Eskom	Standard	Asset Management

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1. EXECUTIVE OVERVIEW

The Eskom premises require the design, supply, erection (and / or installation) and commissioning of a site 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 to 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: • 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. • Horn type loudspeakers are typically used in industrial environments such as workshops, factories, warehouses and also for outdoor installations. • Bidirectional speakers • Cabinet Speakers- Wall/surface mount speakers typically used escape stairs, store rooms and kitchens
Line Level	Depending on local practices, amplifiers usually amplify the audio signals to 50 V, 70 V, or 100 V speaker line level.
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
BMS	Building Management Systems
CBMS	Centralized Building Management System
C&I	Control and Instrumentation
CMD	Construction Management Department
DAC	Digital to Analogue Converter
DCS	Distributed Control System
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
GUI	Graphical User Interface

Abbreviation & Acronyms	Description
HMI	Human Machine Interface
ISO	International Standard
IP	Ingress Protection
NTP	National Time Protocol
PA	Public Address
PEC	Professional Engineering Certificate
PS	Power Station (Eskom premises or facility for non Power Station)
PSM	Power Station Manager (Facilities Manager for Eskom facilities)
ROC	Required Operational Capability
RTS	Return To Service
OEM	Original Equipment Manufacturer
OHSAct	Occupational, Health and Safety Act
PBS	Plant Breakdown Structure
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 Eskom premises.

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, manufacturing, factory acceptance testing, delivery, off-loading at site, storage, installation, testing, commissioning, optimisation, and as-built documentation for the EPPA systems.

(3) All civil *Works* shall be designed and constructed in accordance with the Eskom civil standards, the Construction Regulations and relevant national 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*. Applicable standard shall be identified based on the civil design requirements.

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 proposed representation of the system block diagram showing the sub-systems of the EPPA system.

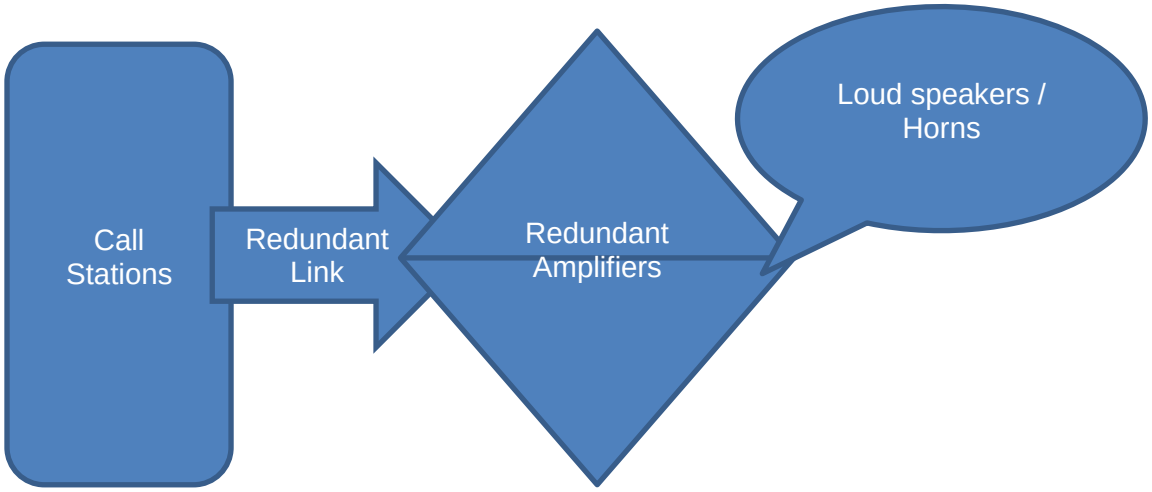

Figure 1: Block Diagram Representation of EPPA System

(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 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 *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*.
(7) Persons performing design work and/or maintenance on public address systems need to demonstrate that they had been trained and found proficient in the specific public address system revision and brand they are designing or maintaining as well as any 3rd party equipment such as GUI

and/or any networking equipment. These training programs or qualifications need to be presented or endorsed by the specific public address system OEM. Designers also need to demonstrate that they had been trained and found proficient in the standards governing the public address system, SANS standards are preferred.

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 the attention of maintenance teams.

3.4.2 General System Requirements and System Architecture

1) Simplified system architecture is as per Figure 2.

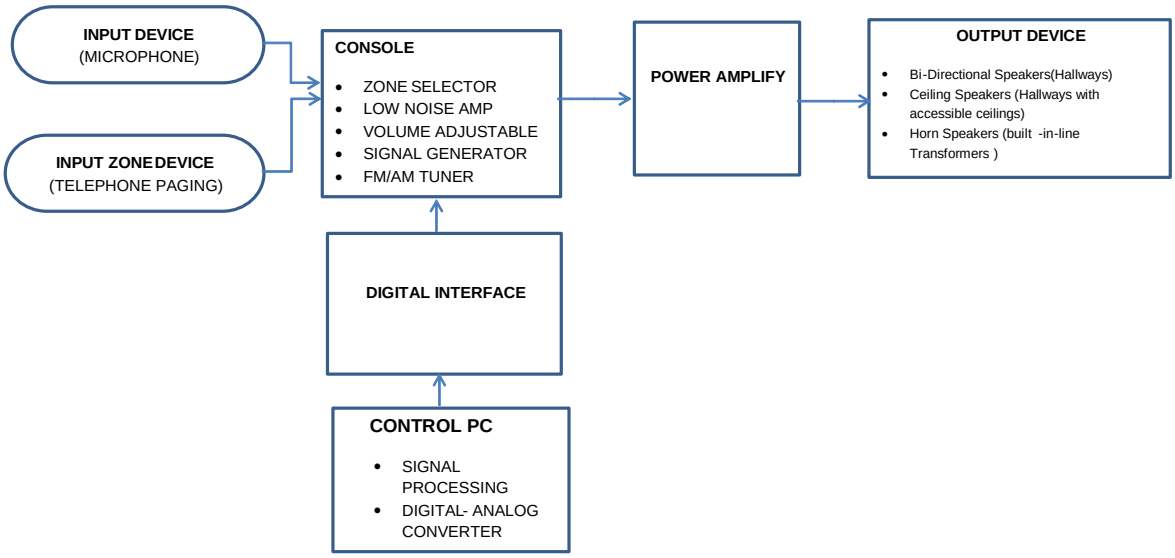

Figure 2: EPPA Simplified System Architecture

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 to suit the specific site using a similar table as shown in 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) To avoid a single point of failure rendering the public address system inoperable, 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 premises control and monitoring systems such as Building Management Systems (BMS) and/or Distributed Control Systems (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 using interface protocols available from both systems.
14) Operational tasks must be performed by menu buttons with visible displays and LED statuses.
15) The system minimum microphone and expandable external line level inputs are designed to suit the user requirements as well as the size of the premises and is guided by the minimum quantities stated in the relevant standards.
16) The system minimum expandable amplifier outputs are designed to suit the user requirements as well as the size of the premises and are guided by the minimum quantities stated in the relevant standards.
17) The system audio channels for general broadcasts (paging, announcements, BGM, etc.) and audio channels for emergency broadcasts which can be processed simultaneously are designed to suit the user requirements as well as the size of the premises.
18) The system shall provide for priority settings to assign different levels of management and permissions 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 with the appropriate IP ratings to suit the installation location environmental conditions shall be used.
24) Recordings of all broadcasts will be stored on more than one local machines in separate locations for a rolling-period of at least sixty (60) days and be downloadable to portable media to assist in incident analysis and post-incident investigations.
25) Restoration software is supplied to read back and analyse recordings.
26) Failure of any one of installed redundant equipment shall be alarmed. This is to take timeous action before the second item fails and render the envisaged functionality inoperable.

3.4.3 Zoning

The compiler must align this table with the premises and fill this before finalising the specification.

“xx” in the 1st paragraph are quantities to be filled once table is complete. The blue text in the table is examples only.

There are xx zones and xx sub-zones to be designed. These 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
E.g. Zone 1 Unit 1	1A ACC
	1B Turbine Hall
	1C Aux bay
	1D Boiler
	1E FFP & FFP s/s

3.4.4 Call Stations / HMI

1) The quantity of call centres are determined by the size of the premises as well as the redundancy requirements. Normally the main call station would be at the Emergency Operations Centre (EOC) or Electrical Operating Desk (EOD). It is the *Contractor's* responsibilities to ensure that these call stations are installed in suitable ergonomic spaces
2) Reception desk is to be used only for (normal) announcement – no zone selection is allowed at reception desk
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 best practice.
4) Call stations should be able to all operate concurrently.
5) Announcements should only be directed to affected or selected 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 local/accessible volume controls. Only adjustable from control panel.
8) 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 *Employer*.
    a. All clear sound alarm;
    b. Fire sound alarm;
    c. Emergency sound alarm;
    d. Pre-announcement sound for normal announcements;
    e. Pre-emergency announcement sound for emergency announcement
9) With respect to prioritizing alarm responses initiated from control panels; EOC takes highest priority.
10) 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 predefined locations which are typically the EOC, EOD or Administration Reception desks.
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 at least the zones/sub-zones identified in this specification plus 20% additional for further expansion.
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 only 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 removable media.

3.4.5 Computers and Servers

Physical Specifications of computer equipment supplied are as per the requirements of the specific premises.

The *Contractor* installs Anti-malware software & security patches/updates for all operating systems that form part of their scope of supply.

1) The minimum specifications for each server shall be as follows:
    a. Redundant connection to each network where the *Contractor's* design showed the server to be essential to the availability of the EPPA system
    b. Use dedicated server hardware
    c. Hot swappable redundant power supplies

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

e. 19" Rack mounted

f. Redundant case fans

g. Adapted to the environmental conditions it is installed at

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 can access the network.
2) Compliance to all Eskom Cyber Security Standards as detailed in Appendix E (Design Standards, Guidelines and Codes).

Network Switches

1) All network switches shall be managed network switches.
2) All network switches shall support the backup and restoring of all configuration settings.
3) All network switches shall be remotely configurable.
4) All network switches shall be SNMPv3 compatible.
5) All network switches shall be IPv4 compatible.
6) All network switches shall have redundant power input ports.
7) Any network switch not located in a network cabinet shall be of industrial Ethernet type and suitable for uncontrolled & harsh environmental conditions.
8) Any network switches which are provided to facilitate data communication between systems shall be layer 3 switches or routers.
9) 24V shall be the preferred voltage level to be used throughout all networks.

Remote Management

1) Each network switch shall be remotely managed, monitored and alarmed via the network management system and with the possibility of being interfaced to existing premises control and monitoring systems such as Building Management Systems (BMS) and/or Distributed Control Systems (DCS).
2) 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.
3) 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. Where alarms are grouped or zoned, the *Contractor* provides an alarm concept for the *Employer's* approval.

   f. Event handling, logging and analysis

   g. Server application monitoring

   h. Network & server availability monitoring

   i. Hardware and software inventory system

4) The network management system shall use a Graphical User Interface (GUI). Based on the premises layout, the placement of the GUI shall be proposed by the *Contractor*.
5) 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.

3.4.7 Time Synchronisation

Time synchronisation for all the relevant components of all EPPA system shall be provided. Where the site has an existing GPS with sufficient spare capacity an interface using either pulse or NTP could be considered or an alternative method of time synchronisation may be proposed.

3.4.8 EPPA System Manager

1) EPPA system manager complies with Emergency Preparedness Public Address System 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 the EPPA system.
3) The system manager shall be capable of monitoring all de-centralised zones centrally and logging all events.
4) The system continuously monitors amplifiers and loudspeaker lines for fault conditions.
5) 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
6) 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 are activated on a pre-assigned Call Stations with possibility of being interfaced to existing premises control and monitoring systems such as Building Management Systems (BMS) and/or Distributed Control Systems (DCS).
7) Equipment housing shall be as per 240-64720986 Emergency Preparedness Public Address System**.**

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:
   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.

3.4.10 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) LED's 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. To allow for future expansion, the site design should not occupy more than 80% of available slots.
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 amplifier 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.
10) The *Contractor* stipulates at tender stage the type of amplifiers envisaged (Digital or Analogue with DAC) and supply equipment datasheets for analysis.

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 measurements for all the areas, using a calibrated decibel meter, need to be conducted by the *Contractor* as input to detail design and again 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 complying with SANS 7240 shall be installed together with speakers in areas with high ambient noise or areas permanently accommodating people with hearing disabilities.

3.4.10.4 Other General Requirements

1) 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 newly designed equipment/infrastructure without unnecessary duplication of equipment.
2) Noise level assessments in each zone and sub-zones shall be done as part of detailed design and again during 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) All cabling is required to be 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. This cable standard will also apply to Eskom Facilities other than Power Stations.
3) Cables are required to only be terminated in instruments, junction boxes or other approved equipment.
4) No intermediate cable joints are permitted.
5) 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.
6) Where possible, existing cable racking and routes shall be re-used else new racking and conduits are provided for by the *Contractor*.
7) On Eskom premises where specific cable numbering conventions are in force, the *Contractor* follows these conventions otherwise the *Contractor* proposes a coding system/structure for the approval of the *Employer*.

3.4.11.2 Fibre Optic Cables

1) The fibre supply shall comply with or exceed ITU-T G.652.D for single mode fibres.
2) Fibre optic cable suitable for Gigabit Ethernet shall be used.
3) Sufficient cores of fibres optic cables shall be provided at each location.
4) As part of the *Contractor's* design they supply fibre optic commissioning and testing procedures for the *Employer*'s approval.

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:

a. The operational philosophy to be used will be in line with the premises Emergency Preparedness and Response plans.

b. EPPA system shall meet site specific functional requirements of Emergency Plan.

c. 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.

d. EPPA system shall be able to be used to make normal announcements and play background music when required.

e. Background Music (BGM) is bypassed during announcements or on activation of any alarm.

f. The system should have a fully fitted facility for testing and should be tested once a week to ensure system availability on all areas.

g. As part of the tender returnable, the *Contractor* provides a methodology on prioritising call stations and how switching between call stations is accomplished.

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. Refer to Eskom Earthing and Lightning Protection Standard listed in Appendix E.

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 plant environments.
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 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 EPPA system.
3) Uniformed signal descriptions and abbreviations complying to the Eskom Plant Labelling and Abbreviation Standard listed in Appendix E, shall be used throughout the EPPA system.
   a. 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. For smaller Eskom facilities, this figure could be reduced based on a proposal from the *Contractor* and acceptance by the *Employer*.
3) Also as a minimum the following shall be provided: All percentage calculations are rounded up
   a. 20% spare installed terminals in the field for terminal equipment.
   b. 10% terminated reserve physical space 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 in every network cabinet.
   e. 10% spare cores in all multi-core fibre optic cables terminated at both ends.
   f. 10% unused network ports per network switch.
   g. 10% spare 1U rack space in all network cabinets.

3.4.18 Life Expectancy

With the exception of computer equipment, all 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:
   a. Reduced life cycle cost/cost of ownership cost.
   b. Interchangeability of equipment.
   c. Reduced number of different types of equipment used on site, thereby also reduced spares holding requirements.
   d. Reduced training requirements of different systems.
2) All similar plant and equipment provided for the complete EPPA system shall be standardized.

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:

HMI (make, model, and size):
   i. Screens.
   ii. Input Devices.
   iii. Computer.
   iv. Desks.
   v. Microphone Consoles.
3) Computers and servers (make, model, and 19” rack mounting).
4) Network equipment (make and model):
   a. Switches and hubs.

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

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

5) Field instrumentation (if any are needed for the PA System):
   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).

6) Cabling (routing, make, size, type, number of conductors, terminations).
7) Racking, trunking and conduits (routing, make, size, type and mountings).
8) Standardisation shall not compromise the plant and/or the EPPA system performance.
9) Also standard product from OEM should be supplied – only proven OEM solutions are acceptable.

3.5 CIVIL INFRASTRUCTURE AND BUILDINGS REQUIREMENTS

3.5.1 Outside Zone Siren Tower Requirements (Where explicitly required)

Where outside Zones in Table 1: Defined Zones Tablesrequire installation of tower sirens, it will be as per Figure 3 – 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. The *Contractor* can also propose other solutions for the outside zones as options for consideration.

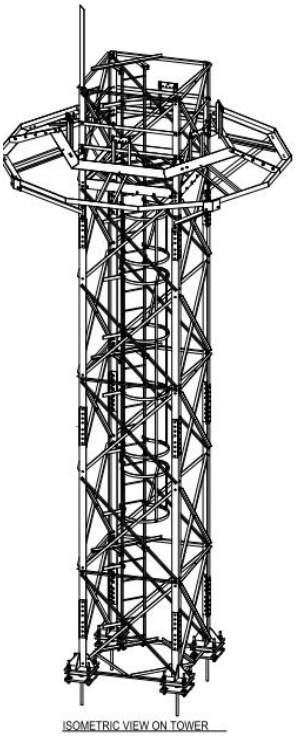

Figure 3: Typical Siren Tower

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:

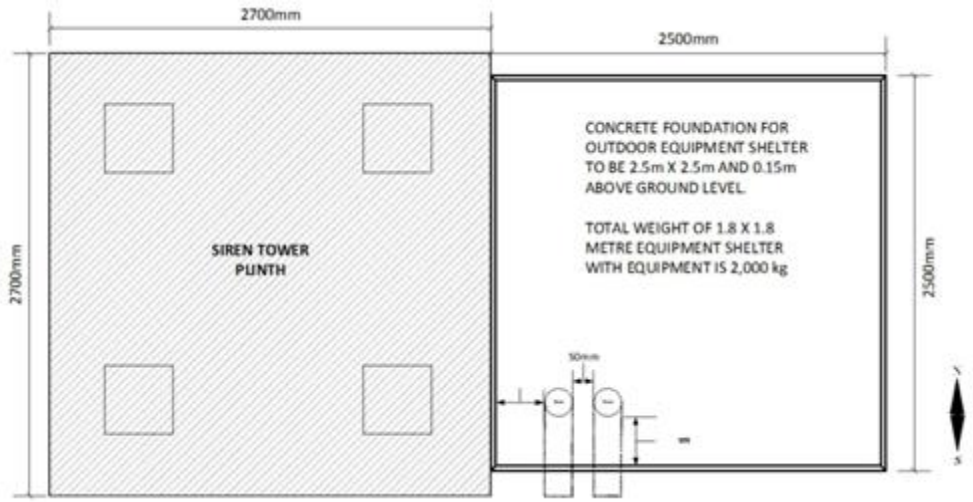

Figure 4: Plan View of the Typical Foundation Design for the Siren Tower Structures.

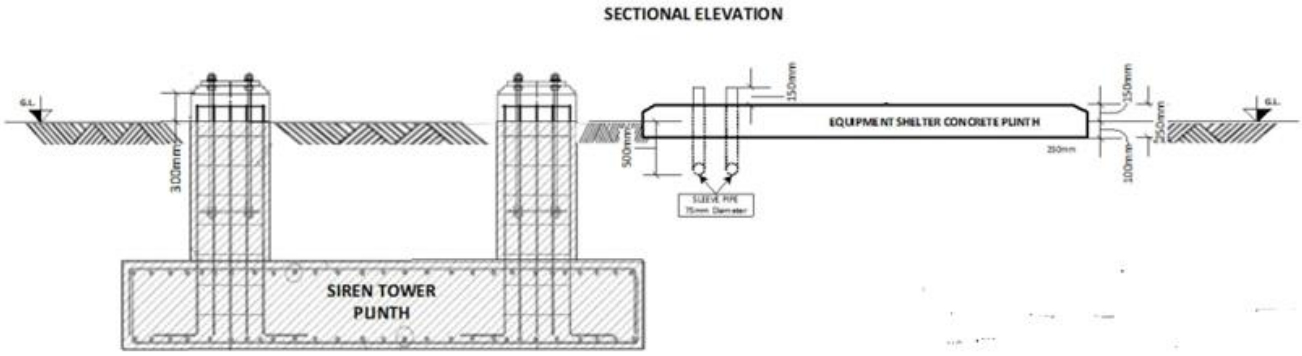

Figure 5: Sectional Elevation View for the Typical Foundation Design for the Siren Tower Structures

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 for a list of Buildings where equipment can be located.
2) The Location Drawings shall be used to detail the location of such equipment. Prior to finalizing location of equipment, the *Contractor* 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 and if not available do their own assessment and measurements.
4) The equipment heat and weight loading are detailed by the *Contractor* and heating and cooling requirements considerations per room.
5) Where supplied HVAC by the *Employer* is not sufficient to support the heat-loading, or in buildings where no HVAC is supplied by the *Employer*, the *Contractor* supplies HVAC that complies with Eskom Works Instruction, 240-143112846.

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) Where applicable, the *Contractor* is responsible for site specific geotechnical assessment and investigations for the design.

3.5.4 Civil and Structural deliverables

1) The supply, delivery and construction of the complete civil *Works* defined in the scope of the *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.
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. *Contractor's* 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

On Eskom premises where KKS/AKZ codes are not in force, the *Contractor* proposes a coding system/structure for the approval of the *Employer*. On stations that do utilize KKS coding the *Contractor* follows Section 3.6.2.1 below.

All applicable KKS standards and codes as per Appendix E 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;

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) On Eskom premises where KKS/AKZ codes are not in force, the *Contractor* proposes a coding system/structure for the approval of the *Employer*.
3) When applying KKS coding, the *Contractor* shall apply the following guidelines and standards when codifying plant:
   a. VGB-B 106 E Parts A-KKS Application Commentaries Part A_General
   b. VGB-B 106 E Part B1-KKS Application Commentaries Part B1_Mechanical Engineering
   c. VGB-B 106 E Part B2-KKS Application Commentaries Part B2_Civil Engineering
   d. VGB-B 106E Part B3-KKS Application Commentaries Part B3_Electrical and C&I Engineering.
   e. VGB-B 106E Part B4-KKS Appliocation Commentaries Part B4 Identification of C&I and Control Tasks.
4) Eskom Plant Labeling and Abbreviation Standard as listed in Appendix E
5) The *Contractor* shall identify all plant indicated or referenced by documentation by the plant's unique codes within the documentation itself.
6) The *Contractor* shall ensure that the codification assigned to plant is consistently maintained throughout the design cycle.
7) 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. The *Contractor* shall provide a complete system-level PBS of the plant within the *Contractor's* scope.
8) 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.
9) The *Contractor* will submit all 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 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 site specific specification and where such a specification does not exist, the *Contractor* shall follow the Eskom Plant Labeling and Abbreviation Standard referenced in Appendix E.
2) Any abbreviations to plant descriptions shall be prepared in accordance to the *Employer*'s abbreviation standard for that specific facility.

3) Detailed name plate or label lists with the service legends and including the 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

The *Contractor* supplies the detailed network and system architecture drawings as part of the *Works*.

The *Contractor* also prepare a list of code 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.) The equipment list shall be submitted with the original implementation documentation describing the design of the system. 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:

1) The code designation of all components within the relevant scope of work or system.
2) The full description of each component, compiled according to the standards referenced in this document.
3) The abbreviated description of the each component, utilising abbreviations as listed in the referenced project abbreviation list.
4) The approval status of each component, in alignment with the list of approval statuses specified for document.

3.7 ELECTRICAL SYSTEMS REQUIREMENTS

3.7.1 General Electrical

1) The electrical system design will include interfaces to currently installed electrical systems at interface points or at zonal points as defined in Table 1: Defined Zones Tables also in accordance to provided Limit of Supply and Services (LoSS) Diagrams.
2) 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.
3) The *Employer* will provide source of connections for the loads to be supplied in according to the Electrical load list supplied.
4) The *Contractor* shall be responsible for sizing and routing of the cables in accordance to their design loads.
5) The *Contractor* shall be responsible for supplying, pulling and termination of all interfacing power cables including racking where routing may need to be extended.
6) All the cabling and racking *Works* shall be done in accordance to Eskom standard 240-56227443.

3.7.2 Battery Backup System

1) 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.
2) The *Contractor* shall be responsible for sizing, installing and commissioning of the Charger as per the Eskom standards listed in Appendix E. The *Contractor* ensures compatibility between the charger and the back-up batteries as not to shorten the predicted life of the batteries. The charger shall be able to drive the full load while charging the batteries and the rated capacities.
3) The technology for the Stand-by batteries shall be Stationary Vented Nickel Cadmium. The Stationary Vented Nickel Cadmium batteries shall comply with Eskom Standard 240-56360086.
4) The minimum life-span of the batteries shall be 15 years.
5) 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.

6) 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 – the charger shall comply with Eskom Standard 240-53114248 – Thyristor and Switch Mode chargers, AC/DC to DC/AC converters and UPS standard.

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:
   a. SANS 10142-Part 1 - The Wiring of Premises Part 1: Low-voltage installations.
   b. 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

FAT, SAT, SIT and Commissioning of the system will be conducted as per IEC 62381 listed in Appendix E.

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, maintenance, security personnel, reception and engineering.
(3) The following is considered to be the minimum requirements for training:
   a. System and component description, layout and design
   b. Alarms
   c. System operation:
      i. Normal operating procedures
      ii. Routine test and inspection procedures
      iii. Normal and emergency shutdown procedures
      iv. Emergency and alarm conditions

d. Operational problems:
    i. Troubleshooting
    ii. Loss of supply (e.g. electrical power)
e. Dangers and precautions
f. Recommended settings
g. Test and inspection plans
h. Inspection and Maintenance Procedures
i. Special tools and equipment
j. Fault Finding:
    i. Items to inspect
    ii. Typical observations and/or deviations
    iii. Recommended corrective actions
k. Recommended spares:
    i. Item description
    ii. Part number/type
    iii. Supplier
    iv. Drawing designation
    v. Quantity installed on plant
    vi. Recommended stock

(4) Practical hands-on training for each individual trainee shall form an integral part of all training.
(5) Administrator training to be conducted by the *Contractor* specifically for system administrators.

3.11 ENVIRONMENTAL ASSESSMENT

Environmental Impact Assessment (EIA) should only be needed where trenching or excavations are envisaged. If the *Contractor's* design cater for such activities then the EIA form part of the *Contractor's* scope of work.

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
(6) A Service Level Agreement (SLA) for a defined period.

3.13 SAFETY ASSESSMENT

3.13.1 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 the detailed design, the hazardous area classification and type of hazard identified with each area shall be completed.

3.13.2 Preliminary Fire Safety Assessment

A Fire Safety Assessment will be completed as part of the detailed design scope.

3.14 TECHNICAL RISK REGISTER

A technical risk register shall be provided and kept up-to-date.

3.15 INTERFACES

Interfaces to 3rd party systems such as the Fire Detection System (FDS), Building Management System (BMS), Distributed Control Systems (DCS) etc. shall be investigated by the *Contractor* and proposals made to the *Employer* on available interfacing protocols.

3.16 QUALITY MANAGEMENT

The compiler of the technical specification adds quality requirements as per agreed tender technical evaluation criteria.

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 and other project contractors.

4.1 BASIC ENGINEERING

4.1.1 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 *Employer*, *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:
   a. Concept designs – during which the rules, philosophies and concepts followed in the various engineering and design activities, are clearly defined, clarified and approved.
   b. Noise level Measurement studies of every zone and sub-zones.
   c. Investigation work – during which the *Contractor* conducts his investigation work.
   d. 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 *Employer* 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 *Employer* 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 *Employer* for approval.
7) Technical clarification is where the *Contractor* shall clarify with the *Employer* and Other Project contractors all the technical issues to permit the *Contractor* to start detailed engineering.
8) As soon as the functional specification is accepted, all equipment having long delivery times shall be planned and technically clarified 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 *Employer*, 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).

4.2 DETAILED ENGINEERING

4.2.1 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). This phase commences directly after the acceptance of the basic design.
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.

4.3 MANUFACTURING

General Requirements

1) The EPPA system shall undergo Factory Acceptance Testing (FAT) at the factory premises and the results shall be submitted to the *Employer* for approval.
2) The *Employer* has the right to appoint representatives of the *Employer* 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 *Employer* 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 *Employer*.
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 *Employer*.
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.

4.3.1 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 *Employer* 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:
   a. Test procedures used during Pre-FAT.
   b. Detailed Test results.
   c. Discrepancies identified during the tests.
   d. Resolution of the discrepancies.
   e. Retests conducted and results thereof.
7) The *Contractor* shall submit the Pre-FAT Report to the *Employer* 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 *Employer*

4.3.2 FAT

1) During FAT, the *Contractor* shall demonstrate that the Eskom premises' EPPA system meets the requirements of this Specification and the detailed engineering design freeze documentation.
2) The FAT shall be done at the *Contractor's* manufacturing facilities and all activities shall be coordinated by the *Contractor*.
3) The *Contractor*, OEM, the *Employer*, 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 *Employer* 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 *Employer* for approval.
8) As a minimum, the proposed FAT procedure shall identify the following:
   a. Major test activities.
   b. Comprehensive list and description of the individual tests to be performed.
   c. How the tests are to be prepared and conducted.
   d. Test dates and durations.
   e. Checklists – how the test results will be documented.
   f. Acceptance Criteria.
   g. How the identified discrepancies will be processed.
   h. Retesting requirements.
9) A Final FAT Report shall be prepared by the *Contractor* that includes the following as a minimum:
   a. Test procedures used during FAT.
   b. Detailed Test results.
   c. Discrepancies identified during the tests.
   d. Resolution of the discrepancies.
   e. Retests conducted and results thereof.
   f. FAT certificate.

10) The *Contractor* shall submit the Final FAT Report to the *Employer* for approval.
11) FAT Completion shall be achieved upon approval of the Final FAT Report by the *Employer*.

4.4 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 *Employer*.
4) The *Employer* 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 *Employer* 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 *Employer* 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.

4.5 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

4.6 SITE INTEGRATION TEST (SIT)

1) The SIT for the EPPA system shall only begin once the following has occurred:
   a. The EPPA system equipment have been installed in their final locations and connected to permanent power supplies.
   b. All available interfaces to 3rd party systems have been implemented.

2) The SIT shall be carried out before system commissioning commences to ensure:
   a. Correct performance of the system.
   b. Safety of plant and personnel.
   c. 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 *Employer* for approval.
5) As a minimum, the proposed SIT procedure shall identify the following:
   a. Major test activities.
   b. Comprehensive list and description of the individual tests to be performed.
   c. How the tests are to be prepared and conducted.
   d. Test dates and durations.
   e. Checklists – how the test results will be documented.

f. Acceptance Criteria.

g. How the identified discrepancies will be processed.

h. Retesting requirements.

6) A Final SIT Report shall be prepared by the *Contractor* that includes the following as a minimum:
   a. Test procedures used during SIT.
   b. Detailed Test results.
   c. Discrepancies identified during the tests.
   d. Resolution of the discrepancies.
   e. Retests conducted and results thereof.
   f. SIT certificate.

7) The *Contractor* shall submit the Final SIT Report to the *Employer* for approval.
8) When all tests are successful and the Final SIT Report is approved by the *Employer*, the system is classified as 'ready for use'. The system is then deemed ready for cold commissioning.

4.7 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 *Employer* 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 *Employer* is a pre-requisite for the Completion of the Plant Area concerned.
4) All drawings to be provided in an agreed format compatible with the facilities documentation packages.
5) All documentation to be provided in PDF format as well as the native format it was developed in e.g. .docx

5. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Grace Mandlazi	Snr. Advisor Technical Support
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6. REVISIONS

Date	Rev.	Compiler	Remarks
February 2021	0.1	A. van den Berg	Initial development to assist all divisions of Eskom in capturing generic requirements for public address systems Final Draft
March 2021	0.2	A. van den Berg	Final Draft After Comments Review Process
March 2021	1	A. van den Berg	Final Document for Authorisation and Publication

7. DEVELOPMENT TEAM

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

- Andre van den Berg
- Kgaugelo Shebe
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- Mauritz Van Der Bank

8. ACKNOWLEDGEMENTS

- All C&I Plant –Care Group members

APPENDIX A: VDSS

This appendix is site/project specific and is developed by the document compiler by using the Eskom templates.

240-85521112	C&I Documentation Requirements from Vendors Template

APPENDIX B: LOSS DIAGRAMS

This appendix is site/project specific and is developed by the document compiler by using the Eskom templates.

240-72350897	C & I Limits Of Supply And Services Template

APPENDIX C: IO FUNCTION BLOCK DIAGRAMS

This appendix is site/project specific and is developed by the document compiler.

APPENDIX D: PROJECT DRAWINGS & SCHEDULES

This appendix is site/project specific and is developed by the document compiler. Add to list as required

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

APPENDIX E: DESIGN STANDARDS, GUIDELINES AND CODES

All Eskom standards, guidelines and other documents listed in this appendix that reference “Power Stations” shall also be applicable to other Eskom facilities.

#	Type	Number	Name
1	SANS	SANS 7240-19	Design, installation, commissioning and service of sound systems for emergency purposes
2	SANS	SANS 7240-16	Sound system control and indicating equipment
3	SANS	SANS 10108	Classification of Hazardous Location (Electrical Plant)
4	EN	EN54-4	Voice Alarm Power Supply Equipment
5	EN	EN54-16	Voice Alarm and Indicating Equipment
6	EN	EN54-24	Loudspeaker Equipment
7	Eskom	240-55410927	Cyber Security Standard for Operational Technology
8	SANS	SANS 10400	The application of the National Building Regulations
9	ISO	ISO 9001	Quality Management Systems
10	Eskom	240-64720986	Emergency Preparedness Public Address System
11	Eskom	240-56227443	Requirements for Control and Power Cables for Power Station Standard
12	SANS	SANS 10142-1	The Wiring of Premises, Part 1 – Low-Voltage Installations
13	Eskom	240-56355466	Alarm Management System Standard
14	Eskom	240-52844017	System Reliability, Availability and Maintainability Analysis Guideline
15	Eskom	240-56355815	Junction Boxes and Cable Termination Standard
16	Eskom	240-49230111	HAZOP Analysis Guideline
17	IEC	IEC 62381	Automation systems in the process industry – Factory Acceptance Test (FAT), Site Acceptance Test (SAT), and Site Integration Test (SIT)
18	Eskom	240-56356396	Earthing and Lightning Protection Standard

#	Type	Number	Name
19	SANS	SANS 62305	Protection Against Lightning
20	Eskom	240-56355731	Environmental Conditions for Process Control Equipment Used at Power Stations Standard (Also applicable to other Eskom facilities)
21	Eskom	240-56355910	Management of Plant Software Standard
22	Eskom	240-56355541	C&I Computer and Equipment Rooms Civil and General Building Requirements Guideline
23	Eskom	240-129014618	Generation Cyber Security Compliance Guideline
24	Eskom	240-56356411	Fire Barrier Seals for Electrical Cable Installations
25	Eskom	240-56360034	Stationary Vented Lead Acid Batteries
26	Eskom	240-56360086	Stationary Vented Ni-Cad Batteries
27	National Act	Act No. 85 of 1993	Occupational Health and Safety Act
28	Eskom	240-86973501	Engineering Drawing Standards
29	Eskom	240-53114248	Thyristor And Switch Mode Chargers, AC/DC To DC/AC Converters And Inverter/Uninterruptible Power Supplies Standard
30	Eskom	240-71432150 240-93576498	Plant Labelling Standard KKS Coding Standard
31	Eskom	240-53114186	Project/Plant Specific Technical Document and Records Management Procedure
32	Eskom	240-143112846	HVAC Works Instruction
33	Eskom	240-56737448	Fire Detection and Life Safety Design Standard
34	Eskom	240-109607332	Plant Labeling and Abbreviation Standard

APPENDIX F: BUILDINGS AND ROOMS SCHEDULE

This appendix is site/project specific and is developed by the document compiler.

APPENDIX G: ELECTRICAL LOAD SCHEDULE TEMPLATE

This appendix is site/project specific and is developed by the document compiler by using the Eskom templates.

240-72345357	24 VDC Load Schedule Consumer Per Battery Charger Template
240-72346360	C&I 220 VAC Load Schedule Consumer per UPS Template

APPENDIX H: HARDWARE AND EQUIPMENT INVENTORY LIST TEMPLATE

This appendix is site/project specific and is developed by the document compiler.

APPENDIX I: SOFTWARE INVENTORY LIST TEMPLATE

This appendix is site/project specific and is developed by the document compiler.

APPENDIX J: CABLE SCHEDULE TEMPLATE

This appendix is site/project specific and is developed by the document compiler.

APPENDIX K: TECHNICAL RISK REGISTER

This appendix is site/project specific and is developed by the document compiler.