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# 1. EXECUTIVE OVERVIEW

Medupi power Station requires the design, supply, erection (and / or installation) and commissioning of a station wide public address (PA) system as part of the emergency preparedness and response plan. The PA system will primarily be used to broadcast informative and guidance voice instructions during the course of an emergency to ensure correct implementation of the emergency response plan. Also, the PA system can be used to make normal announcements and play background music when required.

The main function of the PA system is to ensure effective communication for all employees, contractors and visitors during emergency evacuation. System shall be primarily used to provide clear one-way voice communication and audio alarm tones as well as visual indications during an emergency so as to effect a rapid and orderly evacuation of everyone in response to the emergency.

# 2. GENERAL

## 2.1 INTERPRETATION AND TERMINOLOGY

### 2.1.1 Definitions

| Definition | Description |
|---|---|
| Amplifier | A device which raises the voltage or current generated by a low-level device such as a microphone to the level necessary to operate the loudspeaker(s). Amplifiers normally have an output voltage of 100 volts |
| Background Music | Refers to the playing of music at a low level to produce a comfortable working ambiance. The volume level at which BGM should be played is important to its effectiveness and should ideally be adjusted so that should the music stop it is not immediately noticeable. |
| Controlled disclosure | Controlled disclosure to external parties (either enforced by law, or discretionary). |
| Loudspeaker | A device which converts electrical energy produced by the amplifier into sound energy. For paging and evacuation purposes they mostly fall into two categories:<br>• Ceiling type loudspeakers are usually built into wall mounting cabinets and baffles designed for ceiling mounting. This type of loudspeaker is typically used in indoor environments such as offices, passage-ways, shops and waiting rooms.<br>• Horn type loudspeakers are typically used in industrial environments such as workshops, factories, warehouses and also for outdoor installations.<br>• Bidirectional speakers typically have two or more drivers producing sound in multiple directions. These are typically designed for corridors or concourse areas<br>• Cabinet Speakers- Wall/surface mount speakers typically used escape stairs, store rooms and kitchens |
| Microphone | A device which converts sound energy into electrical energy. The output voltage is very low and typically ranges between 0.0001 volts and 0.005 volts (100µV and 5.0mV). |

| Definition | Description |
|---|---|
| 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. |
| Sound Pressure Level | It is a measure of the ability to convert electrical energy into sound energy. The SPL generated by a loudspeaker varies over a wide range and there are many factors, which determine the SPL. Quoted SPL figures are usually referenced to an input power of 1 watt and measured at a distance of 1 metre. The RMS sound pressure expressed in dB re 20 microPa (The lowest threshold of hearing for 1 kHz). [As points of reference, zero dB-SPL equals the threshold of hearing, while 140dB-SPL equals irreparable hearing damage. |
| Quiescent Condition | Functional condition characterised by the absence of the voice-alarm, fault-warning, disabled and test conditions |
| Voice Alarm Condition | Alert signal, evacuate signal, recorded or live emergency signal broadcast in at least one emergency loudspeaker zone. |
| Zone | Is demarcated area. |

### 2.1.2 Abbreviations

| Abbreviation & Acronyms | Description |
|---|---|
| BGM | Back Ground Music |
| CBMS | Centralized Building Management System |
| C&I | Control and Instrumentation |
| CMD | Construction Management Department |
| DVC | Digital Voice Command |
| EDWL | Engineering Design Work Lead |
| ECM | Engineering Change Management |
| ECSA | Engineering Council of South Africa |
| EN | European Norm |
| EOC | Emergency Operations Centre |
| EOD | Electrical Operating Desk |
| EPPA | Emergency Preparedness Public Address System |
| FAT | Factory Acceptance Test |
| GenTLC | Generation Technical Life Cycle |
| HMI | Human Machine Interface |
| ISO | International Standard |
| IP | Ingress Protection |

| Abbreviation & Acronyms | Description |
|---|---|
| PA | Public Address |
| PEC | Professional Engineering Certificate |
| PEIC | Production, Engineering, Integration, Coal |
| PS | Power Station |
| PSM | Power Station Manager |
| ROC | Required Operational Capability |
| RTS | Return To Service |
| OHSAct | Occupational, Health and Safety Act |
| SANAS | South African National Accreditation System |
| SANS | South African National Standard |
| SHE | Safety, Health & Environmental |
| SIT | Site Integration Test |
| SRD | Stakeholders Requirements Definition |
| SPL | Sound Pressure Level |
| UPS | Uninterrupted Power Supply |
| mV | Mill-Volts |
| µV | Micro Volts |
| VDSS | Vendor Documentation Submittal Schedule |

#### 2.1.3 Applicability

The requirements defined in this document apply to the whole of the Works for the Medupi EPPA System.

## 3. DESCRIPTION OF THE WORKS

### 3.1 OVERALL SCOPE FOR THE WORKS

(1) An open inquiry was previously issued to the market inviting tenderers to participate in the supply of the Medupi Power Station EPPA system. The design scope could not be completed which resulted in the termination of the Contract. However, some segments of the basic design were completed and accepted by the Employer. The details of the completed basic designs are provided under section 4.1 of this specification. The scope includes the review, evaluation, design, updating and acceptance of these existing basic design documentation.

(2) 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.

(3) This shall include the engineering, design, procurement, manufacturing, factory acceptance testing, delivery, off-loading at site, storage, installation, testing, commissioning, optimisation, and as-built documentation for the Medupi Power Station's EPPA systems.

(4) All civil works shall be designed and constructed in accordance with the Medupi Specification for Structural Concrete (84CIVL053 (R03)), the Construction Regulations and relevant national and Employers specifications. The design of civil works shall be executed by a competent civil designer and a professional engineering certificate (PEC) shall be issued by an ECSA registered professional on completion of the works.

## 3.2 GENERAL SYSTEM DESCRIPTION

(1) EPPA system is designed such that it can be used for the purposes of evacuation and public announcements on site.

(2) Below is a representation of the system block diagram showing the sub-systems of the EPPA system.

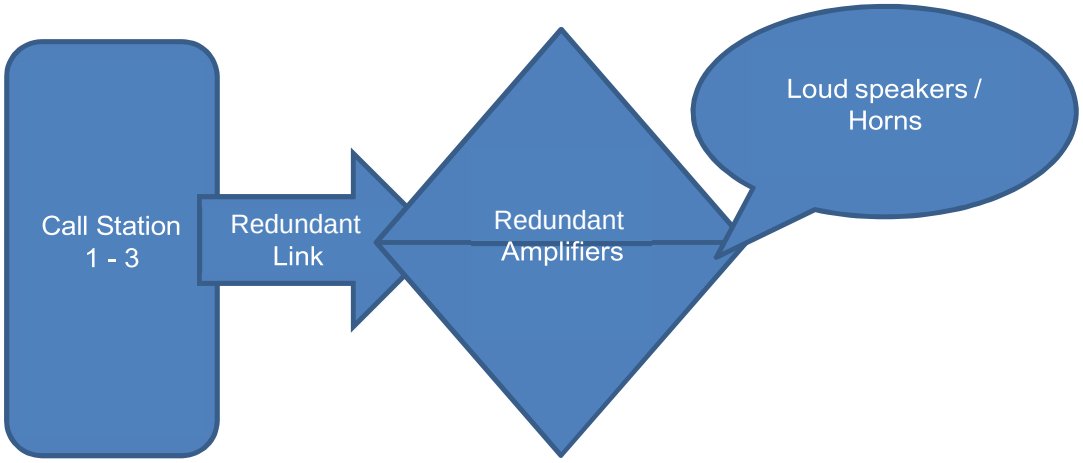


**Figure 1: Block Diagram Representation of EPPA System**

(3) The EPPA system shall be comprised typically of the following sub-systems

i. Call Stations – consisting of input devices, microphones, etc.

ii. Redundant network equipment – such as network switches, linking the call stations with the decentralized amplifiers.

iii. Redundant Amplifiers

iv. Terminal Units such as horns and loud speakers

v. Supporting redundant UPS Power supplies.

## 3.3 DESIGN STANDARDS, GUIDELINES AND CODES

(1) The EPPA system shall comply to the standards and guidelines as detailed in Appendix E (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 guidelines.

(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 Employer. Additional standards proposed by the Contractor shall be submitted to the Employer for approval.

(6) Only the most recent versions of the relevant standards, guidelines, or codes shall be used with this Works.

## 3.4 EPPA DETAILED REQUIREMENTS

### 3.4.1 Overall System Requirements

(1) The EPPA systems shall be configured as fully operational systems, stable, responsive and workable in all respects and are implemented in a consistent and integrated manner.

(2) The EPPA system provided shall be configured, designed, engineered, installed and commissioned using this Specification, OEM best practices and industry best practices.

(3) EPPA shall have self-diagnostic to detect failure and bring it to attention of maintenance team.

(4) Certification of equipment should include Country of origin; Certificate of Conformity; and Certificate of Evacuation.

### 3.4.2 General System Requirements and System Architecture

(1) Simplified system architecture is as per Figure 2 below.

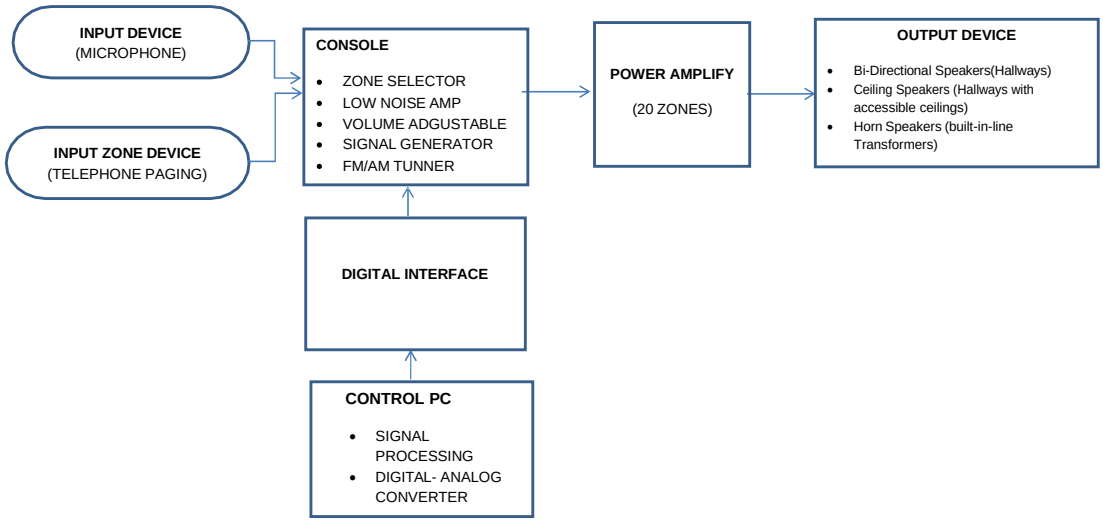


**Figure 2: EPPA Simplified System Architecture**

(2) The EPPA system shall be comprised typically of input devices, microphones, network equipment such as network switches, PH120 cables, central system unit, subsystems unit, amplifiers, speakers, fibre optic patch leads, patch panels, cabinets, racks and back-up supply systems.

(3) The EPPA system shall be zoned as per 3.4.3 below.

(4) System shall be scalable allowing for de-centralised components in different locations under a centralised control over a packet-based network backbone.

(5) De-centralized units shall typically include the power amplifiers and terminal equipment (such as speakers).

(6) The Control PC and digital interface shall be redundant such that if one fails the other takes over automatically.

(7) The system components shall provide network redundancy by doubling on the TCP/IP Ethernet interfaces, supplying two ports for audio and data control transmission on each decentralised device.

(8) The system shall support an additional analogue audio reserve path to allow for an all-call paging in case of a network failure or CPU failure, as well as signal path line faults anywhere between microphone(s) and amplifier(s).

(9) The de-centralised zones shall have their local audio output / inputs, battery surveillance capability, battery charging capability, and speaker line surveillance capabilities.

(10) 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.

(11) All system components shall be modular and of the 19" rack-mount type.

(12) Control of the entire system must be software-driven using the Microsoft latest version of MS OS supported at the time of deployment or any other accepted industry standard operating system.

(13) The system shall not be part of any other system such as a fire control system but be capable of integration with other stand-alone systems such as fire control panels.

(14) Operational tasks must be performed by menu buttons with visible displays and LED statuses.

(15) The system shall cater for an initial of minimum of 4 microphone and external line level inputs which can be expandable to a minimum of 6 such inputs.

(16) The system shall cater for an initial minimum of 32 amplifier outputs which can be expandable up to 40 such outputs.

(17) The system shall cater for a minimum of 16 audio channels for general broadcasts (paging, announcements, BGM, etc.) and 4 audio channels for emergency broadcasts which can be processed simultaneously.

(18) The system shall provide for a minimum of 256 levels of priority settings. This is to assign different levels of management of the system.

(19) The system shall be capable of accommodating A-B speaker wiring configuration.

(20) The system shall be capable of handling of emergency broadcasts, background music and paging announcements, simultaneously in different zones. However emergency conditions “all-call” takes priority over all broadcasts as defined in Section 3.4.4, Call Stations / HMI.

(21) The system shall be capable of broadcasting up to four different emergency messages (alert & evacuation) simultaneously into individual zones or groups of zones, in order to avoid unnecessary evacuations in non-affected areas thereby avoiding a state of panic.

(22) The system shall provide programming of four 3-phase alarm sequences. The phases shall be triggered automatically by a programmable timer, or externally by the fire detection system or the emergency microphone panel. The number of phases can be matched to the requirements.

(23) 42U or 25U racks or cabinets shall be used.

### 3.4.3 Zoning

There are 16 zones and 60 sub-zones to be designed for which are areas that must be covered by the PA system as per Table 1: Defined Zones Tables. Also refer to Appendix D – Project Drawings – for location drawings of these zones.

**Table 1: Defined Zones Tables**

| 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 |
| | 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 |

| Zone | Sub-Zone |
|---|---|
| | 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 Aera |
| **Zone 11 10 000 Silo** | 11A Coal conveyor |
| **Zone 12 Plant West** | 12A North Silo |
| | 12B South Silo & Disel 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 |
| | 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 HV Yard (part of outside zone)** | 16A Outside Zone |

### 3.4.4 Call Stations / HMI

(1) There should be at least 3 call stations with main at Emergency Operations Centre (EOC) and another 2 subordinates at Electrical Operating Desk (EOD) centre and reception desk – it is Contractor responsibility that these call stations are installed in a suitable ergonomic spaces.

(2) Reception desk to be used only for (normal) announcement – no zone selection at reception desk is allowed.

(3) The Call Station / HMI shall present an integrated and standardised set of displays and facilities which are designed to conform to ergonomic principles and modern power plant practice.

(4) Call stations should be able to all operate con-currently provided there are no conflicts in the zones.

(5) Announcements should only be directed to affected areas (zones or sub-zones).

(6) There should be functionality for selection to broadcast to only 1 zone or a group of zones or sub-zones or all the zones

(7) There should be pre-set volumes per zone or sub-zone that cannot be controlled via volume controls;

(8) Re-programming of zone or sub-zone volumes shall be possible without the use of any specialized tools.

(9) The following are the kind of alarms sounds to be activated – these should have distinct difference in sound which are acceptable and to be approved by the Engineer.

i. All clear sound alarm;
ii. Fire sound alarm;
iii. Emergency sound alarm;
iv. Pre-announcement sound for normal announcements;
v. Pre-emergency announcement sound for emergency announcement

(10) With respect to prioritizing alarm responses initiated from control panels; EOC takes highest priority; EOD 2nd priority; Reception desk lowest priority.

(11) The system should have functionality to automatically record all instructions and/or instructions issued over the call stations especially during an incident.

(12) All Call Station Consoles shall cater for future expansion without changes to controllers.

#### 3.4.4.1 Microphones Consoles

(1) Microphones consoles are to be located at the EOC, EOD and Administration Reception desk.

(2) The microphones consoles must provide for a minimum of 10 selectable buttons that can be programmable by the system to select features such as zone select, alert signals, custom functions, and any other input sources and must also be expandable to cater for a minimum of 80 zones or sub-zones and their respective pre-set volume settings.

(3) All microphone unit(s) shall also have the capability of receiving fault indications in the form of flashing LEDs and buzzer feature(s) and allow for such faults to be acknowledged on the microphone unit.

#### 3.4.4.2 Back Ground Music (BGM)

With regards to BGM the system design shall ensure that the EPPA is capable to perform the following:

(1) The system must be able to play back-ground music from any media player input.

(2) The back-ground music shall be selectable to play on any designated zones, group of zones, or all zones.

(3) The BGM shall be programmable to select volume settings individually from the front control panel of the Audio Output module or by programmable software.

#### 3.4.4.3 Tones (Pre-Recorded Messages)

The system detailed design shall ensure that the EPPA system can be pre-recorded as follows:

(1) The system shall accommodate for a minimum of 32 tones and / or pre-recorded messages or a combination thereof.

(2) The tones / pre-recorded messages shall not be stored on a rotary disc or memory stick.

### 3.4.5 Computers and Servers

Physical Specifications

(1) The minimum specifications for each server shall be as follows:

i. Redundant connection to each network where the server is essential to the availability of the EPPA system.

ii. Use dedicated server hardware.

iii. Hot swappable redundant power supplies.

iv. Hot swappable redundant hard drives for servers that are essential to the availability of the EPPA system.

v. 19” Rack mounted.

vi. Redundant case fans.

### 3.4.6 Network Equipment and Security

The EPPA 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 3.3 above.

Network Switches

(3) All network switches shall be managed network switches.

(4) All network switches shall support the backup and restoring of all configuration settings.

(5) All network switches shall be remotely configurable.

(6) All network switches shall be SNMPv3 compatible.

(7) All network switches shall be IPv4 compatible.

(8) All network switches shall have redundant power input ports.

(9) Any network switch 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) Any network switches which are provided to facilitate data communication between systems shall be layer 3 switches or routers.

(11) 24V shall be the preferred voltage level to be used throughout all networks.

Remote Management

(12) Each network switch shall be remotely managed, monitored and alarmed via the network management system and with possibility of being interfaced to the Plant DCS.

(13) 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.

(14) The functionality provided by the network management software shall include – but shall not be limited to – the following:

i. Component configuration.
ii. Component monitoring.
iii. Automatic detection of network devices and changes in any network.
iv. Visualisation/mapping of the network topologies.
v. Individual alarming for each component fault.
vi. Trending.
vii. Event handling, logging and analysis.
viii. Server application monitoring.
ix. Network & server availability monitoring.
x. Hardware and software inventory system.

(15) The network management system shall use a GUI.

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

### 3.4.7 Time Synchronisation

(1) A suitable method of time synchronisation for all the relevant components of all EPPA system shall be provided.

### 3.4.8 EPPA System Manager

(1) EPPA system manager complaint with Emergency Preparedness Public Address System – For Large Area Deployment Standard, 240-64720986**.** The system shall be an independent system of modular design to facilitate future expansion/alteration to the design.

(2) The system manager must be able to cover all the areas of the EPPA system.

(3) The system manager shall provide for and support the backup and restoring of all configuration settings for the complete EPPA system.

(4) The system manager should be used as a central update point for the entire EPPA system for updating of software and virus or malware protection software.

(5) Contractor to provide the initial malware or virus protection software for the entire EPPA system.

(6) The system manager shall be capable of monitoring all de-centralised zones centrally and logging all events.

(7) The system continuously monitors amplifiers and loudspeaker lines for fault conditions.

(8) The monitoring functions, as a minimum, include:

a) Detection of open circuit loudspeaker lines on each connected zone.
b) Detection of short circuit loudspeaker lines on each connected zone.
c) Detection of earth leakage faults on loudspeakers on each connected zone.
d) Detection of microphone capsule failure
e) Power amplifier failure detection

(9) The presence of any fault condition causes the illumination of the “fault” LED on the front of the system manager amplifier. The fault is also indicated by a buzzer / tone which is activated on a pre-assigned Call Stations with possibility of being interfaced to Plant DCS.

(10) Equipment housing shall be as per 240-64720986 _Emergency Preparedness Public Address System – For Large Area Deployment**.**

### 3.4.9 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:

i. Issuing and monitoring authorisations, i.e. user administration.

ii. Access security.

iii. 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.

### 3.4.10 Terminal Equipment

#### 3.4.10.1 Power Amplifiers

(1) Power amplifiers shall be available in various modules; e.g. 60, 120, 240, 360, etc. watt RMS, as may be dictated by the loudspeaker load. Amplifiers shall be sized for maximum 80% of rated load, to allow for future additional loudspeakers.

(2) LEDs shall be provided on the front panel of each amplifier to indicate power on, amplifier fault and over temperature.

(3) In the event that any zone requires more power than can be delivered by a single amplifier it shall be possible to configure the system so as to allocate more than one

power amplifier to that zone. It should be noted that parallel connection of amplifiers to achieve higher power, is not acceptable.

(4) Each power amplifier is equipped with a slot for various input modules.

(5) Each amplifier, irrespective of its rated power, is provided with an integral line output transformer designed to operate on the 50, 70 or 100-volt line output. All loudspeaker outputs are terminated on a chassis mounted socket and associated plug assembly.

(6) Amplifier frequency response shall cover the following range 50Hz to 20kHz ±3dB to within 5% variance.

(7) Distortion is maintained at less than 1% at the rated output of the amplifier at a reference frequency of 1kHz and the signal to noise ratio shall be better than 80dB.

(8) The standby amplifier is automatically switched into service in the event of a failure. The amplifiers are rated the same or higher wattage as the highest powered amplifier in the group it serves.

(9) It shall be ensured that there are adequate standby amplifiers in each zonal rack.

### 3.4.10.2 Loudspeakers

The best suited type of speaker for the location shall be installed at the respective zone or sub-zone.

(1) The following types of speakers are to be used with following characteristics as a minimum:

a. Ceiling mount speakers
   i. Ceramic connecting terminal with fuse-able links
   ii. Approximate frequency response of +/- 50Hz – 20kHz

b. Wall mount speaker
   i. Ceramic connecting terminal with fuse-able links
   ii. Minimum frequency response of +/- 100Hz – 20kHz

c. Bi-Directional Speaker
   i. Ceramic connecting terminal with fuse-able links
   ii. Minimum frequency response of +/- 150Hz – 15kHz

d. Outdoor Horn Speaker
   i. Oval aluminium structure with polyurethane resin paint to ensure weather proofing and corrosion resistance
   ii. IP 66 Rating for dust and weather proof characteristics
   iii. Minimum frequency response of +/- 500Hz – 7kHz

e. Outdoor Very High Output Horn Speaker (to be used as tower siren)

i. With acceptable weather proofing and corrosion resistance
ii. IP 66 Rating for dust and weather proof characteristics
iii. With sound pressure levels suited for the location or zone placed in.

(2) The sound pressure level shall be at least 10dB above the ambient SPL of each area as stipulated in SANS 7420-19.

(3) Sound level measurement for all the areas using a calibrated decibel meter need to be taken to use as input to detail design and after commissioning to confirm compliance.

(4) The detailed design shall ensure that the distance between the centres of the loudspeakers is not greater than 6 m for unidirectional loudspeakers and 12m for bidirectional loudspeakers as stipulated in SANS 7420-19

#### 3.4.10.3 Visual Warning devices

Visual warning devices as per SANS 7240 shall be installed together with speakers in areas with high ambient noise – as a minimum these shall be installed at ACC Fan plant area; Turbine house; HVAC room; Boiler House; WTP Transfer houses; Compressor houses and any other area with high ambient noise.

#### 3.4.10.4 Other General Requirements

(1) Some network infrastructure and equipment used during the construction phase of Medupi Power Station shall be re-used to the maximum extent possible during the permanent phase. An assessment of the existing infrastructure/equipment and its re-usability needs to be completed before commencement of detailed design; this also should ensure that the re-used infrastructure/equipment can be fully integrated with permanent designed equipment/infrastructure without unnecessary duplication of equipment.

(2) All necessary subsequent removal of existing installations shall form part of Contractor scope.

(3) Also noise level assessments in each zone and sub-zones needs to be done as part of detailed design and also acceptance testing.

### 3.4.11 Cabling

#### 3.4.11.1 General Cabling Requirements

(1) As a minimum both indoor and outdoor PH120 speaker cables shall be used.

(2) Fibre optic cable suitable for Gigabit Ethernet as a standard shall be used. This cable will comply with ANSI/TIA-568-B.2-1 standards.

(3) All cabling is required to be suitably protected against mechanical damage, chemicals, dust build-up and heat as per Eskom Standard Document: 240-56227443_Requirements for Control and Power Cables for Power Stations Standard.

(4) Cables are required to only be terminated in instruments, junction boxes or other approved equipment.

(5) No intermediate cable joints are permitted.

(6) Cables are required to be routed separately from electrical power cables and crossovers that bring signal and power cables into close proximity shall be made at right angles.

(7) There shall be use of existing cable racking and routes as far as possible.

#### 3.4.11.2 Fibre Optic Cables

(1) The redundant backbone fibre optic ring topology network infrastructure required for the EPPA system has been installed already as part of the consolidated building management system (CBMS); however, there might be requirements to install additional fibre optic cables and fibre optic patch leads and related consumables for areas where the installation has not been completed by the CBMS Contractor or in areas where the installed capacity does not meet requirements as set out in this design. An assessment of the then installed capacity and the required additional capacity would need to be completed prior commencement of the detailed design.

(2) As per item (1) above, an assessment prior to detailed design needs to be completed – but as a guide, in Appendix D, Project Drawings, the following are included:

(3) Indicative Block Diagram Drawing of Fibre Optic Cables installed as part of CBMS

(4) Indicative Cable Schedule of Fibre Optic Cables installed as part of CBMS

(5) All the fibre optic cables are terminated and spliced onto splice trays in the CBMS cabinets in all buildings, however, where there is no fibre optic cables installed for a particular building, additional fibre optic cables and splice trays shall be provided by the Contractor.

(6) For all additional fibre required (i.e. fibre required but not installed by CBMS contractor at commencement of detailed design):

i. The fibre optic ring main shall consist of a trench system using two, 110 mm outer diameter conduits, a series of manholes, and partially installed blown fibre.
ii. The fibre supply shall comply with or exceed ITU-T G.652.D for single mode fibres.
iii. 12 cores of fibres optic cables shall be provided at each location.

#### 3.4.11.3 Cable Schedules

Accurate records shall be kept in Cable Schedules as per attached template for all cabling forming part of the Works.

### 3.4.12 Operating Philosophy

(1) An operating philosophy document that conforms to the below shall be provided:

i. The operational philosophy to be used will be as per Medupi Power Station Emergency Preparedness and Response and as prescribed by Medupi Risk Department.
ii. EPPA system must meet functional requirements of Emergency Plan, 237-19-SRM-PC.
iii. The PA system will primarily be used to broadcast informative and guidance voice instructions during the course of an emergency to ensure correct implementation of the emergency response plan.
iv. EPPA system shall be able to be used to make normal announcements and play background music when required.
v. Background Music (BGM) is bypassed during announcements or on activation of the alarms.
vi. The system should have a fully fitted facility for testing and should be tested once a week to ensure system availability on all areas.

### 3.4.13 Requirements Related to Safety

(1) No individual EPPA fault shall endanger the safety of the people or plant or jeopardise the integrity of major plant.

(2) The earthing concept applied shall be based on recognised best engineering practices and shall ensure the safe and reliable operation of the EPPA systems and the protection of the electronic equipment against damaging transients.

### 3.4.14 Requirements Related to Availability and Reliability

(1) No individual EPPA fault or two EPPA concurrent faults shall instantaneously cause a failure of the complete system.

(2) No individual EPPA fault shall cause the loss of a call station.

(3) Failure of any microphone shall not inhibit operation of the EPPA system.

### 3.4.15 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 calibration.

(3) Emergency plans shall be provided for system failures and faults such that appropriate measures can be taken immediately without having to first analyse the cause of the failure.

(4) System fully supported with South African resources for minimum period of 15 years.

(5) Maintenance plan, philosophies, procedures and manuals shall be provided.

(6) 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.

### 3.4.16 Integration and Consistency of Design

(1) The HMI shall present an integrated and standardised set of displays and facilities which are designed to conform to ergonomic principles and modern power plant practice.

(2) The design approach of the HMI, and the underlying functionality of the EPPA systems behind the interface shall be consistent across all EPPA systems and functional areas covered by the Medupi EPPA system.

(3) Uniformed signal descriptions and abbreviations shall be used throughout the Power Station EPPA system.

(4) The EPPA system software and database(s) are fully integrated and seamless.

### 3.4.17 Expandability Requirements

(1) The EPPA 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 should be expandable to at least an extra 4 zones and 4 sub-zones in every zone without procuring any extra equipment.

(3) Also as a minimum the following shall be provided:

i. 20% spare installed terminals in the field for terminal equipment.

ii. 10% reserve physical space (rounded up) on all trunk cabling (and / or optic fibre) infrastructure.

iii. 20% reserve power availability per power supply system (power distribution, cabinet power supplies).

iv. Space for 10% additional network cables (rounded up) in every network cabinet.

v. 10% spare cores in all multi-core fibre optic cables (rounded up) terminated at both ends.

vi. 10% unused network ports per network switch (rounded up).

vii. 10% spare 1U rack space in all network cabinets (rounded up).

### 3.4.18 Life Expectancy

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

### 3.4.19 Standardization

(1) The purpose of standardisation of the EPPA is as follows:

i. Reduced life cycle cost/cost of ownership cost.

ii. Interchangeability of equipment.

iii. Reduced number of different types of equipment used on site, thereby also reduced spares holding requirements.

iv. Reduced training requirements of different systems.

(2) All similar plant and equipment provided for the complete EPPA system shall be standardized.

(3) The standardisation shall include for as a minimum the following aspects for all plant and equipment forming part of the Works, and shall include but not be limited to:

i. HMI (make, model, and size):

a) Screens.

b) Input Devices.

c) Computer.

d) Desks.

e) Microphone Consoles

ii. Computers and servers (make, model, and 19” rack mounting).

iii. Network equipment (make and model):

a) Switches and hubs.

b) Fibre optic cable (type of cable and terminations).

iv. Cubicles and enclosures (make, size, construction and colour).

v. Field instrumentation (if any):

a) Instrumentation for each measurement type (make, model, series, accuracies, ranges, process connections, mountings and terminations).

b) Junction boxes or Patch panels (size, colour, arrangement and mounting).

c) Speakers / Horns (make, model, series, mountings and terminations).

vi. Cabling (routing, make, size, type, number of conductors, terminations).

vii. Racking, trunking and conduits (routing, make, size, type and mountings).

(4) Standardisation shall not compromise the plant and/or the EPPA system performance.

(5) Also standard product from OEM should be supplied – only proven OEM solutions are acceptable.

## 3.5 CIVIL INFRASTRACTURE AND BUILDINGS REQUIREMENTS

### 3.5.1 Outside Zone Siren Tower Requirements

The Outside Zones (typically Zone 14 – 16) in Table 1: Defined Zones Tables requires installation of tower sirens as per Figure 3 to cover the outside area surrounding the power plant – the final installation or number of towers to be installed shall form part of detailed designs. The following typical designs for the siren towers are proposed but optimized tower designed are also acceptable. Contrator can also propose other solutions for the outside zones as options for consideration.

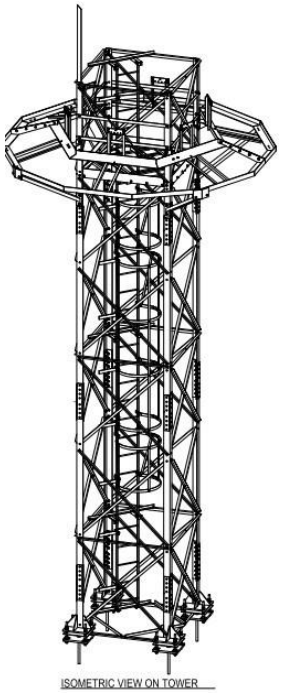


**Figure 3: Typical Siren Tower**

Typical Foundation design for the towers will be as per Figure 4 and Figure 5 below – the designer may change the typical details as required:

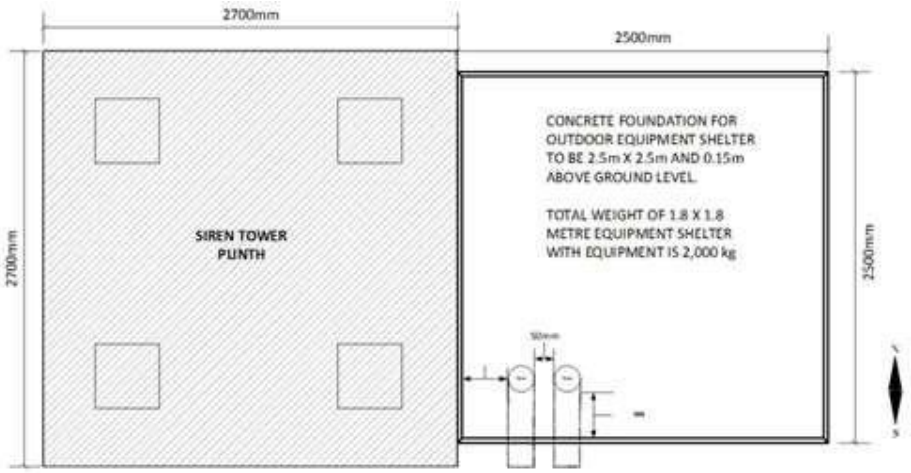


**Figure 4: Plan View of the Typical Foundation Design for the Siren Tower Structures.**

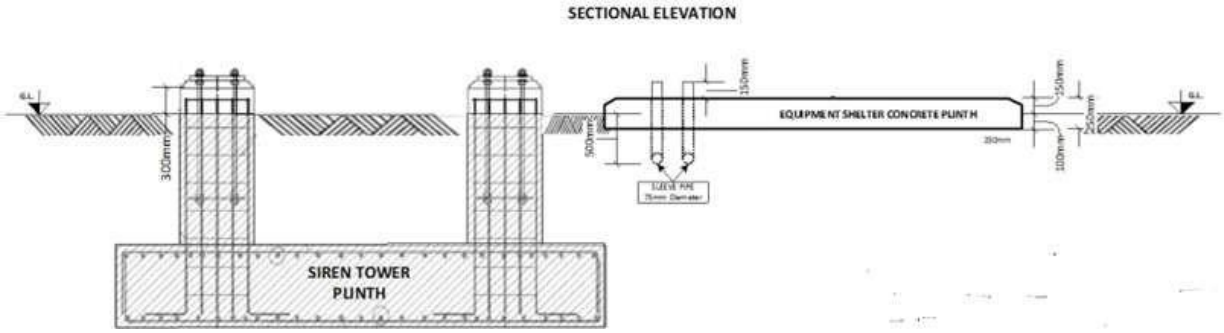


**Figure 5: Sectional Elevation View for the Typical Foundation Design for the Siren Tower Structures**

### 3.5.2 General EPPA Room Requirements

(1) Generally as per the zones and sub-zones defined, equipment such as network equipment and amplifiers should be housed in nearby equipment rooms, substations and buildings. Refer to Appendix D – Project Drawings and Schedules – for a list of Buildings where equipment can be located.

(2) The Location Drawings and provided Hardware and Equipment Inventory List Template shall be used to detail the location of such equipment. Prior to finalizing location of equipment, Contractor is to perform and assessment for approval of where best to locate hardware and equipment considering such items as available space and suitability.

(3) Where existing buildings or infrastructure will be utilised to support equipment, the Contractor's appointed civil\structural professional has to evaluate the structural capacity of the existing structure to ensure original design loads are not exceeded. The Contractor shall request from the Employer the relevant details of the affected buildings\structures.

(4) The equipment heat and weight loading must be detailed in the provided Buildings and Rooms Schedule for air conditioning, heating and cooling requirements considerations per room.

(5) Where supplied HVAC by Employer is not sufficient to support the heat-loading, or in buildings where no HVAC is supplied by the Employer, Contractor is to supply HVAC that complies to Eskom Works Instruction, 240-143112846 – HVAC Works Instruction.

### 3.5.3 General Civil and Structural design requirements

(1) All civil and structural work shall be designed for a 50 year design life. The design and construction shall be done in accordance with the specifications and standards listed in APPENDIX E: DESIGN STANDARDS, GUIDELINES AND CODES, or other approved specialist literature.

(2) The ECSA registered professional shall, in accordance with the Construction Regulations, monitor construction works and issue a PEC once all construction works are completed. The registered professional shall execute their services in accordance with the ECSA Code of Conduct and ECSA Guideline Scope of Services and Tariff of Fees for Persons Registered in terms of the Engineering Professional Act, 2000.

(3) The Contractor is responsible for the surveying of the site (pertaining to the scope) to ensure the Works are integrated with existing site conditions and planned future works where applicable.

(4) The contractor is responsible for site specific geotechnical assessment and investigations for the design.

### 3.5.4 Civil and Structural deliverables

(1) The supply, deliver and construction of the complete civil works defined in the scope of Works.

(2) Geotechnical investigation, geotechnical report, test pits and reinstatement of test pits and all required geotechnical tests by an accredited (SANAS) laboratory.

(3) Site surveying reports.

(4) Civil and structural design reports of all required civil\structural work. The design report shall include design assumptions, design code and specification references and detail calculations.

(5) Where existing buildings or infrastructure will be utilised to support equipment, the Contractor's appointed civil\structural professional has to evaluate the structural capacity of the existing structure to ensure original design loads are not exceeded. This assessment has to be included in the design report. The Contractor shall request the relevant information from the Employer.

(6) Handover Completion Package of civil\structural works that include construction completion reports, corrective action report if required, native drawings (CAD, dgn format, etc.), pdf. For Construction Drawings, As-built drawings, signed-off construction data books and maintenance manuals. Contractors Designer grants to the Employer an irrevocable, nonexclusive, royalty-free licence to any intellectual property to the extent necessary for the operation, maintenance, completion, repair or alteration to any works certified or that of the third party.

(7) Final PEC issued by ECSA registered professional

## 3.6 CONFIGURATION REQUIREMENTS

All applicable KKS standards and codes as per Section 3.3 of this document shall apply. The System main KKS is envisaged to be *CYC*- Loudspeaker System (PA).

### 3.6.1 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"

(1) A complete and comprehensive description of the Contractor's document numbering conventions and revision schema;

(2) A description of the electronic data management system(s) that the Contractor will use for the management of documents and/or configuration items;

(3) A description of the configuration management activities which will be undertaken by the Contractor as well as a rough time-scale thereof;

(4) A description of the baselines that will be established and the content of these baselines;

(5) The release procedure for product configuration information;

(6) The procedure for the control of changes prior to the establishment of baselines as well as after;

(7) The method for processing changes, emanating both internally and from sub-suppliers;

(8) The method for collecting, recording, processing and maintaining the data necessary for producing configuration status accounting records;

(9) The definition of the content and format for all configuration status accounting reports;

(10) A list of audits which will be conducted to ensure adherence to the CM plan.

### 3.6.2 Plant Designation

#### 3.6.2.1 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:

i. The application of KKS plant coding (NMP 45-7)-200-4190
ii. KKS Key Part-Fossil Power Station (NPSZ 45-45)-200-18202
iii. Issuing of KKS certificates-200-94660
iv. VGB-B 106 E Parts A-KKS Application Commentaries Part A_General
v. VGB-B 106 E Part B1-KKS Application Commentaries Part B1_Mechanical Engineering
vi. VGB-B 106 E Part B2-KKS Application Commentaries Part B2_Civil Engineering
vii. VGB-B 106E Part B3-KKS Application Commentaries Part B3_Electrical and C&I Engineering.
viii. VGB-B 106E Part B4-KKS Application Commentaries Part B4 Identification of C&I and Control Tasks.

(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.

#### 3.6.2.2 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 to 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.

#### 3.6.2.3 Plant Designation within Documentation

(1) 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.).

(2) 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.).

(3) 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:

i. The KKS designation of all components within the relevant scope of work or system.

ii. The full verbal description of each component, compiled according to the standards referenced in this document.

iii. The abbreviated description of each component, utilising abbreviations as listed inthe 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;

iv. The approval status of each component, in alignment with the list of approval statuses specified for document.

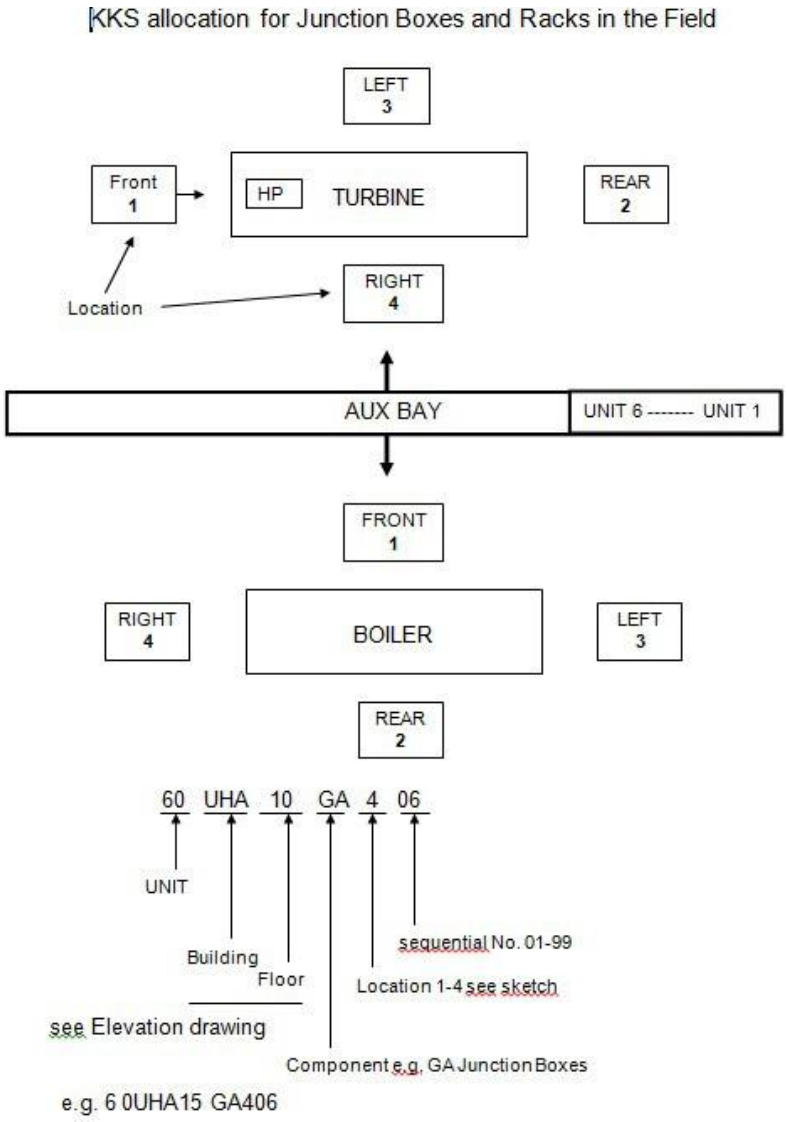


**Figure 6: Example of KKS Coding**

## 3.7 ELECTRICAL SYSTEMS REQUIREMENTS

### 3.7.1 General Electrical

(1) The Contractor will be responsible for the design of the Electrical reticulation to the EPPA loads, this will also include the redundancy required by the EPPA system in accordance to 204-64720986.

(2) The Contractor will be required to provide a load list for all the main connection points that will require source of connection/supply from the Employer Boards as per the VDSS.

(3) The Electrical load List will be used to detail the system's electrical load requirements

and details of such shall be supplied as per Vendor Document Submittal Schedule (VDSS) and provided Electrical Load List templates.

(4) The electrical system design will include interfaces to currently installed electrical systems at interface points or at conceptual zonal points as defined in Table 1: Defined Zones Tables also in accordance to provided Limit of Supply and Services (LoSS) Diagrams.

(5) The Employer will provide source of connections to the Charger (Loads) to be supplied where there are equipped spare circuits available in according to the Electrical load list supplied. Thus, 400V/230V AC Supply.

(6) Where there are no equipped spare circuits available from the nearest source of connection, the Contractor will be required to equip the empty/spare circuits with the appropriately size breakers/circuit.

(7) The Contractor shall be responsible for sizing and routing of the cables in accordance to their design loads from the source of connections to the loads.

(8) The Contractor shall be responsible for supplying, pulling and termination of all interfacing power cables including racking where routing may need to be extended.

(9) All the cabling and racking works shall be done in accordance to Eskom racking and cabling standard 240-56227443.

### 3.7.2 Battery Backup System

(1) The back-up power system to be designed and supplied is to comply with the Eskom Emergency Preparedness Standard 240-64720986, Section 3.11.

(2) The system shall be equipped with EN54 compliant stand-by batteries to cater for a minimum stand-by period of 24 hours and a continuous broadcast of 30 minutes at full power.

(3) The minimum lifespan of the batteries shall be 15 years.

(4) The system must be capable of discharging and re-charging each battery at a pre-determined interval for purposes of keeping each battery in optimal condition.

(5) The system shall be powered by 24VDC via power supply modules working off 220VAC and must be capable of a seem-less transition between AC and DC.

### 3.7.3 Earthing, Lightning and Electrical Protection

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

(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

## 3.8 SECURITY REQUIREMENTS

The interface equipment shall be housed in a lockable cabinet rack to avoid unauthorised personnel tampering with the settings and the rack shall be located inside the nearest building within each zone.

## 3.9 TEST AND COMMISSIONING REQUIREMENTS

(1) All acceptance testing will be based EPPA meeting all specified requirements.

(2) FAT, SAT, SIT and Commissioning of the system will be conducted as per IEC 62381.

## 3.10 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

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.

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## 3.11 ENVIRONMENTAL ASSESSMENT

Environmental Impact Assessment (EIA) should be conducted during the initiation of the project as part of the detailed design**.**

## 3.12 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

## 3.13 EXPANDABILITY ASSESSMENT

At detailed design freeze, an expandability report shall be produced detailing compliance to expandability requirements.

## 3.14 SAFETY ASSESSMENT

### 3.14.1 Industrial Safety Assessment

As per SANS 7240-19, one of the important documents during the preparation of design of emergency evacuations system is to identify hazard within the classified zones. As part of detailed design, the hazardous area classification and type of hazard identified with each area shall be completed by Contractor.

### 3.14.2 Preliminary Fire Safety Assessment

Also a Fire Safety Assessment shall be completed as part of the detailed design scope.

## 3.15 TECHNICAL RISK REGISTER

A technical risk register in the form as per provided template shall be provided and kept up-to-date.

## 3.16 INTERFACES

(1) Interfaces are defined in Limits of Supply and Services Diagrams (LoSS Diagrams)

(2) Interfaces will generally be with the below listed Medupi Packages in Table 2.

**Table 2: List of Medupi Packages**

| Package Number | Package Description |
|---|---|
| 1 | Overland Coal Conveyor |
| 2 | Boiler |
| 3 | Turbine |
| 4 | Low Pressure Services (LPS) |
| 6 | Water Treatment Plant (WTP) |
| 7 | Chimneys and Silos |
| 8 | Civils (Auxiliary Bay, WTP, SSB Buildings) |
| 11 | LV & MV Cabling |
| 12 | LV Switchgear |
| 13 | MV Switchgear |
| 14 | Transformer |
| 15 | Generator |
| 16 | DC/UPS |
| 17A | Unit 6 – 4 & BoP/SER Control & Instrumentation (C&I) |
| 17C | Unit 3 – 1 Control & Instrumentation (C&I) |
| 18 | Centralized Building Management System (CBMS) |
| 19B | IT |
| 20 | Hydrogen/Nitrogen |
| 21 | Laboratory |
| 23 | Diesel generator |
| 27 | Coal Stockyard Equipment |
| 28 | Ash Dump and Equipment |
| 31 | Ash Wash down & Secondary Treatment Plant |
| 32 | Dust handling Plant |
| 33 | Terrace Coal and Ash Plant |
| 35 | Civils (Substations) |

## 3.17 REQUIREMENTS RELATED TO TECHNICAL DOCUMENTATION

(1) All technical documentation shall be supplied as specified in the Vendor Document Submittal Schedule (VDSS – Appendix A).

(2) Some Templates are provided and shall be complete as specified in the VDSS.

### 3.17.1 Description of Some of the Templates

#### 3.17.1.1 Limits of Supply and Services (LOSS)

The scope of supply and services is given in graphical format in the LOSS diagrams. The LOSS diagrams indicate the scope of supply and services for individual items and the supply and interfaces to systems.

The Contractor shall be responsible to identify scope of supply and services that are not indicated on the LOSS diagrams and identify systems and or equipment that are not covered by the LOSS diagrams and red-line the supplied LOSS diagrams.

#### 3.17.1.2 Function IO Block Diagrams

The Functional IO Block Diagrams details the type and quantity of the inputs and outputs from control systems.

The Contractor shall be responsible to identify systems and equipment not covered by the supplied Functional IO Block Diagrams.

### 3.18 QUALITY MANAGEMENT

Quality management procedure as provided shall be complied with.

## 4. PROJECT 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.

### 4.1 EXISTING DESIGNS FOR THE MEDUPI POWER STATION PUBLIC ADDESSING SYSTEM

(1) Approximately 75% of the Basic Design documentation have been submitted by the previous EPPA supplier and have been accepted by the Employer. The Contractor shall be responsible for the review, evaluation, design, updating and acceptance of existing design documentation. The Contractor shall confirm that its review, evaluation, design, update, and acceptance of the existing and new design assures that the design is in full compliance with the Generic Public Address System Technical Specification Standard (240-161708025) and this technical specification document. Any updates and changes to the design documents shall be submitted to Project Manager for acceptance. Once the Contractor has accepted these designs, the Contractor shall take full accountability of these designs.

(2) The existing design documentation and the respective acceptance statuses are listed in APPENDIX L – EXISTING DESIGNS MASTER DOCUMENT LIST. The documentation listed shall be made available to the tenderer on contract award.

### 4.2 BASIC ENGINEERING

#### 4.2.1 General Requirements

(1) Basic engineering is defined as being all activities necessary to clearly identify the

Contractor's scope and design for the EPPA 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. Noise level Measurement studies of every zone and sub-zones.

iii. Preliminary Fire Safety Assessments

iv. Investigation work – during which the Contractor conducts his investigation work.

v. 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 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 EPPA systems and 3rd party systems (including electrical and civil interfaces provided by

others).

## 4.3 DETAILED ENGINEERING

### 4.3.1 General Requirements

(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 EPPA 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.

## 4.4 MANUFACTURING

### 4.4.1 General Requirements

(1) The EPPA 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 EPPA 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.

### 4.4.2 Pre-FAT

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

(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

### 4.4.3 FAT

(1) During FAT, the Contractor shall demonstrate that the Power Station's EPPA 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 EPPA system's functionalities can be done.

(5) The Contractor shall ensure that all EPPA 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.

(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.

## 4.5 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.

(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.

## 4.6 SITE INTEGRATION TEST (SIT)

(1) The SIT for the EPPA system shall only begin once the following has occurred:

i. The EPPA 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.

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.

### 4.7 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.

### 4.8 OPERATIONAL ACCEPTANCE TEST (OAT)

(1) Commissioning shall be concluded with the Operational Acceptance Test (OAT).

(2) 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 EPPA system in its final installed locations and operational platforms and licences.

ii. Verification of all safety functions.

iii. Final High level testing that ensures all components of EPPA system are integrated, fully functional and meet all requirements in their final operational state.

(3) The Contractor shall produce a detailed OAT test procedure 28 days in advance for approval by the Engineer.

(4) The final OAT Report shall be prepared by the Contractor.

(5) The Contractor shall submit the final OAT Report to the Engineer for approval.

### 4.9 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.

## 5. OTHER OPTIONS FOR SOLUTION OR SCOPE OF WORKS

(1) As an option, a solution that does not require EN54 certification is to be provided for.

(2) This option also does not have to comply to provision of background music or BGM.

## APPENDIX A: VDSS

## APPENDIX B: LOSS DIAGRAMS

## APPENDIX C: IO FUNCTION BLOCK DIAGRAMS

## APPENDIX D: PROJECT DRAWINGS & SCHEDULES

| # | Eskom Drawing / Document No. | Drawing / Document Description |
|---|---|---|
| 1. | N/A | Aerial View Of Medupi Showing Locations Of The Defined Zones |
| 2. | N/A | Indicative Block Diagram Drawing of Fibre Optic Cables installed as part of CBMS |
| 3. | N/A | Indicative Cable Schedule of Fibre Optic Cables installed as part of CBMS |
| 4. | N/A | Building List Where Equipment Can Be Located |

## APPENDIX E: DESIGN STANDARDS, GUIDELINES AND CODES

| # | Type | Number | Name |
|---|---|---|---|
| 1 | SANS | SANS 7240-19: 2008 | Design, installation, commissioning and service of sound systems for emergency purposes |
| 2 | SANS | SANS 7240-16: 2008 | Sound system control and indicating equipment |
| 3 | SANS | SANS 10108 :2005 | Classification of Hazardous Location (Electrical Plant) |
| 4 | EN | EN54-4 | European Norm – Voice Alarm Power Supply Equipment |
| 5 | EN | EN54-16 | European Norm – Voice Alarm and Indicating Equipment |
| 6 | EN | EN54-24 | European Norm – Loudspeaker Equipment |
| 7 | Eskom | 240-55410927 | Cyber Security Standard for Operational Technology |
| 8 | SANS | SANS 10400, 1990 | The application of the national building regulations |
| 9 | ISO | ISO 9001 | Quality Management Systems |
| 10 | Eskom | 237-19-SRM-PC | Medupi Power Station Emergency Preparedness and Response |
| 11 | Eskom | 240-64720986 | Emergency Preparedness Public Address System – For Large Area Deployment |
| 12 | Eskom | 240-56227443 | Requirements for Control and Power Cables for Power Station Standard |
| 13 | SANA | SANS 10142-1 | The Wiring of Premises, Part 1 – Low-Voltage Installations |
| 14 | Eskom | 240-56355466 | Alarm Management System Standard |
| 15 | Eskom | 240-52844017 | System Reliability, Availability and Maintainability Analysis Guideline |
| 16 | Eskom | 240-56355815 | Junction Boxes and Cable Termination Standard |
| 17 | Eskom | 240-49230111 | HAZOP Analysis Guideline |

| # | Type | Number | Name |
|---|---|---|---|
| 18 | IEC | IEC 62381 | Automation systems in the process industry – Factory acceptance test (FAT), site acceptance test (SAT), and site integration test (SIT) |
| 19 | Eskom | 240-56355535 | Process Calibration Equipment Standard |
| 20 | Eskom | 240-59937450 | Fire Protection and Life Safety Design |
| 21 | Eskom | 240-56356396 | Earthing and Lightning Protection Standard |
| 22 | Eskom | 0.84/3482 | Medupi Power Station Earthing Standard |
| 23 | SANS | SANS 62305 | Protection Against Lightning |
| 24 | Eskom | 240-56737654 | Inspection Testing and Maintenance of Fire Detection Systems Standard |
| 25 | Eskom | 240-56355731 | Environmental Conditions for Process Control Equipment Used at Power Stations Standard |
| 26 | Eskom | 240-56355910 | Management of Plant Software Standard |
| 27 | Eskom | 240-119638133 | Control Systems Design for Redundancy and Diversity Standard |
| 28 | Eskom | 240-56355541 | C&I Computer and Equipment Rooms Civil and General Building Requirements Guideline |
| 29 | Eskom | 240-72344727 | C&I Control System Architecture Guideline |
| 30 | Eskom | 240-129014618 | Generation Cyber Security Compliance Guideline |
| 31 | Eskom | 200-16714 | Procedure – Commissioning Procedure |
| 32 | Eskom | 200-4190 | Application for KKS Coding |
| 33 | Eskom | 240-56355541 | Control System Computer Equipment Habitat Requirements Guideline |
| 34 | Eskom | 240-56355808 | Ergonomic Design of Power Station Control Suites Guideline |
| 35 | Eskom | 240-56356411 | Fire Barrier Seals for Electrical Cable Installations |
| 36 | Eskom | 240-56360034 | Stationary Vented Lead Acid Batteries |
| 37 | Eskom | 240-56360086 | Stationary Vented Ni-Cad Batteries |
| 38 | Eskom | Alpha KKS 01 | Alpha KKS 01 |
| 39 | Eskom | Alpha KKS 02 | Alpha KKS 02 |

| # | Type | Number | Name |
|---|---|---|---|
| 40 | Eskom | PPZ 200-3340 | KKS Coding And Labelling Procedure KKS – Procedure |
| 41 | Eskom | N.PSZ 45-45 | KKS Key Part Fossil Power Station |
| 42 | Eskom | 200-11757 | Earthing concept |
| 43 | Eskom | | Eskom Contractor Title Block Description |
| 44 | Eskom | | Medupi Quality Management Procedure |
| 45 | National Act | Act No. 85 of 1993 | Occupational Health and Safety Act |
| 46 | Eskom | 240-86973501 | Engineering Drawing Standards |
| 47 | Eskom | 240-57127955 | Geotechnical and Foundation Engineering Standard |
| 48 | Eskom | 240-56364545 | Structural Design and Engineering Standard |
| 49 | Eskom | 200-6166 | Eskom backfill specification |
| 50 | Eskom | 84CIVL053 | Medupi Power Station Specification for Structural Concrete, Rev 3 |
| 51 | Eskom | 200-24289 (Ssz_45-17) | Medupi Power Station Corrosion Protection Specification |
| 52 | Eskom | 240-108614750 | Eskom Standard |
| 53 | Eskom | 240-53114248 | Eskom Standard |
| 54 | Eskom | 240-58552870 | Smart Plant for Owner Operators (SPO) Documentation Metadata Standard |
| 55 | Eskom | 240-71432150<br>240-93576498 | Plant Labelling Standard<br>KKS Coding Standard |
| 56 | Eskom | 240-53114186 | Project/Plant Specific Technical Document and Records Management Procedure |
| 57 | Eskom | 240-109607332 | Eskom Plant Labelling Abbreviation Standard |
| 58 | Eskom | 240-143112846 | HVAC Works Instruction |

## APPENDIX F: BUILDINGS AND ROOMS SCHEDULE

## APPENDIX G: ELECTRICAL LOAD SCHEDULE TEMPLATE

## APPENDIX H: HARDWARE AND EQUIPMENT INVENTORY LIST TEMPLATE

## APPENDIX I: SOFTWARE INVENTORY LIST TEMPLATE

## APPENDIX J: CABLE SCHEDULE TEMPLATE

## APPENDIX K: TECHNICAL RISK REGISTER

## APPENDIX L: EXISTING DESIGNS MASTER DOCUMENT LIST