ensure clear images under fluctuating lighting conditions indoors/outdoors
BLC (Back Light Compensation)	Required to manage glare and strong backlight especially in turbine halls and areas with reflective surfaces
Coverage Distance	Minimum 100-200m clear coverage for wide industrial zones like coal and ash plants
Frame Frequency	25-30 fps minimum for smooth monitoring and accurate AI event detection in high activity areas
Lens	Varifocal/zoom lens (2.8-12mm or higher) for flexibility in monitoring both wide areas and specific machinery
ONVIF Compliance	Must be ONVIF compliant to integrate seamlessly with existing video management and AI systems
Image format	Support JPEG, H.264,H.265 for efficient storage and transmission over power station networks
Remotely Configurable	Cameras must allow remote adjustment of zoom, focus, exposure, and analytics setting for operational ease.
Resolution	Minimum 1080p (Full HD); 4K preferred for high detail monitoring in critical plant areas

SNR (Signal to Noise Ratio)	Greater than 50 dB for high quality imaging, especially on low light coal and turbine areas
WBC (White Balance Control)	Auto/Manual modes to ensure accurate colour in varying lighting across indoor and outdoor zones
Wide Dynamic Range (WDR)	>120 dB to handle extreme contrast in environments with shadows, machinery lights, and sunlight
Scalability and Flexibility	Must support system expansion, integration with AI analytics, and compatibility with future upgrades
Environmental Damage Resistance	Industrial grade IP66/67 and IK10 ratings to withstand dust, moisture, vibration, and impacts in harsh conditions.

NB: all cameras shall have a 360-degree coverage and motion detection for comprehensive surveillance.

2.1.1 Requirements Definition

i. Coverage areas and blind spot analysis (site survey, CAD drawings, or 3D modelling).
ii. Resolution, frame rate, and storage requirements.

2.1.2 Technology Selection

i. Camera types (IP, PTZ, thermal, low-light, panoramic).
ii. Video analytics capabilities (AI object detection, facial recognition, license plate recognition, behaviour analysis).
iii. Network and bandwidth requirements (wired/wireless, PoE switches, fibre backbone).
iv. Data storage strategy (local NVRs, cloud, hybrid, redundancy).
v. Cybersecurity compliance (encryption, secure protocols, firewalls).

2.1.3 Recording and Storage

i. Continuous recording with configurable frame rates and resolutions.
ii. Storage capacity to retain footage for a minimum of 30 days/month.
iii. Redundant storage solutions for data backup.

2.1.4 Network Infrastructure

i. Integration with the existing power plant network.
ii. Scalability to accommodate future expansion.
iii. Network security measures, including encryption and secure access protocols.

2.1.5 Monitoring and Control

i. Centralized monitoring station with a user-friendly interface (suitable location to be proposed/identified).
ii. Real-time monitoring capabilities for security personnel.
iii. Remote access for authorized personnel (names to be provided by the Client).

2.1.6 Integration

i. Seamless integration with access control systems, alarms, and other security infrastructure.

ii. Compatibility with industry-standard and national Key Point protocols.

2.1.7 Power Supply

i. Power-over-Ethernet (PoE) support for simplified installation.
ii. Backup power solutions to ensure continuous operation during power outages.

2.1.8 Compliance and Standards

The surveillance camera system must comply with relevant security, industry standards and regulations, including but not limited the list section 2.4. The contractor shall provide documentation certifying compliance with these standards.

2.1.9 Risk Assessment

i. Failure modes and redundancy.
ii. Environmental suitability (IP rating, vandal resistance, power backup).

2.2 INSTALLATION, COMMISSIONING AND MAINTENANCE REQUIREMENTS

2.2.1 Installation Plan

2.2.1.1 Pre-installation Checks

i. Site readiness (power supply, network infrastructure, mounting structures).
ii. Hardware verification (cameras, NVRs, switches, cables).
iii. Environmental checks (lighting conditions, interference sources).

2.2.1.2 Installation Practices

i. Proper mounting angles and heights (field of view coverage).
ii. Secure cabling (termination, labelling, surge protection).
iii. Network configuration (IP addressing, VLANs, QoS for video traffic).
iv. Power supply integrity (UPS, surge protection, PoE compliance).

2.2.1.3 Integration and Interfacing

i. Connectivity with control rooms and monitoring stations.
ii. Linking to access control, alarms, and BMS if applicable.
iii. Cybersecurity hardening (firewall rules, password policies, firmware updates).

2.2.2 Commissioning

2.2.2.1 Functional Testing

i. Camera image quality tests (resolution, clarity, low-light performance, frame rates).
ii. Field of view validation vs. design drawings.
iii. Verification of smart features (motion detection, intrusion detection, facial/plate recognition accuracy).
iv. Alarm/event response times and notifications.

2.2.2.2 Performance Testing

i. Bandwidth utilization and network performance under load.
ii. Storage performance (capacity, retention time, redundancy testing).
iii. Failover testing (network loss, power outage recovery).

2.2.2.3 System Integration Tests

iv. Central monitoring and control software validation.
i. Access rights and user roles verification.
ii. Cross-system integration with alarms, PA, and access control.

2.2.2.4 Cybersecurity and Data Protection

i. Penetration testing and vulnerability scans.
ii. Authentication and encryption validation.
iii. Compliance with data retention and privacy policies.

2.2.2.5 Handover and Training

i. End-user training on system operation and troubleshooting.
ii. Provision of manuals, SOPs, and escalation processes.
iii. Final acceptance testing and sign-off with stakeholders.

2.2.3 Maintenance and Support

2.2.3.1 Warranty

i. Minimum 8 to 10 years warranty for all hardware components.
ii. Schedule for maintenance and requirements.

2.2.3.2 Maintenance Services

i. Regular maintenance schedule to ensure optimal system performance and availability.
ii. Prompt response times for issue resolution.

2.2.4 Documentation

The contractor shall provide comprehensive documentation, including but not limited to:

i. System architecture diagram.
ii. User manuals for system operation and troubleshooting.
iii. As-built documentation.
iv. Installation reports (camera positions, test results, serial numbers).

NB: Documentation formatting and labelling requirements shall be as per the Eskom requirements to be provided to the successful contractor.

2.3 PURPOSE

The purpose of this document is to outline the technical specifications for the installation of a comprehensive surveillance camera system at Kusile Power Station. The surveillance system is intended to enhance the plant monitoring at the power station, ensuring the safety of personnel, protecting critical infrastructure, and enabling effective incident response.

2.3.1 Applicability

This document shall apply to all stakeholders involved and authorized in the safety of personnel and plant at Kusile Power Station.

2.3.2 Limitations of this Revision

Areas identified in section 1.1 are a comprehensive or exhaustive list at the time of compiling and publishing this document. Accessibility might be a challenge in some areas of the plant due to plant conditions from operations.

2.4 NORMATIVE AND INFORMATIVE REFERENCES

2.4.1 Normative

The applicable documents are listed in tables 3 to 5 below. These documents (of the specific indicated revision) form part of this specification.

This section does not include documents cited in other sections or appendices of this specification, documents that are recommended for additional information or documents that serve as examples.

In the event of a conflict between the text of this specification and the applicable parts of the documents listed below, the text of [5] takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations, unless a specific exemption has been obtained from the relevant authorities.

Table 3: Applicable Standards and Codes

Document title	Document number	Revision
[1] Video Surveillance Systems for use in Security Applications.	BS EN 62676-4	
[2] Electrical security installations - CCTV installations – CCTV surveillance systems for use in security applications.	SANS 10222-5:2007	
[3] Video surveillance systems for use in security applications.	IEC 62676	
[4] Information Security, Cybersecurity and Privacy Protection – Information Security Management Systems (ISMS) Requirements	IEC 27001	

Table 4: Applicable Eskom Documents

Document title	Document number	Revision
[5] Specification for CCTV Surveillance with Intruder Detection.	240-91190304	2
[6] Information Security - IT/OT Remote Access Standard	32-373	
[7] Cyber Security Configuration Guideline of Networking Equipment for Operational Technology	240-91479924	
[8] Specification for Electrical Terminal Blocks	240-70413291	
[9] Definition of operational technology (OT) and OT / IT collaboration accountabilities	240-55683502	
[10] Cyber security standard for Operational Technology	240-55410927	

Table 5: Other Applicable Documents

Document title	Document number	Revision
[11] Kusile Power Station Electrical Tunnel/Trench (Conceptual layout)	146838 ES 00071	A

2.4.2 Informative

The following documents as listed in table 6, although not invoked in this specification, provide additional information or examples.

Table 6: References

Document title	Document number	Revision
[12] Video surveillance systems for use in security applications.	IEC EN62676-4	
[13] IEEE Guide for Developing System Requirements Specifications.	IEEE Std1233	1998
[14] Systems and software engineering, Life cycle processes, Requirements engineering.	ISO 29148	2011
[15] European Standard: Alarm systems.	EN 50132-1	2010
[16] Planning, design, installation and operation of CCTV Surveillance Systems	BSIA	2014
[17] Quality Management Systems	ISO 9001	

2.5 DEFINITIONS

2.5.1 Disclosure Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

Table 7: Definition of Terms

Term	Definition
Automatic Gain Control	Automatic gain control (AGC) increases the cameras sensitivity automatically when the ambient light deteriorates.
Availability	Relates to the ability of the system-of-interest to be accessed and operated when needed.
Back Light Compensation	Electronically compensates for high background lighting to give details which would normally be silhouetted.
CCTV Camera	The unit that contains an imaging device that produces a video signal from an optical image.
CCTV system	A system that consists of camera equipment as well as any monitoring and associated equipment for transmission and controlling purposes that is necessary for surveillance of a defined security zone.
AI CCTV camera	A smart surveillance system that uses artificial intelligence to automatically detect, analyse, and respond to activities in real time.
Constrained	A statement that expresses measurable bounds for an element or function of the system. That is, a constraint is a factor that is imposed on the solution by compulsion and may limit or modify the design changes.
Coverage Distance	The distance covered visually between a fixed camera's position and the next camera.
Frames Frequency	The number of frames per second (fps).
Maintainability	Relates to the ability of the intended system to be easily serviced or repaired, including the ability to be easily diagnosed. In this context, maintainability is synonymous with 'Repairability' or 'Serviceability'.
May	Expresses a non-mandatory suggestion with optional compliance by the implementer.
Must	Preferably not used in requirement statements. If both "shall" and "must" are used there is an implication of difference in the degree of responsibility upon the implementer, which is undesirable.
ONVIF Compliance	ONVIF is an international specification with the aim of 'promoting and developing global standards for interfaces of IP-based physical security products.
Reliability	Relates to the ability of the intended system to perform within the specification limits with correct and consistent results over time. This includes the numerical reliability characteristics (with confidence levels, if appropriate).
Remotely Configurable	Ability to change camera settings through a network.
Shall	Expresses a mandatory demand or a binding requirement.
Should	Expresses a non-mandatory preference, desire, target or recommendation. Other implementations of the requirement can be accepted, but the implementer (if challenged) should be able to demonstrate that these other implementations are equivalent or better.
Signal to Noise Ratio	The ratio between useful television signal and disturbing noise signal.
White Balance Control	Automatically adjusts a colour camera's colour to maintain white areas.
Wide Dynamic Range	Ability of camera to provide clear images when there are very light and very dark areas simultaneously in the camera's field of view.
Will	Expresses the future tense or a declaration of intent. For example, "The operator will initialise the system by…" conveys an item of information for the designer but it does not constitute a requirement on the designer.

2.6 ABBREVIATIONS

Abbreviation	Description
AGC	Automatic Gain Control

Abbreviation	Description
CCTV	Closed-Circuit Television
DVM	Digital Video Manager
DVR	Digital Video Recorder
FPS	Frames per Second
LCD	Liquid Crystal Display
ONVIF	Open Network Video Interface Forum
RAM	Reliability, Availability and Maintainability
SNR	Signal to Noise Ratio
WBC	White Balance Control

3. SYSTEM REQUIREMENTS

The components that are common to the existing and the extension system and are required for the entire system to operate are not listed since they are already available. The extended CCTV system can be broken down into four parts. These parts indicate the chain of signalling to provide the footage from the cameras to where the footage is required.

Monitoring Stations: These are the points where a human operator accesses the live and archived/recorded footage from the cameras. These are the access points for the system, and they are made up of the physical machines and the software running on them. Desks and chairs are not included.

Camera Servers: The DVM Camera Servers run the DVM camera server software package which allows interfacing to cameras, analytics, and basic camera administration, amongst others.

Network and Cabling: This consists of network switches and the wired or fibre links joining the network components to each other and to the existing network. Included are the cable trunking, conduits and supports for the conduits.

Field Devices: These include the cameras installed in the area to be monitored as well as supporting equipment e.g., illuminators, supports, shields etc.

3.1 Functional Requirements

3.1.1 Coal Handling Plant

- **Conveyor Speed Detection** – AI cameras must continuously monitor and detect abnormal variations in conveyor belt speed to prevent overloads or system inefficiencies.
- **Conveyor Misalignment Monitoring** – The system should detect belt misalignment in real time to minimize spillage and prevent damage to the conveyor structure.
- **Belt Tear Identification** – AI-powered video analytics must identify early signs of belt tears or damage to reduce downtime and costly repairs.
- **Belt Slip Detection** – Cameras must monitor and alert when conveyor belts experience slippage between the pulley and belt surface.
- **Access Monitoring and Intrusion Detection** – The system must provide real-time monitoring of restricted conveyor areas, with automated alerts and image capture (snapshots) of unauthorized personnel.

- **PPE (Personal Protective Equipment) Compliance** – AI algorithms must detect personnel working without the required PPE (helmets, reflective vests, safety boots, etc.).
- **Dust and Visibility Hazard Detection** – Monitor excessive dust emissions in coal handling areas that may impair visibility or indicate faulty dust suppression systems.
- **Structural integrity Monitoring (Visible Defects)** – Detect visible cracks, leaks, or abnormal movements in ash silos and hoppers that may indicate mechanical or structural failures.
- **Personnel Trip, Slip and Fall Detection** – The camera system must identify and generate alerts for human accidents (falls, slips, or trips) within the coal handling plant.
- **Trip Hazard Detection** – AI analytics should recognize and flag the presence of obstacles, spillage, or obstructions that may create unsafe walking conditions.
- **Event Recording and Incident Evidence** – The system must store video evidence of abnormal events (belt failures, intrusions, accidents) with time-stamped logs for incident investigation.
- **Integration with Plant Monitoring Systems** – AI CCTV alerts and status updates must integrate seamlessly into Kusile's central monitoring systems for immediate operator response.

3.1.2 Ash Handling Plant

- **Conveyor/Belt Monitoring (Speed, Misalignment, Slip, Tear)** – Detect and alert on abnormal belt performance for ash conveyors to prevent blockages and breakdowns.
- **Ash Leakage/Spillage Detection** – AI cameras must identify ash spillages or leaks along transfer points, conveyors, and hoppers to minimize environmental and safety risks.
- **PPE Compliance Monitoring** – Detect personnel entering the AHP area without proper PPE such as respirators, safety helmets, and protective clothing.
- **Dust and Visibility Hazard Detection** – Monitor excessive dust emissions in ash handling areas that may impair visibility or indicate faulty dust suppression systems.
- **Access Monitoring and Unauthorized Entry Detection** – Provide real-time alerts and image capture of unauthorized personnel in high-risk areas like ash silos, hoppers, and conveyors.
- **Trip, Slip and Fall Detection** – Identify and alert on personnel falls or unsafe movements due to wet, dusty, or uneven surfaces common in ash plants.
- **Blockage and Overflow Detection** – Monitor hoppers, silos, and conveyors for signs of material blockages or overfilling conditions.
- **Structural Integrity Monitoring (Visible Defects)** – Detect visible cracks, leaks, or abnormal movements in ash silos and hoppers that may indicate mechanical or structural failures.
- **Fire and Hotspot Detection** – AI cameras must identify smoke, sparks, or hotspots that may result from ash handling equipment overheating or spontaneous combustion.
- **Integration with Plant Monitoring Systems** – Ensure all AI-generated alerts are transmitted to the central control room for immediate operator action and incident recording.

3.1.3 Flue-Gas Desulfurization

- **Conveyor and Slurry System Monitoring** – Detect abnormal speed, misalignment, slippage, or blockages in limestone/gypsum conveyors and slurry feed systems.

- **Leakage and Spillage Detection** – Identify slurry leaks, water seepage, or gypsum spillage around tanks, conveyors, and pipelines.
- **Tank and Pipeline Integrity Monitoring** – Detect visible cracks, corrosion, or abnormal conditions in slurry tanks, absorber units, and pipelines.
- **PPE Compliance Monitoring** – Ensure workers in chemical handling areas wear appropriate PPE (respirators, chemical suits, gloves, helmets).
- **Chemical Exposure Hazard Detection** – Monitor for unsafe personnel activity in areas with potential chemical splash or gas release risk.
- **Slip, Trip and Fall Detection** – Identify unsafe movements or accidents caused by wet, chemical-contaminated, or slippery surfaces.
- **Unauthorized Access Monitoring** – Detect and capture intrusions into restricted areas such as absorber units, chemical storage, and slurry tanks.
- **Dust and Emission Monitoring** – Identify excessive limestone dust or abnormal visible gas emissions around absorber units and chimneys.
- **Fire, Smoke and Hotspot Detection** – Detect sparks, overheating equipment, or smoke near electrical panels, pumps, and conveyor systems.
- **Integration with Plant Monitoring System**– Enable seamless transfer of AI alerts and event logs to the central control system for immediate response and compliance tracking.

3.1.4 Turbine and Auxiliaries, and Lifts/Switchgear Rooms

- **Equipment Integrity and Leak Detection** – Monitor turbines, BFPs, heaters, and associated piping for visible leaks (oil, steam, or water) and abnormal vibrations.
- **Thermal/Hotspot Monitoring** – Detect overheating in turbine casings, bearings, heaters, switchgear panels, and cable joints to prevent fire or equipment damage.
- **Access Control and Intrusion Detection** – Provide real-time alerts and capture images of unauthorized entry into turbine hall, switchgear rooms, or high-risk plant areas.
- **PPE Compliance Monitoring –** Verify that personnel working in high-risk areas wear required PPE (ear protection, helmets, insulated gloves, arc-flash suits in switchgear).
- **Trip, Slip and Fall Detection –** Identify personnel accidents around rotating machinery, elevated platforms, or cable trenches.
- **Arc Flash and Electrical Hazard Monitoring** – AI cameras must detect visible sparks, flashes, or smoke inside switchgear rooms and electrical equipment areas.
- **Obstruction and Trip Hazard Detection** – Identify misplaced tools, cables, or equipment in walkways and access routes around turbine and pump areas.
- **Fire and Smoke Detection** – Early identification of smoke, flames, or overheating equipment in turbine halls, heating plants, and electrical rooms.
- **Emergency Muster and Evacuation Support** – Cameras must support personnel tracking and assist with confirming safe evacuation during emergencies in turbine and electrical areas.
- **Integration with Plant Monitoring and Protection Systems –** AI CCTV alerts (thermal, fire, intrusion, PPE violations, hazards) must integrate with SCADA and plant protection systems for rapid operator response.

3.1.5 Milling plant area

- **Equipment Integrity and Leak Detection** – Monitor mills and associated piping for visible leaks (pf leaks) and abnormal vibrations.
- **PPE Compliance Monitoring –** Verify that personnel working in high-risk areas wear required PPE (ear protection, helmets, insulated gloves).
- **Trip, Slip and Fall Detection –** Identify personnel accidents around rotating machinery, elevated platforms, or cable trenches.
- **Obstruction and Trip Hazard Detection** – Identify misplaced tools, cables, or equipment in walkways and access routes around the fan areas.
- **Fire and Smoke Detection** – Early identification of smoke, flames, or overheating equipment around the mills.
- **Emergency Muster and Evacuation Support** – Cameras must support personnel tracking and assist with confirming safe evacuation during emergencies the fan areas.
- **Integration with Plant Monitoring and Protection Systems –** AI CCTV alerts (thermal, fire, intrusion, PPE violations, hazards) must integrate with SCADA and plant protection systems for rapid operator response.

3.1.6 Boiler Fans (ID, FD, PA)

- **Equipment Integrity and Leak Detection** – Monitor fans and associated piping for visible leaks (pf leaks) and abnormal vibrations.
- **PPE Compliance Monitoring –** Verify that personnel working in high-risk areas wear required PPE (ear protection, helmets, insulated gloves).
- **Trip, Slip and Fall Detection –** Identify personnel accidents around rotating machinery, elevated platforms, or cable trenches.
- **Obstruction and Trip Hazard Detection** – Identify misplaced tools, cables, or equipment in walkways and access routes around the fan areas.
- **Fire and Smoke Detection** – Early identification of smoke, flames, or overheating equipment around the fans.
- **Emergency Muster and Evacuation Support** – Cameras must support personnel tracking and assist with confirming safe evacuation during emergencies the fan areas.
- **Integration with Plant Monitoring and Protection Systems –** AI CCTV alerts (thermal, fire, intrusion, PPE violations, hazards) must integrate with SCADA and plant protection systems for rapid operator response.

3.2 SYSTEM DEFINITION

3.2.1 Context

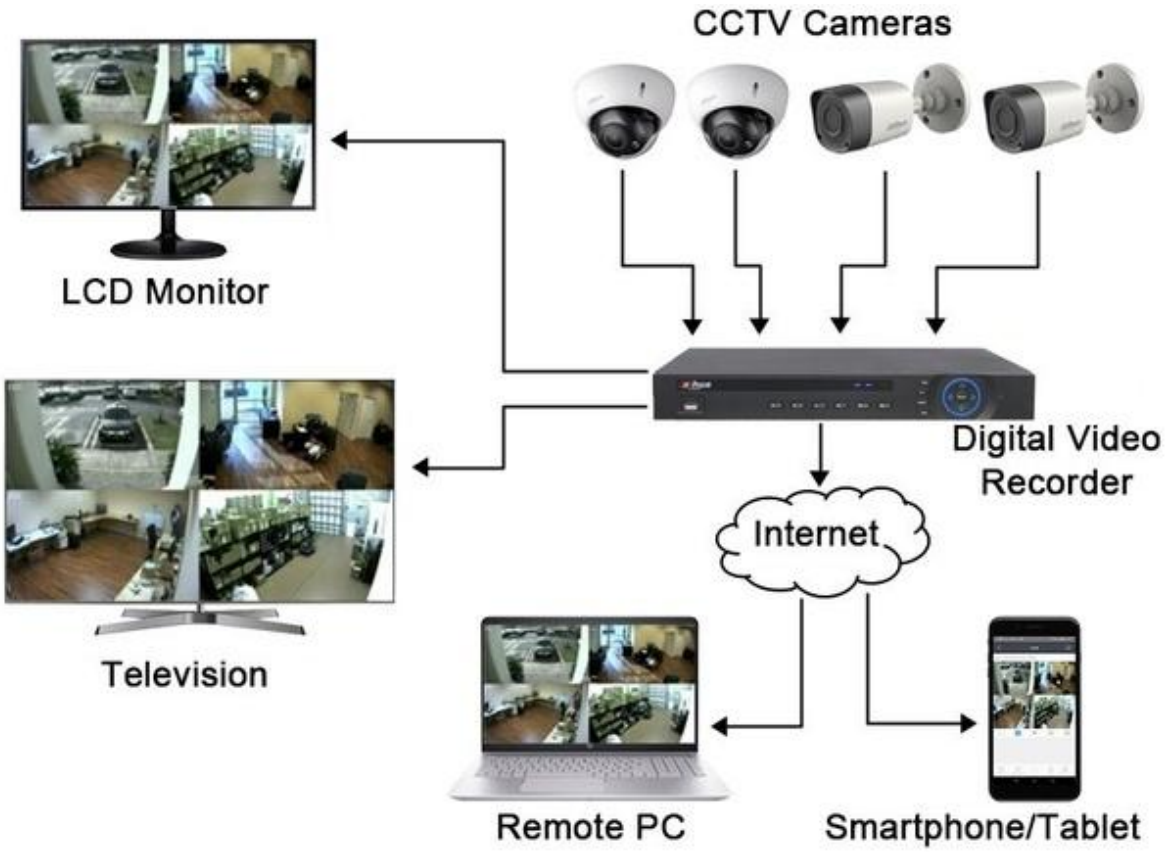

Figure 1: Overview of additional CCTV system – Plant Monitoring

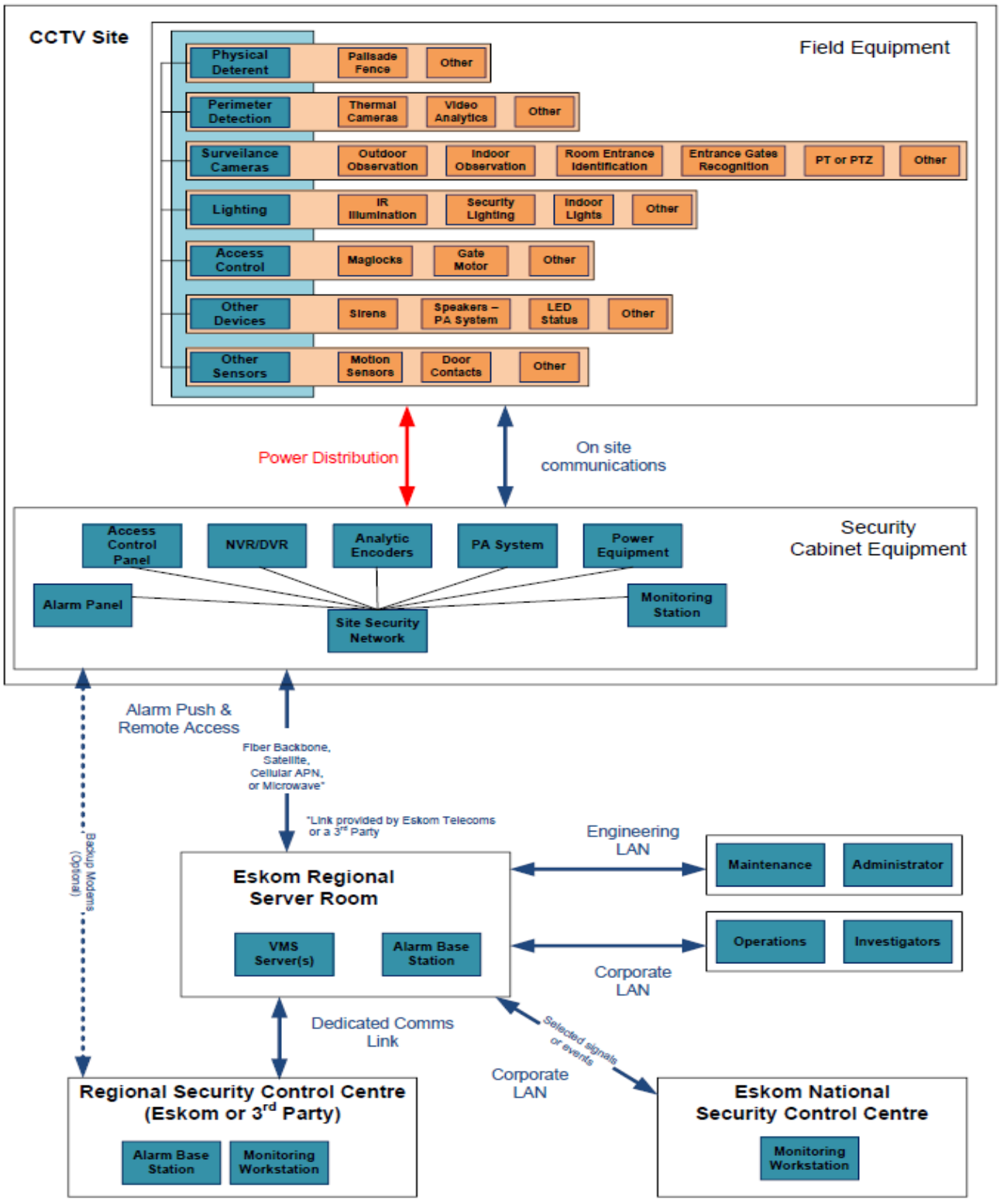

Figure 2: Functional Block Diagram of CCTV System - Security

3.2.2 External Interfaces Identification

i. The external interfaces for the monitoring system will be the remote access capabilities.

3.3 REQUIRED STATES AND MODES

i. Any additions to the existing infrastructure shall not impact the current modes of operation.
ii. The system shall be available during power failures.
iii. Maintenance shall be minimal to minimise downtime.

3.4 SYSTEM FUNCTION AND PERFORMANCE REQUIREMENTS

The following formulae shall be used to evaluate the performance of CCTV and Intruder detection systems and shall be calculated monthly (adapted from DISPAVACE8).

System Availability

System Availability shall be greater than 98%

$$\boldsymbol{System\ Availability} = (\boldsymbol{Total\ hours}) / (\boldsymbol{Total\ non\ operational\ hours})\boldsymbol{Total\ Hours} \times \mathbf{100}$$

This can be calculated per site or per region.

System Reliability

Monthly System Reliability shall be greater than 95%

$$\boldsymbol{Monthly\ System\ Reliability} = \boldsymbol{Number\ of\ Faults\ in\ a\ Month} / \boldsymbol{Number\ of\ Systems\ Installed} \times \mathbf{100}$$

This can be calculated per site or per region.

System Dependability

Any single zone of the alarm / detection system shall give no more than 7 false detections in any 7-day period.

To measure this as a KPI, the following formulae below shall be used.

Monthly System Dependability shall be greater than 85%

$$\boldsymbol{Per\ Site\ System\ Dependability} = (\mathbf{1} - \boldsymbol{Number\ of\ false\ alarms\ in\ a\ month} / \mathbf{400})^2$$

This calculation is per site. Per region, the System dependability is the average of the per site values.

NOTE: This formula was chosen so as to reflect the following:

- 0 false alarms is ideal – 100% Dependable.
- 7 faults per 7 days is acceptable - 85% Dependable.
- 30 faults per 7 days indicates a poorly functioning system – 50% Dependable.
- 100 false alarms per 7 days indicates an unusable system – 0 % Dependable.

3.4.1 System Function (Monitoring)

The specific functional requirements for this type of system:

i. Observation and identification will be required from cameras that will be for monitoring purpose.

ii. The monitoring will be onsite in the plant control rooms on the operator control desks (both units and outside plant). Remote access will be for the identified personnel.

3.4.2 System Function (Security)

Not part of this scope to be done by Eskom Security.

3.5 RELATIONSHIPS BETWEEN STATES, MODES AND FUNCTIONS

N/A

3.6 SYSTEM EXTERNAL INTERFACE REQUIREMENTS

See section 3.2.2

3.6.1 Interface

The system will interface with existing systems at Kusile Power Station and may require access clearance from others.

3.7 EXTERNAL ENVIRONMENTAL REQUIREMENTS

All equipment shall be designed for application in 'special' environmental conditions as follows (adapted from Table 2 of IEC 60255-1):

i. Ambient air temperature: -25°C to +55°C (installed indoors); or -25°C to +70°C (installed outdoors, within enclosures).
ii. Altitude: < 2 500 m.
iii. Pollution: Location in urban areas with industrial activities and without special precautions to minimize the presence of sand or dust (conditions as per classes 3C2 and 3S2 in IEC 60721-3-3).
iv. Relative humidity (24h average): 98%.
v. All outside equipment Including fasteners and supports should be corrosion resistant and appropriate for the environment on site.
vi. After fabrication, metal surfaces including doors and removable covers shall be prepared and finished with corrosion protection.
vii. Paint work damaged during transport and delivery shall be made good as per manufacturer repair specification at no cost to Eskom. If site re-painting is necessary, the equipment and labels shall be carefully masked, and any overpaint which occurs in spite of the masking must be removed. If the damage is not repairable, Eskom reserves the right to return the equipment.
viii. All nuts, bolts and washers use for the construction to be stainless steel. Screws can be cadmium plated.
ix. Equipment installed will need added dust protection.
x. Convection cooled (fan-less) equipment are strongly preferred. If fans are used, they shall be speed controlled and the electronics shall be isolated and conformal coated to protect against dust ingress.

3.8 EXTERNAL RESOURCE UTILISATION REQUIREMENTS

i. The expected life of equipment shall be a minimum of 8 to 10 years.
ii. All power cable shall be appropriately sized to ensure voltage drops along cable runs remain within the operating specifications of the equipment being powered.
iii. All equipment shall be effectively protected against overvoltage due to lighting strikes or switching surges by strategically placed surge arrestors.
iv. Descriptive cable markings shall be used as agreed to with Eskom. These shall be reflected on the drawings.
v. Cable selection and routing shall always be done in such a way that operation of equipment is not affected by electrical interference. This may be achieved by separating power and communications cables, shielding of cables, or a combination of the two.
vi. Equipment shall not be affected by electrostatic discharges that are applied directly to the equipment or to metal objects in the proximity of the equipment: All electronic equipment shall be a class 2 device as specified in IEEE 1613-2009, 8 Electrostatic discharge tests.

3.9 PHYSICAL CHARACTERISTICS REQUIREMENTS

Over and above the requirements covered in section 3.7 and 3.8 above the following additional requirements shall be catered for:

i. Cable routing.
ii. Outdoor cables and trenching (where required).
iii. Interface to security cabinets.
iv. Backup power supplies.
v. Communication.

3.10 SAFETY

The site-specific Health and Safety plan shall be accepted by an Eskom Health and Safety practitioner before any installation begins.

3.11 RELIABILITY, AVAILABILITY AND MAINTAINABILITY

The RAM for the CCTV system must involves a combination of quality components, robust design, proactive maintenance, and user-friendly interfaces. Regular monitoring, testing, and adherence to best practices in system design and operation contribute to the overall effectiveness of the CCTV system in providing continuous and reliable surveillance.

3.11.1 Reliability

The reliability of the system shall have the ability to consistently, accurately capture and record video footage without failures or disruptions.

3.11.2 Availability

The availability of the system being supplied over its life in percentage of time shall be 99.99% or greater measured annually.

3.11.3 Maintainability

The system should be designed to cater for ease and efficiency of repairs (availability of spares), upgrades and maintenance.

3.12 AFFORDABILITY

The design should try to minimise costs for construction plus running costs.

3.13 SYSTEM LIFE-EXPECTANCY

i. All equipment shall be supported and maintainable until the station's end of life.
ii. Proven technology shall be utilized.

3.14 SECURITY

The system shall be designed to protect the plant and the station from unauthorised access and cyber-attacks.

3.15 DESIGN AND CONSTRUCTION REQUIREMENTS

3.15.1 General Design and Manufacturing Process Constraints

a) Flexibility, expandability, scalability, and reusability must be provided to support future areas of growth or changes in technology and purpose:

i. **Expandability:** the capability of the intended system to be easily modified in response to potential areas of growth in requirements. Once modified, the system may require different procedures with respect to operations, maintenance, or both.

ii. **Flexibility:** the ease with which the intended system can be modified to be able to handle input variety and input volume changes, differing from those for which the system was specifically designed. An example would be anticipated changes in the quality of coal delivered to a coal-fired power-station at some future date.

iii. **Scalability:** the capability of the intended system to continue operating correctly with minimal change in current procedures as the system is enlarged to accommodate growth; and

iv. **Reusability:** the capability of the intended system to be deployed into scenarios different to the initial requirement and environment.

b) Training of personnel who will use or support the system identified by the client shall be provided.

3.15.2 Sub-System Requirements

N/A.

3.15.3 Engineering Disciplinary Requirements

Kusile Power Station engineers shall be able to connect to the Local OT Security Server remotely from the Eskom Engineering (OT) LAN to perform maintenance and administrative tasks on the system.

3.15.3.1 Civil and Structural

To be catered for in the design proposals.

3.15.3.2 Mechanical and Materials

To be catered for in the design proposals.

3.15.3.3 Chemical and Process

N/A.

3.15.3.4 Electrical

See section 3.8

3.15.3.5 Instrumentation and Control

Manual and automatic actions for system initiation and control, indicators, alarms, manual controls that are used to operate the system, required ranges and accuracies to be provided for in the designs.

3.15.3.6 Computer Hardware and Software

For any software that may require licences (if any):

i. All licenses covering the equipment, standard software and application software provided shall be provided for.
ii. All licenses shall remain valid in the event of the failure and replacement of faulty equipment.
iii. All licenses provided shall be valid for the entire life of the system being provided.
iv. All licenses shall be site licenses for use at Kusile Power Station Site.

3.15.3.7 Fire Detection and Protection

To be catered for in the design proposals.

3.15.4 Human Factors Engineering Requirements

N/A.

3.15.5 Documentation

The Contractor is responsible to plan for the supply of the documentation during the design, supply, installation, testing, commissioning and handover of the CCTV System and a document is thus any written or pictorial information describing, defining, specifying, or certifying activities, requirements, procedures and or results.

All documentation (entire architectural, equipment room layout, loop diagrams drawings, datasheets etc.) issued by the Employer for this contract is copyright protected and are not to be copied or distributed by the Contractor [10].

The Contractor shall submit all documentation on a formal transmittal form in triplicate to the Project Manager. All documents, reports and engineering documentation shall be compiled and presented in English language be in the required Microsoft Office Word, PowerPoint, Excel, PDF and or Project file extensions format.

The Contractor shall implement a legible, comprehensive, and complete documentation (control system), including their revision status and of the document status in relation to the "as designed" system status. Software licence, network architecture manuals and drawings, document control, loop diagrams, termination diagrams are included.

The drawing documentation format shall include:

Drawing number (Employer and makers number)

i. Revision.

ii. Approval status.

iii. Location of drawing at that stage.

iv. Drawing KKS number.

v. Drawing description.

vi. Sheet number.

vii. Transmittal number.

3.15.6 Packaging, Handling and Transporting Requirements

i. All the identified equipment that will be supplied as part of the scope shall be packaged such that it can be easily transported without being damaged.
ii. Dedicated areas shall be provided by Kusile Power Station for temporary storage.
iii. A detailed inventory of all equipment that is stored in the storage areas shall be provided.

3.16 OTHER REQUIREMENTS

To ensure that the CCTV camera system is designed, installed, and commissioned to the highest international standards, it is essential that the appointed contractor holds valid ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health and Safety Management) certifications:

- ISO 9001 provides assurance of consistent quality management practices, reducing errors, ensuring compliance with technical standards, and guaranteeing reliable system performance.
- ISO 14001 ensures that environmental impacts such as electronic waste, cabling offcuts, batteries, packaging, and energy use are managed responsibly and in compliance with environmental legislation.

3.17 ISO 45001 DEMONSTRATES THAT THE CONTRACTOR PRIORITIZES OCCUPATIONAL HEALTH AND SAFETY BY IDENTIFYING HAZARDS SUCH AS WORKING AT HEIGHTS, ELECTRICAL RISKS, AND MANUAL HANDLING, AND IMPLEMENTING CONTROLS TO PROTECT WORKERS AND THE PUBLIC.PRECEDENCE OF REQUIREMENTS

Shall be dealt with contractually.

3.18 VERIFICATION

The Contractor shall demonstrate that the CCTV System hardware equipment has been tested satisfactory by producing the test certificates. The contractor shall demonstrate the functionality of the system prior to the installation of the system in the production environment through a FAT. Furthermore, it is the responsibility of the Contractor to ensure that the system is tested after installation to the satisfaction of the Employer's data quality requirements with commissioning and a SAT.
The Testing environment needs to be accommodated that may be used as training once the system is deployed in production by the Contractor. As well as the production environment needs to be created for production or security. The submissions shall include the various test phases as stated in section 3.5 of [5].

3.19 NOTES

This project is of a strategic nature and covers aspects of compliance to requirements of the National Key Point. All the information and discussions will be treated in strict confidentiality and should not be shared without the consent of Eskom.

4. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Christopher Nani	Power Station General Manager
Sipho Shabangu	Risk and Assurance
Fulufhelo Netshiongolwe	Engineering Manager (Acting)
Abel Vuma	Maintenance Manager
Dumi Gama	Operating Manager
Isaac Sithole	Compliance Manager (GMR 2.1)
Siyabonga Mahaye	Outage Manager

5. REVISIONS

Date	Rev.	Compiler	Remarks
February 2024	1	Joseph Ngqendesha	First issue
July 2024	2	Joseph Ngqendesha	Removed Security scope – to be done by Eskom Security
October 2024	3	Joseph Ngqendesha	Included costing on tables 1 to 3 from the site clarification meeting
September 2025	4	Sibonelo Mtambo	Included AI Cameras scope

5.1 PLANNED FUTURE UPDATES

To Be Determined.

6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- Harold Marobane
- Joseph Ngqendesha
- Puseletso Ndlovu
- Sibonelo Mtambo

7. ACKNOWLEDGEMENTS

N/A

APPENDIX A: REQUIREMENTS TRACEABILITY

N/A.