

	<p style="text-align: center;">Specification</p>	<p style="text-align: center;">Medupi Power Station</p>
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EXECUTIVE OVERVIEW

Medupi power Station requires the design, supply, erection (and / or installation) and commissioning of an intelligent plant monitoring and surveillance system (IPMSS) with integrated artificial intelligence. The intelligent surveillance or monitoring system using the self-learning artificial intelligence will primarily be used to detect and alarm abnormal and unauthorized activities in the plant. The system will also be used for plant condition monitoring where suitable and also to investigate unauthorized human initiated plant trips. The system should use a combination of surveillance and monitoring techniques and technologies best suited for the application and plant area. A multi-sensor approach is proposed using technologies with different physical sensing mediums. As a minimum the following monitoring techniques and technologies should be used each integrated with some artificial intelligence to be able to execute the plant monitoring and alarming functions:

- 1) CCTV surveillance with integrated artificial intelligence
- 2) Distributed Acoustic Sensing or technology with similar functionalities
- 3) Drone technologies

The project scope is divided into two main components:

- A. Digitisation of the plant and creation of a Digital Twin
- B. Asset Monitoring and Management

In order to accurately monitor the plant, first step is to create a digital twin of the plant from which any changes could be tracked and possibly alarmed as potential abnormalities depending on AI algorithm. Then once the digital twin is created, active monitoring through the multi-sensors and technologies referenced above will further enhance the effectiveness of the solution culminating in better asset monitoring and management. With the self-learning capability, the surveillance system will be trained to differentiate between normal and authorized activities versus the abnormal and unauthorized activities. The selection of the areas and technologies to be implemented will be based on suitability of the technology for that particular plant area and risk of plant trip or load loss or plant damage due to the unauthorized and abnormal activity. Medupi currently has cameras installed as part of its centralized building management system (CBMS) which will need to be integrated into the IPMSS as well to provide a wider site coverage for the IPMSS.

2. GENERAL

2.1 INTERPRETATION AND TERMINOLOGY

2.1.1 Definitions

Definition	Description
Artificial Intelligence	Simulation of human intelligence processes by computer systems.
Controlled disclosure	Controlled disclosure to external parties (either enforced by law, or discretionary).

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System	An integrated set of constituent pieces that are combined in an operational or support environment to accomplish a defined objective. These pieces include people, hardware, software, firmware, information, procedures, facilities, services and other support facets.
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2.1.2 Abbreviations

Abbreviation & Acronyms	Description
AI	Artificial Intelligence
BIM	Building Information Model
CBMS	Centralized Building Management System
CCTV	Closed Circuit Television
C&I	Control and Instrumentation
CMD	Construction Management Department
CRM	Customer Relation Management
DAS	Distributed Acoustic Sensing
DVR	Digital Video Recorder
EDWL	Engineering Design Work Lead
ECM	Engineering Change Management
EOD	Electrical Operating Desk
EPPA	Emergency Preparedness Public Announcement
ERP	Enterprise Resource Planning
ETL	Extract Transform Load
GIS	Geographic Information System
HMI	Human Machine Interface
IP	Ingress Protection
IPMSS	Intelligent Plant Monitoring and Surveillance System
LiDAR	Light Detection and Ranging

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LOD	Level of Detail
LPR	License Plate Recognition
NVR	Network Video Recorder
PS	Power Station
PSM	Power Station Manager
PTZ	Pan-Tilt-Zoom
SCADA	Supervisory Control and Data Acquisition
SLAM	Simultaneous Localization and Mapping
SSB	Station Services Building
UPS	Uninterrupted Power Supply
mV	Mill-Volts
μV	Micro Volts
VDSS	Vendor Documentation Submittal Schedule
VMS	Video Management Software

2.1.3 Applicability

- (1) The requirements defined in this document apply to the whole of the Works for the Medupi IPMSS Project.

3. DESCRIPTION OF THE WORKS

3.1 OVERALL SCOPE FOR THE WORKS

- (1) The Works shall provide for all plant and material and all equipment and services to execute all Works to fulfil all requirements specified in this Specification.
- (2) This shall include the engineering, design, procurement, delivery, off-loading at site, storage, installation, testing, commissioning, optimisation, training of the system, system administration, maintenance of the system and as-built documentation for the Medupi IPMSS.

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3.1.1 Digitisation and Digital Twin Creation

- (1) The first objective is to develop a digital replica of the plant which is continuously updated in order to pick up changes in plant conditions, capturing the layout and function of each section and system and representing it in near to real life imagery.
- (2) The mapping and digitisation shall be conducted using drones and terrestrial (fixed and mobile) LiDAR to create a 3D BIM site model for digital twin simulation and analysis. This encompasses all plant infrastructure, including processing and structural systems.
- (3) The digital model should be delivered as a 3D CAD file and .obj 3D mesh, with each component modelled individually for integration and system analysis purposes.
- (4) The digitized model of the plant should also be made available on supplied HMI with easy navigations to specific plant areas from overall plant imagery.
- (5) The required Level of Detail (LOD) should be LOD 300 for structural systems for layout creation and LOD 200 encompassing all machinery and process plant.
- (6) The digital twin shall be used and configured to automatically create and update an asset register for the whole plant. As the plant has different sections and zone – the created asset register should be configured such that one is able to view only items from a section on the register as one navigates the digital twin created. For example, from the asset register created from the digital twin, one should be able to view at a given time all items (or assets) at stores or warehouse discriminable within the specified LOD 200.

3.1.2 Asset Monitoring and Management

- (1) The Works also requires the installation of advanced security and monitoring systems using AI and connectivity at all plant access points and strategic locations to oversee critical infrastructure within the generation units and surrounding structures.
- (2) The security systems should enable smart monitoring with centralised and linked information, detecting people, vehicles, and objects, and analysing individual behaviours for inconsistencies and outliers.
- (3) The system should operate on a secure central database with links to reaction units or operators and historical data.
- (4) The objective is to deploy smart sensors and devices such as LiDAR, RGB, and thermal cameras for comprehensive site monitoring to reduce sabotage, theft, and optimise plant operations.
- (5) Asset monitoring and preventative maintenance will be implemented for all critical processes within the plant as well.
- (6) Specialised drones with enterprise-grade RGB and thermal cameras will inspect and map external structures and create accurate digital replicas for desktop analysis, while confined space drones equipped with RGB, thermal, and SLAM LiDAR will map and inspect internal structures such as stacks, support systems, warehouses, and generation units. The inspection system should be small enough to fit into access hatches and manholes to enable the inspection of critical infrastructure.

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- (7) A Professional Engineer (Pr. Eng) report will detail findings, classify identified issues, and provide recommendations for remedial actions. The data must be linked to a digital asset management system hosted on local server, enabling map, point cloud, engineering report, and 3D model uploads and access to historical records and change analysis.

3.2 GENERAL SYSTEM DESCRIPTION

- (1) The IPMSS shall implement a technology-driven asset management and security solution to enhance the effective management of the plant. The proposed solution should leverage the latest digital technologies, AI, and smart sensors to optimise plant management, improve security breach detection speed and accuracy, and employ proactive, continuous maintenance to ensure all systems operate at peak performance.
- (2) The IPMSS should be designed, installed, and trained to detect, alarm and record abnormal and unauthorized activities (human or other activities) that has a potential for a unit load loss or to trip or damage the plant.
- (3) The data platform to be used for the IPMSS shall be able to receive, analyse and correlate the incoming events, visual data, meta data, and logs from the disparate systems, such as the video analytics, sensor data, license plate recognition, emergency calls, internal departmental incidents and activation and emergency notifications, into one unified common operational forensic platform, fusing all the information together to provide a forensic picture, for managing the enterprise risk and monitoring abnormal scenarios.
- (4) Solution components should include a Data Fusion Command and Control platform AI system, integration to EPPA system, a Video Analytics component based on deep machine learning for behaviour analysis and abnormal activity detection, a Face Recognition component with link to different type of watch lists, a Video Content Analysis for historical forensic search and an LPR detection system for managing vehicle watch lists.
- (5) The system should offer additional modules for a machine learning engine and predictions module, which will analyse the data and correlated logs and events, to generate big data-based trends, predictions, abnormal peaks of events and data relationships. The machine learning engine should include an AI BOT to recommend tasks to assist people who are reporting incidents and collect additional information with them to better address and resolve the incident.
- (6) The proposed solution shall utilise and be able to integrate the existing already installed systems such as the existing VMS, BMS, SCADA, Cameras, analytics, biometric, SAP, payroll, access control and EPPA systems.
- (7) Below in Figure 1 is a representation of the simplified system architecture showing the subsystems of the IPMSS.

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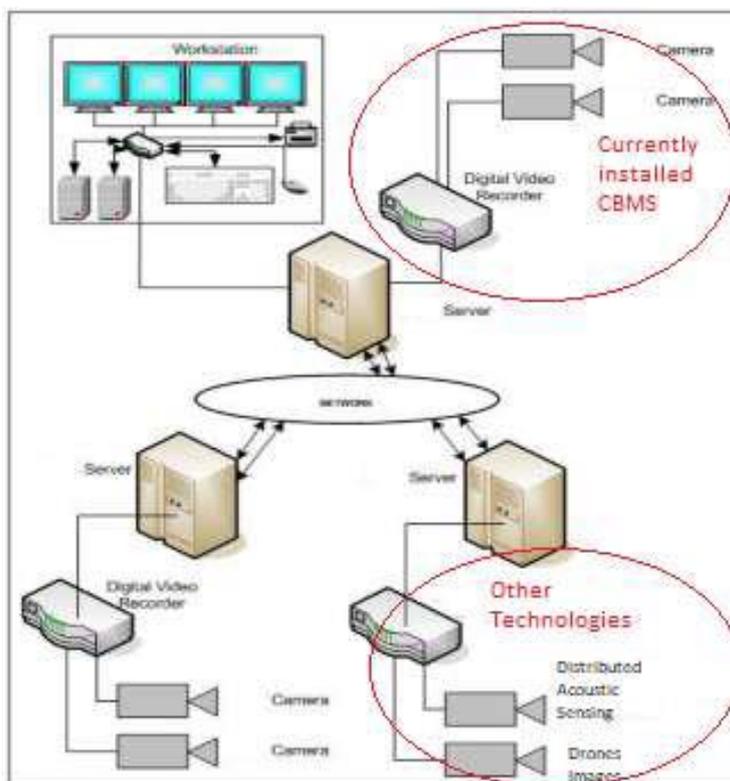


Figure 1: Simplified System Architecture

(8) The typical sub-systems of the IPMSS which are part of the scope of works include:

- i. Industrial surveillance cameras (inclusive of thermal and SLAM LiDAR) to be installed at specified areas.
- ii. Digital Video Recorders (DVRs) and Network Video Recorders (NVRs).
- iii. AI and video Analytics modules.
- iv. Long term recording storage servers.
- v. Servers for storage of information.
- vi. Servers and computers for artificial intelligence implementation.
- vii. Network to connect the different areas.
- viii. Interfaces to currently installed video feeds from Medupi CBMS.
- ix. Interfaces to other plant monitoring technologies such as drones and distributed acoustic sensing systems.
- x. Workstations to view alarms, live and recorded feeds.
- xi. Workstations to view and extract reports on condition of plant areas.
- xii. Engineering workstations for engineering the system.

(9) The system shall have the following functionalities as a minimum:

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- i. Digitization or point cloud representation of the plant at agreed intervals per system area depending on criticality and risk probability.
- ii. GIS engine / digital twin / Building information management (BIM) – for managing dynamic layers of geo-referenced or CAD data, real time tracking and data display, management and activation of devices straight from the map, display of vector and aerial images, virtual fences, etc.
- iii. 2D and 3D facility layout and floor plans - display of all building and plant plans and blueprints, floor plans, location of sensors and devices, etc. Including support of 3D dynamic display of external and internal building with sensors.
- iv. Live feeds from all technologies implemented accessible from any of the workstations provided.
- v. Video streaming server – for remote cameras to be connected with the multi-cast video streaming engine. This would allow a control room to view the live stream of these cameras on any remote user.
- vi. All technologies implemented to have a measure of artificial intelligence (AI) to detect abnormal or unauthorized activities through training of the technologies.
- vii. Alarms of detected abnormal or unauthorized activities from all implemented technologies accessible from any of the workstations provided.
- viii. Minimum storage of at least 7 days for all feeds and records.
- ix. Reports on prevailing plant condition extracted from all technologies implemented and accessible from all workstations provided.
- x. Open-architecture integrated Command and Control engine with API that allows the integration and fusion of systems such as: CCTV, intrusion alarm, access control, fire alarm, EPPA, perimeter, dashcams, radars, drones, ICT, IP Telephony, radio communications, building controllers, cyber systems, ERP, CRM, IT & external data sources based on ETL processes, intelligence & social media and other 3rd party systems.
- xi. Real time integration, with algorithms and analytics – radars, day/night cameras for continuous tracking, drone integration and dispatch, video analytics, facial recognition and license plate recognition through a VMS platform.
- xii. Sensor management and rule engine with automated actions – monitoring of sensor data, plotting of sensors, controlling sensors via commands, creating simple or complex scenarios and defining automated operations and correlations via the rule engine and orchestrate the events arriving from the integration server.
- xiii. Incident management system - for automatic incident reporting that allows data correlation, fusion, and analysis, with incident templates, triage tree and escalations, managing incidents.
- xiv. Computer aided dispatch – for dispatching the closest available responder to the incident location. Should allow for defining hierarchy and linking responders to different territories, managing job titles and roles, response per incident type, dispatching groups or individuals.
- xv. AI based BOT for automated Incident handling and analysis – A programable bot that can analyse the most common incidents and recommend actions to operators or external reporting.

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xvi. Threat intelligence monitoring – with api links to social medial platforms such as Facebook, Twitter, News, Weather, Interpol, Travel Advisory, other external and internal intelligence sources. Convert to incident with procedure, mass notifications, GEO positioning of threat, Trend Analysis, etc.

3.2.1 Chosen Technologies to be Implemented

- (1) The following technologies as a minimum shall be implemented to cover the suited areas as per below:
 - a. Point cloud digitization of the whole plant to be used to identify differences in plant from different digitization dates and use this to alarm for possible abnormalities to plant using implemented AI. Also, the digital twin will be used to maintain an asset register of the plant.
 - b. Industrial cameras – to be installed at every unit's:
 - i. Boiler house (0M, 9M and 16M)
 - ii. Turbine hall and Lube Oil Room
 - iii. PJFF area
 - iv. On top of Unit and Station transformers
 - c. Distributed acoustic sensing or similar technology – to be installed at:
 - i. perimeter fences of plant even plant outside the main Medupi plant
 - ii. specified cable trays to monitor conditions of cables
 - iii. along Overland Conveyor 1 (OV1) to monitor condition of OV1 – the belt connecting Medupi and the mine.
 - d. Drone technologies – to be deployed for:
 - i. Boiler tube inspections
 - ii. ACC system inspections
 - iii. Silo inspections
 - iv. Reaction to any detection of abnormal or unauthorized activities on any plant.
 - (2) Other technology options can be proposed to cover the above areas for considerations only as options.

3.2.2 Abnormal and Unauthorized Activities

Abnormal and unauthorized activities include but is not limited to the below:

- 1) Detection of a person who usually does not work in a certain area.
- 2) An activity that usually does not happen in a certain area.

3.2.3 Abnormal and Unauthorized Activities Detection

Abnormal and unauthorized activities detection methods include but is not limited to the below:

- 1) Self-training to detect faces that usually do not work in an area.

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- 2) Self-training to detect activity that usually does not happen in a certain area.

3.2.4 Abnormal and Unauthorized Activities Alarming

Once an abnormal and or an unauthorized activity is detected, the following typical alarming should occur:

- 1) An alarm is sounded in that area where the abnormal and unauthorized is detected.
- 2) The sounded alarm is then followed by a voice warning with alerting all that an unauthorized person or activity has been detected and telling all to ensure that they have the necessary the authorization to be in the area or the activities been undertaken.
- 3) In noisy areas where sounded alarms cannot be reasonably heard, visual warning devices can be used.

3.3 DESIGN STANDARDS, GUIDELINES AND CODES

- (1) The IPMSS shall comply to the standards and guidelines as detailed in Appendix B (Design Standards, Guidelines and Codes) as a minimum:
- (2) The Contractor shall obtain his own copies of International and National standards.
- (3) The Contractor shall report any conflict within this Specification, with any referenced standards, specifications or technical guideline.
- (4) This Specification shall take precedence over differences existing between this Specification and any document except for statutory requirements.
- (5) Substitutions of any standard shall be approved by the Engineer. Additional standards proposed by the Contractor shall be submitted to the Engineer for approval.
- (6) Only the most recent versions of the relevant standards, guidelines, or codes shall be used with this Works.

3.4 INTELLIGENT PLANT MONITORING AND SURVEILLANCE SYSTEM DETAILED REQUIREMENTS

3.4.1 Overall System Requirements

- (1) The IPMSS shall be configured as fully operational systems, stable, responsive, reliable, and workable in all respects and are implemented in a consistent and integrated manner.
- (2) The IPMSS provided shall be configured, designed, engineered, installed and commissioned using this Specification, OEM best practices and industry best practices.
- (3) The System shall have self-diagnostic to detect failure and bring it to attention of maintenance team.
- (4) The System shall have AI capabilities for self-learning to be able to detect, alarm and record abnormal and unauthorized activities within selected areas as defined in this Specification.

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3.4.2 General System Requirements and System Architecture

- 1) System shall be scalable allowing for de-centralised components in different locations under a centralised control over a packet-based network backbone.
- 2) De-centralized units shall typically include the video surveillance cameras and warning devices with centralized redundant long-term video recordings storage servers.
- 3) The system components shall provide network redundancy by doubling on the TCP/IP Ethernet interfaces.
- 4) The system manager shall be capable of monitoring all de-centralised zones centrally and logging all events with an option to interface this with existing plant DCS especially for alarming system failures.

3.4.3 General Human Machine Interface (HMI) Requirements

- 1) Live Feed viewing screens or workstations shall be installed at the Outside Plant Control Room, Electrical Operating Desk (EOD), Emergency Operations Centre and Access Control Building.
- 2) Two Engineering Workstation with live feed viewing shall be installed at the SSB Computer Room.
- 3) The Engineering Workstations shall have installed all the analysis and reporting software for the implemented technologies.
- 4) A minimum of 2 screens per installation of workstations or viewing screens is required.
- 5) Overview Mimic through which one can navigate to the different zones of the plant is required.
- 6) Typical zones for the plant are as proposed below and in the aerial photo below as well.
- 7) Live video feeds for zones where Contractor did not install can be sourced from the CBMS of Medupi – integration to CBMS is a requirement of this specification.

Zone	Sub-Zone
Zone 1 Unit 1	1A ACC 1B Turbine Hall 1C Aux Bay 1D Boiler 1E FFP & FFP s/s
Zone 2 Unit 2	2A ACC 2B Turbine Hall 2C Aux Bay 2D Boiler 2E FFP & FFP s/s
Zone 3 Unit 3	3A ACC 3B Turbine Hall

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	3C Aux Bay 3D Boiler 3E FFP & FFP s/s
Zone 4 Unit 4	4A ACC 4B Turbine Hall 4C Aux Bay 4D Boiler 4E FFP & FFP s/s
Zone 5 Unit 5	5A ACC 5B Turbine Hall 5C Aux Bay 5D Boiler 5E FFP & FFP s/s
Zone 6 Unit 6	6A ACC 6B Turbine Hall 6C Aux Bay 6D Boiler 6E FFP & FFP s/s
Zone 7 BOP South	7A WTP & WTP South 7B BFO s/s & Pump House 7C LAB & Lab offices 7D Fly ash & LP Gas 7E Water Head Tank & Fire Pump House 7F SSB 7G Aux Boiler 7 H Aux Cooling & sandblasting & ACC construction
Zone 8 H-Block	8A H-Block
Zone 9 Admin Building	9A Admin office block & Helipad 9B Canteen 9C Fire Station & Workshop / Stores & s/s 9D Workshop & stores & Garage store 9E Warehouse B & Filling Station & Petrol Diesel & TH1
Zone 10 Access control	10A Access Control Building & Isotope 10B Sewage Treatment Plant & Dams 10C Recreational Area
Zone 11 10 000 Silo	11A Coal conveyor
Zone 12 Plant West	12A North Silo 12B South Silo & Diesel Generator & S/S West 12C South Chimney 12D North Chimney
Zone 13 Coal stockyard	13A TH2 & TH3 & Coal Offices 13B TH4 & TH5 & TH6 & Coal stock yard pollution control dam

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	13C Waste Storage Area 13D Stacker / Reclaimer
Zone 14 Ash Plant (out of perimeter fence)	14A Workshop & offices 7 TH 14B Overland Conveyor
Zone 15 Raw water dams (Outside perimeter fence)	15A Raw Water Dams
Zone 16 outside zones	16A Outside Zone

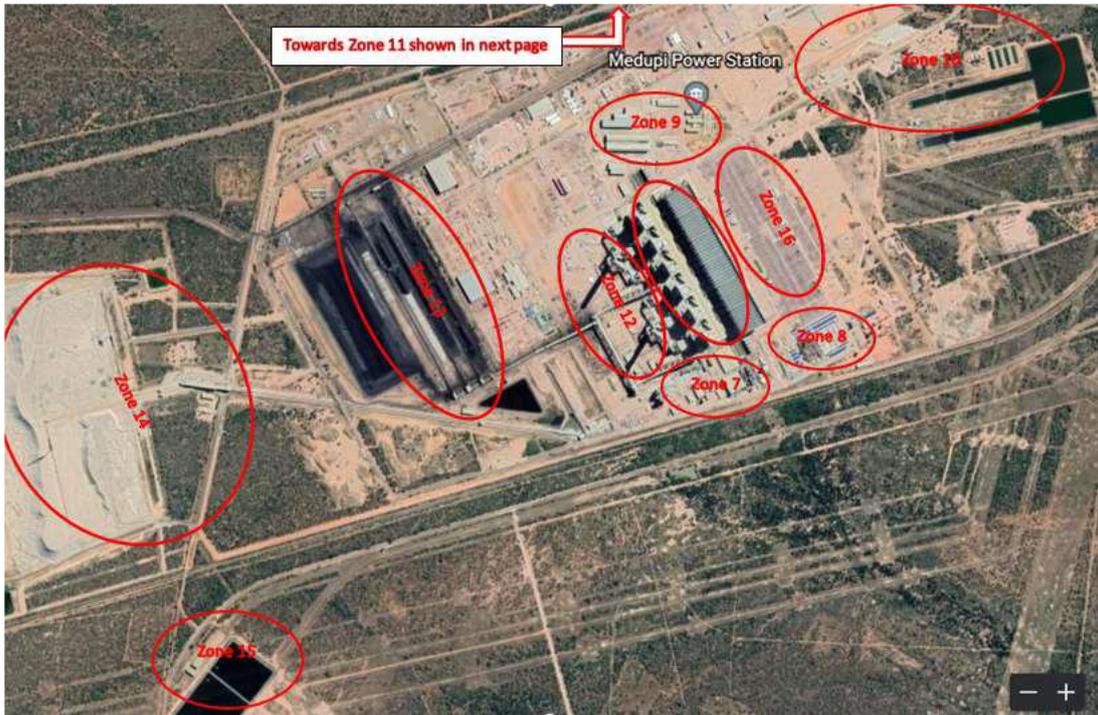


Figure 2: Medupi Zones

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Figure 3: Zone 11

3.4.4 Camera System

- 1) The Contractor shall provide all hardware, software and cabling required for the system to be fully functional as part of the Works.
- 2) The cameras shall have a minimum resolution of 640x480 pixels.
- 3) The thermal cameras should have a minimum temperature sensitivity of 0.05°C.
- 4) The cameras should have a minimum detection range of 1000 meters.
- 5) The cameras should have a minimum frame rate of 30 fps.
- 6) The cameras should have a minimum spectral range of 7.5 µm to 14 µm.
- 7) The cameras should be capable of being integrated with existing surveillance systems.
- 8) The cameras should be able to withstand harsh environmental conditions such as extreme temperatures, dust, and moisture.
- 9) The camera system shall consist of the following:
 - i. IP and PTZ cameras
 - ii. Opto-thermal camera system that can scan its surrounding area in 360°.
 - iii. camera lens
 - iv. camera housings

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v. camera housing mountings

vi. camera brackets

vii. Poles for fitting cameras

- 10) All cameras shall require low maintenance.
- 11) Lighting condition should not affect the effectiveness of the camera to fulfil the functionalities of the System as specified in this Specification.
- 12) Where cameras are required to be pole mounted in outdoor locations, the Contractor shall design, supply and install all necessary equipment in order to satisfy the requirement. This includes the pole and its fittings as well any necessary cooling system.
- 13) If the pole mounted outdoor cameras require external power, the Contractor's scope shall include furnishing and installing an armoured power cable, suitable for direct burying, from the camera to a substation distribution board, furnished by others and as directed by the Employer.

3.4.4.1 Location or Installation Details

- 1) With reference to 3.2.1 above and Appendix C – Buildings and Room Schedules details of proposed installations are red-marked – these can be changed to best suit the solution offered.
- 2) It is Contractor's responsibility to ensure best suited location are selected to best achieve the specified requirements.

3.4.4.2 Camera Technology Suitability Proving

- 1) Two reference sites where technology has been implemented is required as part of the support documentation for the technology proving – these sites need not be power plants
- 2) To further proof technology suitability to the Medupi environment, access will be granted before commencement of the basic design for technology proving at which point the opto---thermal cameras proposed or similar to the ones proposed shall be used at one of the selected areas to check the effectiveness of detection of unauthorized and abnormal activities or conditions.
- 3) The results of the above sample checking through reports produced by the system will be used as input to the technology suitability proving phase of the project.
- 4) Standard product from OEM should be supplied - only proven OEM solutions are acceptable.

3.4.5 Distributed Acoustic Sensing System or Technology with Similar Functionalities

- 1) The Distributed Acoustics Sensing (DAS) should typically be of single mode fibre with monitoring length of up to 100KM without requiring the use of a remote optically pumped amplifier.
- 2) The DAS system shall be covert in nature thereby "buying time" for response team. Visual and audio alarms can be triggered by the system to act as a deterrent – in some cases wild animals are the unauthorized intruders who could damage for example installed cameras installed along perimeter fencing.

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- 3) The system shall have automatic alarms configured that can be rule based and from the AI or training of the system. These alarms shall be immediately raised on all HMI installed for the IPMSS. These alarms shall also be prioritized as be Eskom requirements.
- 4) The DAS system should also be able to monitor changes in temperature and strain along the length of the fibre optic. This property will ensure that the system is able to be used in applications such as sensing fires and temperature rises in bearing of rollers in conveyor belts.
- 5) The accuracy of locating an event along the whole length of the fibre should be less than 10m, typically 1.8m.
- 6) The accuracy of classifying the nature of the event should be better than 97%.
- 7) The DAS system should use an integrator that uses a single sensing channel that can be cost effectively upgraded by software to detect distances from 10km to 15km to 45km to 60km up to 100km.
- 8) The single sensing cable or channel shall be able to be divided into independent monitoring areas with specific detection parameters for that specific area.
- 9) Integrator shall be able to monitor distance up to 100km using single fibre strand.
- 10) Integrator shall have open application programming interface to be able to integrate to external systems and the centralized HMI or CBMS (if required).
- 11) Integrator shall be modular allowing for hot swapping of system components and or cards.
- 12) DAS system shall be able to be integrated into the implemented drone dispatch system.
- 13) DAS system shall be able to be managed and controlled over a TCP/IP Network.
- 14) Detection events shall be stored both on the integrator and the centralized servers as per Figure 1: Simplified System Architecture.
- 15) Detectable events such as intrusion by human, intrusion by wild animal, vehicles, heavy duty vehicle, fire, rise in temperatures, etc shall be classified using AI machine learning as a mechanism to accurately distinguish or classify the events.

3.4.5.1 Location or Installation Details

- 1) With reference to 3.2.1 above and Appendix C – Buildings and Room Schedules details of proposed installations are red-marked – these can be changed to best suit the solution offered.
- 2) It is Contractor's responsibility to ensure best suited location are selected to best achieve the specified requirements.

3.4.5.2 DAS Technology or Similar Technology Suitability Proving

- 1) Two reference sites where technology has been implemented is required as part of the support documentation for the technology suitability proving – these sites need not be power plants but preferably power plants or similar applications or processes.
- 2) To further proof technology suitability to the Medupi environment, access will be granted before commencement of the basic design for technology proving at which point the DAS system proposed or similar to the ones proposed shall be used at one of the selected areas to check the effectiveness of detection of unauthorized and abnormal activities or conditions.

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- 3) The results of the above sample checking through reports produced by the system will be used as input to the technology suitability proving phase of the project.
- 4) Standard product from OEM should be supplied - only proven OEM solutions are acceptable.

3.4.6 Drone System

- 1) Drone system should be suited for the environment it will operate in.
- 2) The system shall be modular with normal video and thermal imaging camera modules.
- 3) Drone should have anti—collision or collision resistant structure as it will navigate through small spaces and corners in the plant.
- 4) Images (thermal and optical) from the drone should be able to detect small cracks in all structures, leaks in tubes, smokestack inspections, ash and coal silo inspections,
- 5) Drones should have a minimum 2-hour flight time endurance
- 6) Telemetry range of up to 50km is required for control of the drone as well.
- 7) Position control of the drones shall be GPS and altitude shall both be GPS and barometer based.
- 8) Flight modes shall include as well GPS-based waypoint autonomy.
- 9) For the duration of the Contract Period, an additional exercise to implement an autonomous 'drone-in-a-box' solution to automate inspections and monitoring on a regular continuous basis, where data is captured and uploaded to the server for automated reporting. This additional exercise will establish the viability and legality of implementing such a solution and the effectiveness it can provide.

3.4.6.1 Location or Installation Details

- 1) The drone shall have a docking station where when not in operation it will be securely docked including its controllers, and all its batteries charged.
- 2) The docking station shall also be used as a point of contact for configuration of the drone, downloads or uploads of any software or data, software upgrades, etc.

3.4.6.2 Drone Technology Suitability Proving

- 1) Two reference sites where the particular drones have been implemented is required as part of the support documentation for the technology suitability proving – these sites need not be power plants but preferably power plants or similar applications or processes.
- 2) To further proof technology suitability to the Medupi environment, access will be granted before commencement of the basic design for technology proving at which point the drones proposed or similar to the ones proposed shall be used at one of the selected areas to check the effectiveness of detection of unauthorized and abnormal activities or conditions.
- 3) The results of the above sample checking through reports produced by the system will be used as input to the technology suitability proving phase of the project.
- 4) Standard product from OEM should be supplied - only proven OEM solutions are acceptable.

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3.4.7 Digital Video Recorder or Network Video Recorder

- 1) All equipment and materials shall be industrial based and able to be operated in the harsh power station environment.
- 2) The digital video recorder (DVR or NVR) shall be capable of recording whilst playing back archived footage.
- 3) All software and firmware upgrades shall be made available for the life of the system.
- 4) Any software and firmware upgrade shall not impair the recording of footage from cameras.
- 5) All DVR or NVR shall be integrated into 19" rack mount and or wall mounted cabinets supplied by the Contractor depending on the space available and environmental conditions.
- 6) The Contractor shall recommend the relevant image and video compression method in order to manage storage space for DVR or NVR efficiently also taking into consideration the picture quality required by Employer.
- 7) The digital video recorder (DVR or NVR) shall maintain the specified recording quality (resolution) irrespective of the size of the screen image.
- 8) The operator shall have the ability to remove connected cameras from the DVR without affecting the ability to display other cameras.
- 9) The digital video recorder shall provide a user-programmable twelve-character title for each camera and shall record time and date and title with each video image.
- 10) The DVR or NVR shall be capable of recording and playing back in Full screen, picture-in picture, or 'quad' multi-screen display.
- 11) The DVR or NVR shall have an Event log feature, displaying every event which is recorded on disk.
- 12) The event log shall be searchable by time, date, camera number, camera title, event type, and the state of the event.
- 13) The DVR or NVR shall have the intelligence to monitor events and record images accordingly. The system shall also be able to retrieve this recorded information as required by the authorised personnel using passwords.
- 14) The DVR or NVR shall be capable of prioritizing recordings from cameras which are in alarm conditions.
- 15) The DVR or NVR shall have the ability to move telemetry cameras to a pre-set position on alarm.
- 16) The DVR or NVR shall be capable of forcing individual or groups of cameras into alarm recording condition.
- 17) The DVR or NVR shall provide alarm and event logs for all the alarms/activity.

3.4.8 Video Management Software

- 1) The VMS shall be a highly scalable enterprise level software solution.
- 2) The VMS shall offer a complete video surveillance solution that shall be scalable from one camera to multiple cameras.
- 3) The VMS shall be capable of the following functions:

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- i. Configuration of system components
- ii. Configuration of cameras and monitors
- iii. Multiple live video connections
- iv. Configuration of graphics screens
- v. Programming of alarm-triggered automatic events (e.g., in case of the camera registering unauthorized activity, the DVR shall alert the operator with the camera footage).
 - 4) The VMS shall allow the following as a minimum:
 - i. Live display of cameras and their identification.
 - ii. Control of cameras.
 - iii. Retrieval and playback of archived video (without affecting live recording).
 - iv. Instant Replay of live video.
 - v. Graphical representation of plant and camera location.
 - vi. Configuration of system settings.
 - vii. Search function
 - viii. Priority recording
 - ix. Activity Detection
 - 5) The VMS shall support IP network connectivity.
 - 6) The VMS shall support PTZ functionality on all PTZ cameras.
 - 7) Each camera shall be configured independently from other cameras in the system and altering these settings shall not affect the recording and display settings of other cameras.
 - 8) The VMS shall be used to generate the Graphical User Interfaces (GUI), e.g., site maps, floor layouts. The Contractor shall submit proposals for the GUI for acceptance by the Engineer during Basic Engineering.
 - 9) A map shall represent the area of activity of the user, including position of the cameras and map of situation.
 - 10) An instant replay function shall be available.

3.4.9 Archiving

- 1) All events and alarms from the IPMSS shall be archived and stored in the IPMSS servers for a period of not less than 5 years.
- 2) The DVR / NVR shall be capable of storing video and audio, online, for a period of five years at the originally recorded resolution. This information can be further archived onto external storage media and online servers for long term storage provided by Contractor.
- 3) The online storage capacity shall be scalable.
- 4) The DVR / NVR shall encrypt information copied to external storage and shall be capable of detecting modifications in this information. This information may represent video, audio or still images.

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- 5) The DVR / NVR shall archive the information such that there is no loss of quality or content. Such information shall have 100% availability.
- 6) The DVR / NVR shall allow for both local and remote archiving on online servers provided by Contractor.

3.4.10 Typical CCTV Analytics

- 1) Image classification (human, vehicle, animal)
- 2) Improve the safety and security of workers using PPE detection and receiving alerts when employees are too close to dangerous machinery or enter a hazardous or restricted area without PPE
- 3) Ensure building security using facial recognition to manage access and GPS and indoor floor plan to track workers and incidents in real time
- 4) Reduce hazardous materials risks with accurate and immediate alerts to leaks, sparks, abnormal equipment activity, and smoke and fire, as well as
- 5) Worker and operation safety and compliance
 - i. PPE detection
 - ii. Person running
 - iii. Person falling
 - iv. Crowd density and classification
 - v. Person / vehicle moving in the wrong direction
 - vi. Fire and smoke detection
 - vii. Blocked accesses or areas
 - viii. Behavioural workflow monitoring
 - ix. Violence detection
 - x. Vandalism detection
 - xi. Tailgating

3.4.11 Weapons Detection

- 1) At all access points detection of weapons that are known, concealed, disguised or overt is required.
- 2) Sensing or detection methods can include typically targeted magnetic sensing or X-Ray scanning.
- 3) The weapons detection system shall be integrated to the central servers of the IPMSS for live feed viewing, archiving and alarming.
- 4) Alarm shall be raised and sounded at the local site where weapon is detected and on the IPMSS HMI

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3.4.12 Network Equipment and Security

The System shall ensure it provides for the following as a minimum:

- 1) Identity – identification of network users, hosts, application, data and services so that only legitimate users and information can access the network.
- 2) Compliance to all Eskom Cyber Security Standards as referenced in Section **Error! Reference source not found.** above.
- 3) All networks shall be managed networks.
- 4) All network equipment shall support the backup and restoring of all configuration settings.
- 5) All network equipment shall be remotely configurable.
- 6) All network equipment shall be SNMPv3 compatible.
- 7) All network equipment shall be IPv4 compatible.
- 8) All network equipment shall have redundant power input ports.
- 9) Any network equipment not located in a network cabinet shall be of industrial Ethernet type and suitable for an uncontrolled & harsh (and prevailing Medupi Power Station) environmental conditions.
- 10) 24V shall be the preferred voltage level to be used throughout all networks.

Remote Management

- 11) Each network equipment shall be remotely managed, monitored and alarmed via the network management system.
- 12) The remote management, monitoring, alarming and diagnostic facilities provided for each network switch network management system shall be a single software package with a single interface via which all functionality is accessed.
- 13) The functionality provided by the network management software shall include – but shall not be limited to – the following:
 - a. Component configuration.
 - b. Component monitoring.
 - c. Automatic detection of network devices and changes in any network.
 - d. Visualisation/mapping of the network topologies.
 - e. Individual alarming for each component fault.
 - f. Trending.
 - g. Event handling, logging and analysis.
 - h. Server application monitoring.
 - i. Network & server availability monitoring.
 - j. Hardware and software inventory system.
- 14) The network management system shall use a graphical user interface.

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- 15) Network loads, malfunctions and failures of the network components shall be detected promptly, and countermeasures are initiated automatically in due time through the use of the network management system.

3.4.13 Time Synchronisation

- 1) A suitable method of time synchronisation for all the relevant components of all System shall be provided.

3.4.14 User Management System

- (1) A user management system shall be provided for.
- (2) The functionality provided by the user management software shall include – but shall not be limited to – the following:
 - a. Issuing and monitoring authorisations, i.e., user administration.
 - b. Access security.
 - c. Configuration of each user's access rights or access level.
- (3) Usernames with passwords shall be used as a login for access to any workstation, server or network switch.
- (4) The user management system shall require passwords to be changed at regular intervals.
- (5) Rules shall be applied for the allowable password format.
- (6) A transparent, deep-structured authorisation concept with groups and roles shall be defined and documented such that access to the resources is organised.
- (7) The rights structure for user groups and users to directories and software packages shall be documented in a comprehensible manner.

3.5 Requirements Related to TRAINING OF THE SYSTEM or machine learning

- (1) For the AI of all technologies implemented to be fully realized, system will need to be trained for a minimum period of 12 months after commissioning.
- (2) Every month of the 12 allocated for training of the system, the system (all technologies implemented) will be tested to check that it is able to detect correctly unauthorized or abnormal activities
- (3) The training of the system shall for part of this scope of work.

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3.6 Requirements Related to Maintainability

- (1) The components installed shall be protected from the harsh or hazardous power plant environment.
- (2) All installations shall allow for safe and easy access for maintenance and configuration.
- (3) System fully supported with South African resources for minimum period of 15 years.
- (4) Maintenance plan, philosophies, procedures and manuals shall be provided.
- (5) Studies are to be conducted to [identify critical spare and recommend the minimum and maximum stock values to be kept on-site in order to reduce system downtime.](#)

3.7 Expandability Requirements

- (1) The System design shall provide for later expansion of the system such that future changes and enhancements can be readily incorporated.
- (2) As a minimum the system (each implemented technology type) should be expandable to at least an extra 4 areas without procuring any extra equipment.
- (3) Also, as a minimum the following shall be provided:
 - a. 20% spare installed terminals in the field for terminal equipment.
 - b. 10% reserve physical space (rounded up) on all trunk cabling (and / or optic fibre) infrastructure.
 - c. 20% reserve power availability per power supply system (power distribution, cabinet power supplies).
 - d. Space for 10% additional network cables (rounded up) in every network cabinet.
 - e. 10% spare cores in all multi-core fibre optic cables (rounded up) terminated at both ends.
 - f. 10% unused network ports per network switch (rounded up).
 - g. 10% spare 1U rack space in all network or server cabinets (rounded up).

3.8 Life Expectancy

- (1) All equipment will be supported and maintained for 15 years after the last taken-over system.

3.9 Standardization

- (1) Standard product from OEM should be supplied – only proven OEM solutions are acceptable.

3.10 Earthing, Lightning and Electrical Protection

- (1) All conductive IPMSS system equipment enclosures and conductive equipment that may come into contact with live conductors shall be earthed to the station earth mat.

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- (2) All metal casings shall be properly earthed (grounded) to the earth mat to avoid any electromagnetic interference which may arise from portable RF transmitters, cell phones and other equipment used on the plant.
- (3) All earthing required to eliminate any interference shall be provided.
- (4) All field cables and network cables shall be earthed (grounded). The cables shall be earthed at one end or both ends depending on the interference signal and shall comply with an overall recognized earthing arrangement.
- (5) Lightning and Surge protection shall be included in all the circuits where there is exposure to potential lightning.
- (6) All earthing and surge protection shall as a minimum be in accordance with the following standards and specifications:
 - i. SANS 10142-Part 1 - The Wiring of Premises Part 1: Low-voltage installations.
 - ii. 240-56356396 – Earthing and Lightning Protection Standard

3.11 Life-Cycle Cost Assessment

As part of detailed design, a life cycle management functional specification or Report shall describe and define the following points as a minimum:

- (1) Life cycle costing considerations and total cost of ownership calculations.
- (2) System and component replacement strategy.
- (3) System and component maintenance strategy.
- (4) Spares management strategy.
- (5) Standardisation strategy

3.12 Test and Commissioning Requirements

- (1) All acceptance testing will be based IPMSS meeting all specified requirements.
- (2) FAT, SAT, SIT and Commissioning of the system will be conducted as per IEC 62381.

3.13 Configuration Requirements

All applicable KKS standards and codes as per Section **Error! Reference source not found.** of this document shall apply.

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3.13.1 Configuration Management Plan

The Contractor shall prepare a configuration management (CM) plan utilizing ISO 10007 as a reference guide for the scope of work. The CM plan shall include the following:

The process of managing documentation for the project works will be supported by the following”

- a) A complete and comprehensive description of the Contractor’s document numbering conventions and revision schema.
- b) A description of the electronic data management system(s) that the Contractor will use for the management of documents and/or configuration items.
- c) A description of the configuration management activities which will be undertaken by the Contractor as well as a rough timescale thereof.
- d) A description of the baselines that will be established and the content of these baselines.
- e) The release procedure for product configuration information.
- f) The procedure for the control of changes prior to the establishment of baselines as well as after.
- g) The method for processing changes, emanating both internally and from sub-suppliers.
- h) The method for collecting, recording, processing and maintaining the data necessary for producing configuration status accounting records.
- i) The definition of the content and format for all configuration status accounting reports.
- j) A list of audits which will be conducted to ensure adherence to the CM plan.

3.13.2 Plant Designation

3.13.2.1 Plant Designation System

- 1) The Contractor shall apply the Kraftwerk-Kennzeichensystem (KKS) codification system to uniquely identify the systems, sub-systems and components constituting the Plant.
- 2) The Contractor shall apply the following guidelines and standards when codifying plant:
 - a) The application of KKS plant coding (NMP 45-7)-200-4190
 - b) KKS Key Part-Fossil Power Station (NPSZ 45-45)-200-18202
 - c) Issuing of KKS certificates-200-94660
 - d) VGB-B 106 E Parts A-KKS Application Commentaries Part A_General
 - e) VGB-B 106 E Part B1-KKS Application Commentaries Part B1_Mechanical Engineering
 - f) VGB-B 106 E Part B2-KKS Application Commentaries Part B2_Civil Engineering
 - g) VGB-B 106E Part B3-KKS Application Commentaries Part B3_Electrical and C&I Engineering.
 - h) VGB-B 106E Part B4-KKS Application Commentaries Part B4 Identification of C&I and Control Tasks.

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- 3) The Contractor shall identify all plant indicated or referenced by documentation by the plant's unique KKS codes within the documentation itself.
- 4) The Contractor shall ensure that the codification assigned to plant is consistently maintained throughout the design cycle, e.g., the KKS codes indicated in the O&M manuals are consistent with the KKS codes indicated in the original process and instrumentation diagram.
- 5) The Employer shall supply the Contractor with a system-level plant breakdown structure (PBS) of the existing plant at the Site, as well as a preliminary system-level plant breakdown structure of the plant within the Contractor's scope at contract initiation. The Contractor shall review the PBS to ensure alignment with the Contractor's design philosophy and shall expand the PBS to the complete system level (Fn level of the KKS hierarchy). The Contractor shall provide a complete system-level PBS with the submission of the process flow diagrams of the plant within the Contractor's scope.
- 6) The Contractor shall codify all equipment, and any components which are required to be codified as per the guidelines and standards referenced in this document. The Contractor shall indicate equipment and component codification in drawings and documents indicating or referencing such plant.
- 7) The Contractor will submit all KKS codes designated by the Contractor, with the documents in which they were originally designated, to the Employer for review. The Contractor will remain responsible for ensuring that the codes designated are unique and meet the requirements established by the various standards applicable to the Project. Where any ambiguities or doubts with regards to KKS codification exist, the Contractor will engage the Employer for resolution.

3.13.2.2 Plant Labelling

- 1) The Contractor shall manufacture and install labels according to the Medupi Label specification, 200-3340.
- 2) Any abbreviations to plant descriptions shall be prepared in accordance with the Employer's abbreviation standard, 200-5343.
- 3) Detailed name plate or label lists with the service legends and including the KKS Code shall be prepared by the Contractor and submitted to the Employer for review and comment before commencing the manufacture of the labels. On plant areas where labels do not make ergonomically sense please consult site configuration management for guidance.

3.13.2.3 Plant Designation within Documentation

The Contractor shall prepare a list of KKS designations allocated to components for each scope of delivery or system (this list will be referred to as equipment list in the rest of this document for simplicity's sake, but includes documents such as cable schedules, valve schedules, etc.). The equipment list shall be submitted with the original implementation documentation describing the design of the system (e.g., process and instrumentation diagram, single line diagram, etc.). The Contractor shall ensure that the equipment list accurately represents the implementation documentation which it accompanies. The content of the lists will be agreed to per discipline with the Employer. As a minimum, the equipment list shall include:

- a) The KKS designation of all components within the relevant scope of work or system.

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- b) The full verbal description of each component, compiled according to the standards referenced in this document.
- c) The abbreviated description of each component, utilising abbreviations as listed in the referenced project abbreviation list and abbreviated to a number of characters as required by the project digital control system (DCS) and as per the label requirements in, 200-3340.
- d) The approval status of each component, in alignment with the list of approval statuses specified for document

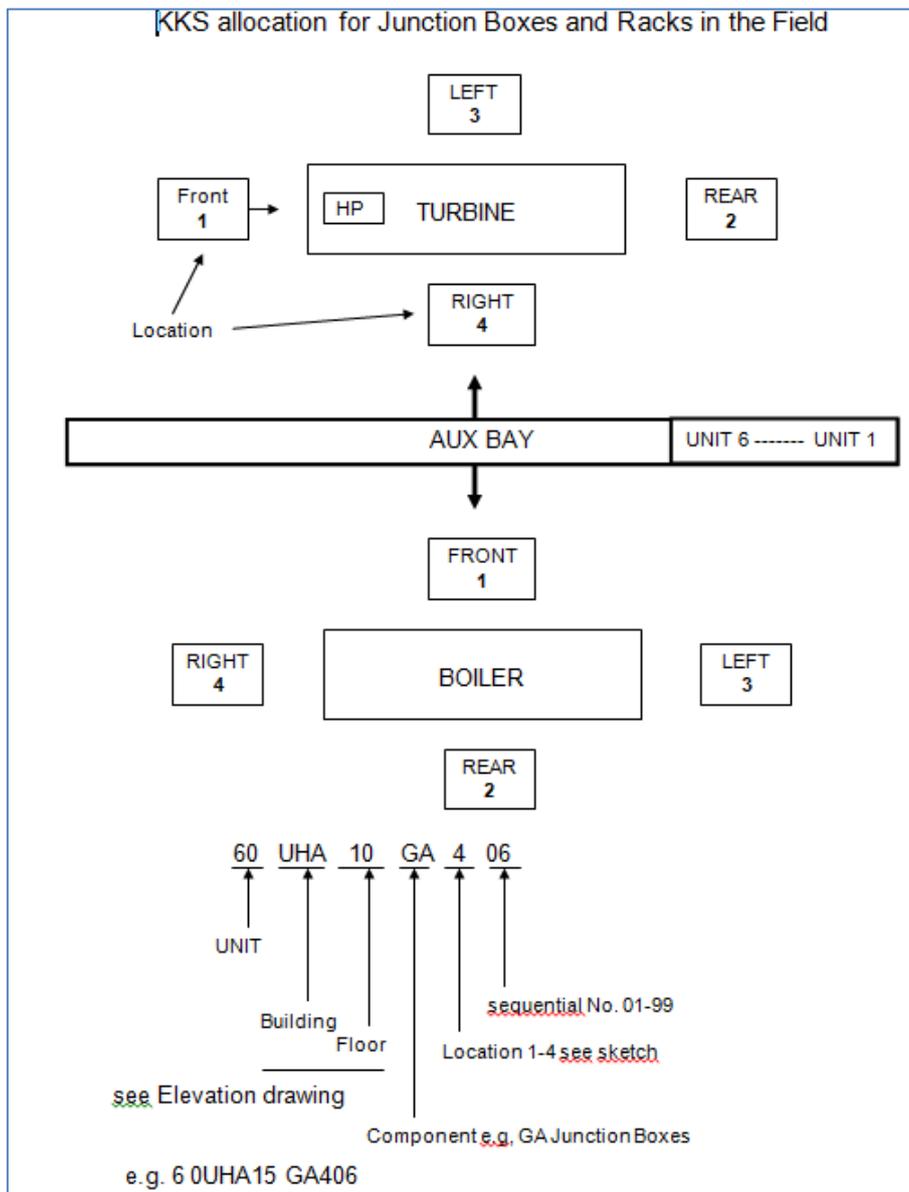


Figure 4: Example of KKS Coding

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3.14 DOCUMENTATION Requirements

All documents shall be supplied by Contractor as specified in VDSS, Appendix A of this Specification.

3.15 Quality Management

Quality management procedure as provided shall be complied with.

3.16 training Requirements

Training should be provided as per following training requirements:

- (1) The Provision of detailed training manuals incorporating all aspects of the training that will be provided.
- (2) Formal theoretical training to personnel in the operation, maintenance and general running of the *system* and equipment before commencing testing and commissioning is required. The disciplines to be trained are operating (All shifts=10 personnel, including emergency personnel, reception personnel and security officers), control and instrumentation(C&I) maintenance (6 x personnel) and C&I engineering (4 x personnel).
- (3) The following is considered to be the minimum requirements for training:
 - i. System and component description, layout and design
 - ii. Alarms
 - iii. System operation:
 - a) Normal operating procedures
 - b) Routine test and inspection procedures
 - c) Normal and emergency shutdown procedures
 - d) Emergency and alarm conditions
 - iv. Operational problems:
 - a) Troubleshooting
 - b) Loss of supply (e.g., electrical power)
 - v. Dangers and precautions
 - vi. Recommended settings
 - vii. Test and inspection plans
 - viii. Inspection and Maintenance Procedures:
 - a) During plant operation

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- b) During shut down periods
 - ix. Special tools and equipment:
 - a) Requirements
 - b) Training
 - x. Fault Finding:
 - a) Items to inspect
 - b) Typical observations and/or deviations
 - c) Recommended corrective actions
 - xi. Recommended spares:
 - a) Item description
 - b) Part number/type
 - c) Supplier
 - d) Drawing designation
 - e) Quantity installed on plant
 - f) Recommended stock
- (4) Practical hands-on training for each individual trainee shall form an integral part of all training.
- (5) Administrator training should be included for engineering training provided.
- (6) Training of 2 Eskom personnel to have drone pilot licenses shall be provided for.

3.17 execution methodology

- (1) The Contractor shall be responsible for carrying out all activities and supplying everything to provide the Works.
- (2) This shall include clarification and co-ordination with Employer personnel, Other Project Contractors and the Engineer.

1.1.1 Technology Suitability Proving

- (1) During the Tendering phase of the project Tenderers will be required to attend a compulsory site briefing where tenderer will be expected to use their equipment to take site reading using their respective equipment to prove their proposed technology suitability.
- (2) Results from the site readings will be submitted as part of Tender submission to be evaluated as part of proving the technology suitability.

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3.17.1 Basic Engineering

- (1) Basic engineering is defined as being all activities necessary to clearly identify the Contractor's scope and design for the IPMSS system concerned.
- (2) The basic engineering activity shall include the Contractor's interfacing and participation with the Engineer, Employer personnel and Other Project Contractors through clarification meetings in order to reach the basic design freeze (DF) completion.
- (3) As a minimum, basic engineering shall consist of the following activities:
 - i. Concept designs – during which the rules, philosophies and concepts followed in the various engineering and design activities, are clearly defined, clarified and approved.
 - ii. Investigation work – during which the Contractor conducts his investigation work.
 - iii. Scope definition – during which detailed scope definition and clarifications are performed.
- (4) During the Contractor's investigation work, the Contractor shall take responsibility for collecting all information from the Engineer to enable the Contractor's design to be completed.
- (5) The Contractor shall identify any discrepancies that would lead to shortcomings and/or deviations in the Works and shall make the Engineer aware of such discrepancies and provides recommendations, where applicable. The Contractor takes action on such discrepancies.
- (6) Any discrepancies identified are redlined by the Contractor and submitted to the Engineer for approval.
- (7) Technical clarification is where the Contractor shall clarify with the Engineer and Other Project Contractors all the technical issues to permit the Contractor to start detailed engineering.
- (8) All equipment having long delivery times shall be planned and technically clarified early in the technical clarification stage to allow early Detailed Engineering to commence in parallel.
- (9) The Contractor shall be responsible for maintaining the minutes of the meetings, a deviation schedule and list of open points (LOP) for all engineering activities and shall record all changes to scope during the basic engineering phase.
- (10) Where the Contractor's system interfaces to 3rd party systems (including electrical and civil interfaces provided by others), the Contractor shall coordinate, through the

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Engineer, with Other Project Contractors and design the interface to ensure the overall design is complete and well-engineered.

- (11) The Contractor shall take full responsibility for all technical interfaces between the IPMSS systems and 3rd party systems (including electrical and civil interfaces provided by others).

3.17.2 Detailed Engineering

- (1) Detailed engineering is defined as being all activities required to translate the Contractor's scope and design, as defined at basic design freeze, into fully functional IPMSS system(s).
- (2) As a minimum, detailed engineering shall consist of the development, technical clarification and acceptance of the documents defined in as being required for the Detailed Engineering design freeze in Appendix A – Vendor Document Submittal Schedule.

3.17.3 Manufacturing

- (1) The IPMSS system shall undergo Factory Acceptance Testing (FAT) at the factory premises and the results shall be submitted to the Engineer for approval.
- (2) The Engineer has the right to appoint representatives of the Engineer and Other Project Contractors, on behalf of the Employer, to inspect all parts during manufacture and to be present at any of the tests specified.
- (3) The Engineer is free to specify additional 'hold and witness points' during the fabrication and factory testing of the IPMSS system.
- (4) The Contractor shall issue preliminary notification of hold and witness points by giving not less than twenty-eight (28) days of advance notice to the Engineer.
- (5) The Contractor shall confirm hold and witness points at least seven (7) days prior to the activity, as shown in the Approved Programme.
- (6) Arrangements for witnessing inspections shall be made through the Engineer.
- (7) A minimum of fifty-six (56) days' notice shall be given by the Contractor for inspections and shall be shown in the Approved Programme.

i. Pre-FAT

- (1) The Contractor shall prepare a detailed test procedure in preparation for the Pre-FAT.

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- (2) The requirements of the Pre-FAT procedure shall be the same as that of the FAT procedure
- (3) The Contractor shall conduct a pre-factory acceptance test at the Contractor's manufacturing facilities in preparation for the FAT.
- (4) The Pre-FAT shall be shown in the Approved Programme.
- (5) The Contractor shall submit the QC procedures and Pre-FAT test and inspection results to the Engineer for approval prior to the commencement of FAT.
- (6) A Final Pre-FAT Report shall be prepared by the Contractor that includes the following as a minimum:
 - i. Test procedures used during Pre-FAT.
 - ii. Detailed Test results.
 - iii. Discrepancies identified during the tests.
 - iv. Resolution of the discrepancies.
 - v. Retests conducted and results thereof.
- (7) The Contractor shall submit the Pre-FAT Report to the Engineer for approval.
- (8) Pre-FAT Completion shall be achieved, and the system considered ready for FAT upon approval of the Pre-FAT Report by the Engineer

ii. FAT

- (1) During FAT, the Contractor shall demonstrate that the Power Station's IPMSS system meets the requirements of this Specification and the detailed engineering design freeze documentation.
- (2) The FAT shall be done at the Contractors manufacturing facilities and all activities shall be coordinated by the Contractor.
- (3) The Contractor, OEM, the Engineer, and Other Project Contractors shall attend the FAT.
- (4) The Contractor shall provide all facilities and simulation at the FAT venue such that testing of the IPMSS system's functionalities can be done.
- (5) The Contractor shall ensure that all IPMSS system hardware and software is available and operational in time for the individual tests.
- (6) The Engineer determines if any further testing is required in addition to that specified, such as that of any new technologies being used.
- (7) The Contractor shall prepare a detailed test procedure in preparation for FAT and submit same to the Engineer for approval.

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- (8) As a minimum, the proposed FAT procedure shall identify the following:
 - i. Major test activities.
 - ii. Comprehensive list and description of the individual tests to be performed.
 - iii. How the tests are to be prepared and conducted.
 - iv. Test dates and durations.
 - v. Checklists – how the test results will be documented.
 - vi. Acceptance Criteria.
 - vii. How the identified discrepancies will be processed.
 - viii. Retesting requirements.
- (9) A Final FAT Report shall be prepared by the Contractor that includes the following as a minimum:
 - i. Test procedures used during FAT.
 - ii. Detailed Test results.
 - iii. Discrepancies identified during the tests.
 - iv. Resolution of the discrepancies.
 - v. Retests conducted and results thereof.
 - vi. FAT certificate.
- (10) The Contractor shall submit the Final FAT Report to the Engineer for approval.
- (11) FAT Completion shall be achieved upon approval of the Final FAT Report by the Engineer.

3.17.4 Procurement, Erection & Installation

- (1) This stage shall consist of the procurement, installation, on-site inspection and testing of all equipment forming part of the Works as well as other items that the Employer has specified such as free issued items.
- (2) Quality inspections and tests shall be carried out by the Contractor after erection to prove the compliance of the installation with the Specification and the detailed engineering design freeze documentation.
- (3) Erection and installation shall only be considered complete once the quality inspections and tests for the installation concerned have been approved by the Engineer.
- (4) The Engineer reserves the right to appoint representatives, on behalf of the Employer, to inspect all parts during erection and to be present at any of the quality inspections and tests.

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- (5) The Engineer is free to specify hold and witness points during the installation and testing stages of the project.
- (6) The Contractor shall give twenty-one (21) days advance notice to the Engineer of holds and witness points.
- (7) The Contractor shall confirm hold and witness points at least nine (9) days prior to the test activity.
- (8) The Contractor shall provide all test equipment for any inspections and tests.

3.17.5 Site Integration Test (SIT)

- (1) The SIT for the IPMSS system shall only begin once the following has occurred:
 - i. The IPMSS system equipment have been installed in their final locations and connected to permanent power supplies.
 - ii. All available interfaces to 3rd party systems have been implemented.
- (2) The SIT shall be carried out before system commissioning commences to ensure:
 - i. Correct performance of the system.
 - ii. Safety of plant and personnel.
 - iii. Compliance with the Specification and the detailed engineering design freeze documentation.
- (3) As a minimum, the SIT testing and inspection activities provided by the Contractor shall consist of site integration and site acceptance activities defined in IEC 62381.
- (4) The Contractor shall prepare a detailed test procedure in preparation for SIT and submit same to the Engineer for approval.
- (5) As a minimum, the proposed SIT procedure shall identify the following:
 - i. Major test activities.
 - ii. Comprehensive list and description of the individual tests to be performed.
 - iii. How the tests are to be prepared and conducted.
 - iv. Test dates and durations.
 - v. Checklists – how the test results will be documented.
 - vi. Acceptance Criteria.
 - vii. How the identified discrepancies will be processed.
 - viii. Retesting requirements.
- (6) A Final SIT Report shall be prepared by the Contractor that includes the following as a minimum:
 - i. Test procedures used during SIT.

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- ii. Detailed Test results.
 - iii. Discrepancies identified during the tests.
 - iv. Resolution of the discrepancies.
 - v. Retests conducted and results thereof.
 - vi. SIT certificate.
- (7) The Contractor shall submit the Final SIT Report to the Engineer for approval.
- (8) When all tests are successful and the Final SIT Report is approved by the Engineer, the system is classified as 'ready for use'. The system is then deemed ready for cold commissioning.

3.17.6 Commissioning

- (1) Commissioning is defined as bringing into service all items of the Works and meeting the functional requirements and performance criteria of the Specification.
- (2) The Contractor shall commission all interfaces to control equipment provided by the Employer.
- (3) Commissioning shall include all testing and verification of the stated performance criteria
- (4) The Contractor shall adhere to the requirements in 200-16714: Medupi Commissioning Procedure.

3.17.7 Operational Acceptance Test (OAT)

- (1) Commissioning shall be concluded with the Operational Acceptance Test (OAT).
- (2) OAT can only commence after training of the system is completed.
- (3) As training of the system will occur over a 12-month period – mini-OAT tests are expected every month as part of continual testing of effectiveness of the training of the system.
- (4) The Contractor shall request commencement of operational acceptance test from the Engineer. The minimum OAT testing and inspection requirements shall be:
 - i. Overall or high-level functional testing of the complete IPMSS system in its final installed locations and operational platforms and licences.
 - ii. Verification that the training of the system produced desired results – thus system is able to detect unauthorized or abnormal activities.
 - iii. Final High-level testing that ensures all components of IPMSS system are integrated, fully functional and meet all requirements in their final operational state.

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- (5) The Contractor shall produce a detailed OAT test procedure 28 days in advance for approval by the Engineer.
- (6) The final OAT Report shall be prepared by the Contractor.
- (7) The Contractor shall submit the final OAT Report to the Engineer for approval.

3.17.8 As Built Document Package

- (1) “As Built” documentation, as listed in Appendix A – Vendor Document Submittal Schedule and shall be supplied by the Contractor to the Engineer upon completion of commissioning.
- (2) 3 hard copies and 2 soft copies of As Built documentation shall be provided by the Contractor as part of the Works.
- (3) Approval of the ‘As Built’ documentation by the Engineer is a pre-requisite for the Completion of the Plant Area concerned.

3.18 Other Options for Solution or Scope of Works

- (1) As an option, a solution that does not fall within the defined technologies can be provided for consideration.
- (2) This option also does not have to comply to provision of this specification, but it must provide for the defined functionalities and be suited for the area of monitoring

4. Material List

Short Description	Details	Quantity per floor									Total	
		Ground	1st	2nd	3rd	4th	5th	6th	7th	Common Area		
Network Camera Series	Lens DC-iris, IR corrected, CS-mount Video compression H.264 Main and Baseline Profile (MPEG-4 Part 10/AVC) Motion JPEG. Memory 256 MB RAM, 128 MB Flash. 8-20 V DC or Power over Ethernet (PoE). IEEE 802.3af, RJ-45 10BASE-T/100BASE-TX PoE	6	6	6	6	6	6	6	6	6	0	48
Digital High Speed Network Dome System	Video Compression MPEG-4 Part 2 (ISO/IEC 14496-2), SP level 0-3. Up to 25 fps video in all resolutions. Camera live	1	1	1	1	1	1	1	1	1	1	9

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	view for up to 5 clients. Image Sensor 1/4" Ex-view HAD CCD. Digital Zoom 12X (216X total zoom)										
Pan-Tilt Motor Camera	Pan/Tilt Pan range 0° to 355°. Tilt range 10° to -80°. Pan speed 7.5°/s Tilt speed 6°/s. Designed for operator control. Protocol Pelco-D. Temperature: -20 °C to 65 °C. Ports One RS-485 port	1	1	1	1	1	1	1	1	1	9
Network Controller	Processor: Cold Fire 32 Bit Hi Performance free scale processor @ 166 MHZ... 4 DOs, 24 VAC TRIACS with LED indication... 6 DIs which can be configured as Potential free contact or pulse counter @ 15 Hz...6 AOs, 0-10 Vdc... 12-bit A/D resolution	1	1	1	1	1	1	1	1	4	8
Digital Video Manager	Database Server, Camera Server & Video Analytics Server, EBI Stations, Network	0	0	0	0	0	0	0	0	1	1
Camera Servers	The Camera Servers manage all camera operations during normal operation of the system. They are capable of supporting a large amount of disk space for online video storage and access to high capacity archiving mechanisms for the transfer of stored video to off-line media. The storage media commonly used is a SCSI interfaced RAID unit.	0	0	0	0	0	0	0	0	4	4

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Appendix A: VDSS

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Appendix B: DESIGN STANDARDS, GUIDELINES AND CODES

#	Type	Number	Name
	Eskom	240-55410927	Cyber Security Standard for Operational Technology
	SANS	SANS 10400, 1990	The application of the national building regulations
	ISO	ISO 9001	Quality Management Systems
	Eskom	240-56227443	Requirements for Control and Power Cables for Power Station Standard
	SANA	SANS 10142-1	The Wiring of Premises, Part 1 – Low-Voltage Installations
	Eskom	240-56355466	Alarm Management System Standard
	Eskom	240-52844017	System Reliability, Availability and Maintainability Analysis Guideline
	Eskom	240-56355815	Junction Boxes and Cable Termination Standard
	Eskom	240-49230111	HAZOP Analysis Guideline
	Eskom	240-56356396	Earthing and Lightning Protection Standard
	Eskom	0.84/3482	Medupi Power Station Earthing Standard
	SANS	SANS 62305	Protection Against Lightning
	Eskom	240-56355910	Management of Plant Software Standard
	Eskom	240-129014618	Generation Cyber Security Compliance Guideline
	Eskom	200-16714	Procedure – Commissioning Procedure
	Eskom	200-4190	Application for KKS Coding
	Eskom	240-56355541	Control System Computer Equipment Habitat Requirements Guideline
	Eskom	240-56356411	Fire Barrier Seals for Electrical Cable Installations
	Eskom	240-56360034	Stationary Vented Lead Acid Batteries

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Eskom	240-56360086	Stationary Vented Ni-Cad Batteries
Eskom	Alpha KKS 01	Alpha KKS 01
Eskom	Alpha KKS 02	Alpha KKS 02
Eskom	PPZ 200-3340	KKS Coding and Labelling Procedure KKS – Procedure
Eskom	N.PSZ 45-45	KKS Key Part Fossil Power Station
Eskom	200-11757	Earthing concept
Eskom		Eskom Contractor Title Block Description
Eskom		Medupi Quality Management Procedure
National Act	Act No. 85 of 1993	Occupational Health and Safety Act
Eskom	240-86973501	Engineering Drawing Standards
Eskom	200-24289 (Ssz_45 17)	Medupi Power Station Corrosion Protection Specification
Eskom	240-58552870	Smart Plant for Owner Operators (SPO) Documentation Metadata Standard
Eskom	240-71432150 240-93576498	Plant Labelling Standard KKS Coding Standard
Eskom	240-53114186	Project/Plant Specific Technical Document and Records Management Procedure
Eskom	240-109607332	Eskom Plant Labelling Abbreviation Standard

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Appendix C: Buildings and rooms schedule

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Appendix D: ELECTRICAL LOAD SCHEDULE TEMPLATE

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Appendix E: HARDWARE AND EQUIPMENT INVENTORY LIST TEMPLATE

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Appendix F: SOFTWARE INVENTORY LIST TEMPLATE

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Appendix G: CABLE SCHEDULE TEMPLATE

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Appendix H: TECHNICAL RISK REGISTER

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