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Duvha Power Station
Public Address System
Upgrade**

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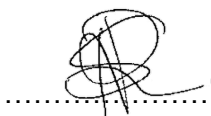
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C3.1: EMPLOYER'S WORKS INFORMATION

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1 Description of the works

1.1 Executive overview

The current Public Address (PA) system at Duvha Power Station is deficient and this poses a safety risk to all employees at Duvha Power station. The age of the current PA system is beyond usable and repair life. PA system assessment done by Eskom Telecommunication revealed that the current PA system installed is not SANS 7240, ISO 7240 & 8201 compliant, thus not compliant with the current PA System Eskom standard. The following has been deemed to be non-compliant:

- Occupational Health and Safety Act 85 of 1993: Section 8: an employer has to ensure that his employees are working in a safe environment. With the PA system not functioning, Duvha does not comply. Should an emergency happen, there could be a delay in proper response and may result in injury or death.
- ISO 8201:2017 (Ed. 2) Audible emergency evacuation signals.
- SANS 7240-16:2008 (Ed. 1), Part 16: Sound systems for emergency purposes
- ISO 7240-19:2008 (Ed. 1) Fire detection and alarm systems - Design, installation, commissioning and service of sound systems for emergency purposes

This is an emergency and evacuation system which needs to be available to all personnel during emergencies. The project entails the detailed design, supply, installation and commissioning of the PA system terminal equipment, distributed power amplifiers, power cabling and associated racking as indicated in Appendix C: Limits of Supply and Services (LOSS).

1.2 Employer's objectives and purpose of the works

The objectives of the works are as follows:

- (1) The objective of this project is to replace the current obsolete PA system in all areas covered and not covered, to ensure complete coverage in the whole Duvha Power Station perimeter.
- (2) Ensuring compatibility by expansion and the replacement of the obsolete TOA SX-2000 Main Head End Unit.
- (3) Replacement of the existing PA system terminal equipment and cabling to ensure compliance to Eskom Standard (240-161708025 Generic Public Address Systems Technical Specification Standard) and SANS 7240 part 4, 16, 19 & 24.

1.2.1 Operating Philosophy

- (1) The PA system is used for phased evacuation during emergencies (i.e. fire, bomb threats).
- (2) There are two types of siren / pre-recorded sound alarms for fire and emergency evacuations.
- (3) The procedure of how to operate the PA system is highlighted in the 240-31708091 - Emergency Alarm PA System Testing Rev 02 work instruction.
- (4) The system operation is tested once a week to ensure system availability on all areas.

1.2.2 Loudspeaker Zones

Table 1: Loud Speaker Zones and Figure 1: Station Zone Layout and provides more info on the zoning of the PA system.

Zone	Description
1	All areas located at Unit 1
2	All areas located at Unit 2

3	All areas located at Unit 3
4	All areas located at Unit 4
5	All areas located at Unit 5
6	All areas located at Unit 6
7	All areas located West of the Turbine hall
8	All areas located at the Main entrance
9	WTP and LPS
10	All areas located East of the Unit 1
11	All areas located East of the Boiler hall
12	All areas located South of the Unit 1
13	All areas located around Simulator building
14	All areas South of Cooling Towers 1-3

Table 1: Loud Speaker Zones

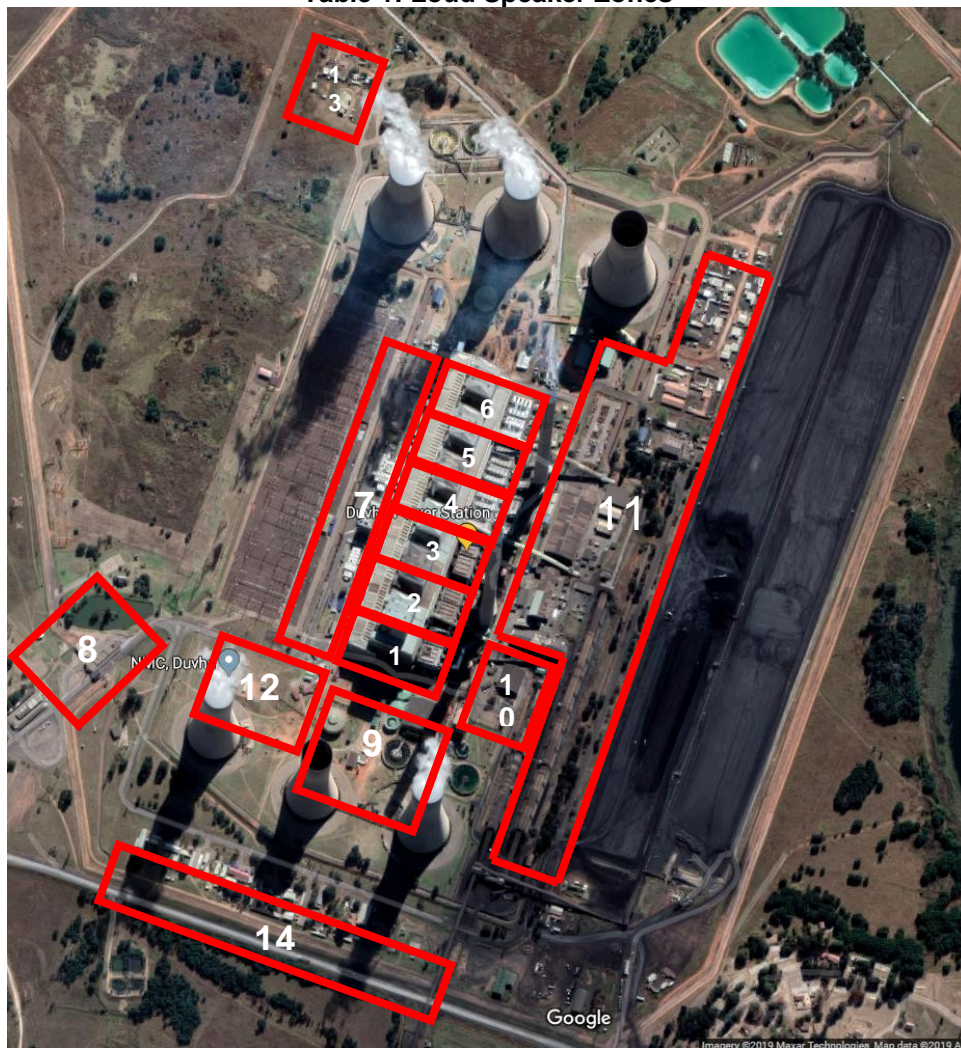


Figure 1: Station Zone Layout

1.2.3 Project Execution Phases

The project execution is divided into two phases as illustrated below in table 1.

PHASE	DESCRIPTION
Phase 1	Complete detailed design for phase 1, Supply, Installation, commission zone amplifier cabinets, UPS and Main head end unit. Replacing/upgrading existing PA system cabinet.
Phase 2	Complete detailed design for phase 2, Replacement and/or Install of PA System Terminal Equipment (Horn, Ceiling & Box speakers) and PH120 wiring at the various zones.

Table 2: Execution Phases

- (1) The objective of phase 1 is to prioritise areas with high occupancy first, getting the various zone amplifier cabinets connected and communicating with the head end unit and connecting to old terminal equipment. The connections will kick-start the restoration of a non-functional PA system.
- (2) The objective of phase 2 is to install terminal equipment (Horn, Ceiling & Box speakers) in areas not covered by the old system and also to upgrade the old terminal equipment (Horn, Ceiling & Box speakers).
- (3) Phase 1 Scope of Work (SOW) includes the following:
 - i. Detailed Design for the complete SANS 7240 / EN 54 compliant PA System.
 - ii. Supply, Install and commission all new terminal equipment (zone amplifier cabinets) that are SANS 7240 / EN54 compliant, including associated compliant cabling in the amplifier and UPS cabinets.
 - iii. Interface all terminal equipment (zone amplifier cabinets) to the PA system manager at the EP centre.
 - iv. Connection between new amplifiers and old terminal equipment that can be re-used (Horn, Ceiling & Box speakers).
- (4) Phase 2 Scope of Work (SOW) includes the following:
 - i. Design, supply, installation and commissioning of SANS 7240 / EN54 terminal equipment (Horn, Ceiling & Box speakers) in areas not previously covered.
 - ii. Replace all old terminal equipment (Horn, Ceiling & Box speakers).

1.3 Interpretation and terminology

1.3.1 Abbreviations

Abbreviation & Acronyms	Description
BGM	Back Ground Music
CBMS	Consolidated Building Management Systems
C&I	Control and Instrumentation
CMD	Construction Management Department
CoE	Centre Of Excellence
COTS	Commercially-off-the-shelf
DCS	Distributed Control System
EDWL	Engineering Design Work Lead
ECM	Engineering Change Management
EN	European Norm

EOD	Electrical Operating Desk
EPPA	Emergency Preparedness Public Address System
FAT	Factory Acceptance Test
GenTLC	Generation Technical Life Cycle
ISO	International Standard
IP	Ingres Protection
LOSS	Limits of Supply and Service
PA	Public Address
PEI	Production, Engineering, Integration
PS	Power Station
PSM	Power Station Manager
PSR	Plant Safety Regulations
ROC	Required Operational Capability
RTS	Return To Service
OHSAct	Occupational, Health and Safety Act
SIT	Site Integration Test
SANS	South African National Standard
SHE	Safety, Health & Environmental
SRD	Stakeholders Requirements Definition
SPL	Sound Pressure Level
UPS	Uninterrupted Power Supply
mV	Mill-Volts
µV	Micro Volts
VDSS	Vendor Documentation Submittal Schedule

1.3.2 Definitions

Definitions	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 ambience. 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: <ul style="list-style-type: none"> • 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
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).
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 µPa (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 Management and start up.

2.1 Management meetings

Regular meetings of a general nature may be convened and chaired by the *Project Manager* as follows:

Title and purpose	Approximate time & interval	Location	Attendance by:
Kick off meeting , implementation strategy	One off 60 minutes (Time to be announced by Project Manager)	Project Managers office	PM, System Engineer and <i>Contractor</i>
Risk register and compensation events	As and when required	Project Managers office	PM, System Engineer and <i>Contractor</i>
Overall contract progress and feedback	Weekly on Monday at 08:30	Project Managers office	<i>PM. Contractors' Manager</i>
Commissioning	Once off	Project Managers office & Site	PM. <i>Contractors' Manager & Supervisor</i>

- (1) Meetings of a specialist nature may be convened as specified elsewhere in this Works Information or if not so specified by persons and at times and locations to suit the Parties, the nature and the progress of the works.
- (2) Records of these meetings shall be submitted to the Project Manager by the person convening the meeting within five days of the meeting.
- (3) All meetings shall be recorded using minutes or a register prepared and circulated by the person who convened the meeting.
- (4) Such minutes or register as in point (3) shall not be used for the purpose of confirming actions or instructions under the contract as these shall be done separately by the person identified in the conditions of contract to carry out such actions or instructions.

2.2 Documentation control

- (1) All formal communication between the *Employer* and the *Contractor* shall take place through the *Employer's Buyer* before contract is awarded.
- (2) All formal communication between the *Employer* and the *Contractor* shall take place through the *Employer's Project Manager* after contract has been awarded.

- (3) All formal communication shall be marked with the date and a reference code in the form DVP-XXX-nnn where:
 - i. XXX is the acronym of the *Contractor*
 - ii. nnn is the sequential number of the communication
- (4) All formal communication must be acknowledged by the recipient
- (5) The *Contractor's* site manager must keep a daily log, which needs to be signed by the Employer's Supervisor daily.

2.3 Health and safety risk management

- (1) The *Contractor's* personnel is to undergo Safety Induction Training at Duvha prior to commencement of this contract and all the relevant Documentation is to be approved by Safety Officials and the Project Manager before any activities can be started on site.
- (2) Project Manager to allocate responsible person with PSR for the allocation of permits as and when required so that the *Contractor* can perform their duties on site.
- (3) The *Contractor* complies with the requirements of the Duvha Power Station Safety, Health & Environmental Specifications SAS 0012: Duvha Power Station *Contractors* safety manual
- (4) The documents are completed by the *Contractor's* and submitted to the Employer before taking possession of the works.
- (5) These documents are valid for the duration of the works.
- (6) The induction course is presented by the Safety Risk Department at Duvha Power Station.
- (7) The *Contractor* makes arrangements with Safety Risk Management at telephone number 013-690-0143.
- (8) The *Contractor* submits all the documents as indicated in the Safety, Health & Environmental Specifications relevant to the work to Safety Risk Management before the induction course.
- (9) The *Contractor* completes all appointments required and ensures that the appointee and appointees fully understand their responsibilities and are competent and trained to execute their duties.
- (10) The appointees/appointee ensures that all duties are carried out and records are kept by the *Contractor* for review/audit by the Employer or Inspector of Machinery.
- (11) Management has the right and authority to visit and inspect the *Contractor's* work place or Site establishment.
- (12) The *Contractor* supplies and ensures that his employees wear the necessary PPE according the risk assessments performed on the specific tasks to be carried out.
- (13) The *Contractor* ensures that everyone entering Duvha Power Station under his supervision is medically, physically and psychologically fit to enter Duvha Power Station.
- (14) The medical examination, at the *Contractors* cost, is carried out by a Registered Professional Occupational Health Practitioner and the examination shall include the following tests:
 - i. Eye Test, Blood Pressure,
 - ii. Heart Function,
 - iii. Hearing Test and
 - iv. Lung Function.
- (15) A thorough examination is done and previous physical injuries, as well as occupational diseases/complications are covered.
- (16) If at any point in time during the execution of the works, the *Contractor* has a radiation-related incident/exposure, the onus is on the *Contractor* to immediately notify the Employer, the Medical Station, the Risk Manager and the Safety Risk Management Department.
- (17) The onus thereafter is for the *Contractor* to immediately arrange, at his/her cost, for blood samples to be taken by a Registered Laboratory and for this sample to be sent to the Accelerator Laboratory in Cape Town for full radiation exposure tests. This test results are then to be discussed with the Duvha Occupational Health Practitioners, who will then advise the Power Station Management on the risk, if any, of the incident/exposure.

- (18)The *Contractor* takes full responsibility and accountability for all other people/staff/personnel/labour that he/she employs or utilises, whether in full-time/part-time/contract basis, in executing the works or other work whilst on the Employers premises.
- (19)The *Contractor* ensures that Safety Harnesses are used for all work carried out in elevated positions, as defined in the Occupational Health and Safety Act, No 85 of 1993 or any other Code of Practice or standard or the Construction Regulations.
- (20)All safety equipment or Machinery used complies with the SANS Codes of Quality and Practice or any Code as stipulated in the Occupational Health and Safety Act, No 85 of 1993, and any amendments thereto.
- (21)The *Contractor* at all times consider himself as "Employer" as defined in the Occupational Health and Safety Act, No 85 of 1993 and do not consider himself as under supervision or management of the Employer with regard to Health and Safety Requirements but only from a Commercial Contractual Condition of Contract. Under no circumstances does the *Contractor* consider himself a sub-ordinate or being given supervision.
- (22)The *Contractor* provides and maintains his own facilities as required in the Occupational Health and Safety Act, No 85 of 1993 or any other Code of Practice or standard or the Construction Regulations, if not agreed contractually or arranged by the Employer.
- (23)The *Contractor* has Safety Systems in place at his premises for the total contract period and these shall include the following:
 - (24)Safety Management Structure and Compliance to these
 - (25)Statutory Appointments
 - (26)Records and documentation of all Risk and Hazard Analyses.
 - (27)Planned Job Observations Records and Documents.
 - (28)Employment history and records of all personnel, part-time or full-time or contract labour.
 - (29) Medical History of all personnel, part-time or full-time or contract labour
 - (30)Training and Competency Records with regard to Safety, Health and Environment.
 - (31)Training and Competency Records with regard to the skills he uses to carry out the works or any other works in the Employers premises.
 - (32)Compensation Commissioner Records and proof of registration.
 - (33)Records and documentation with regard to any sub-*Contractor* or labour-only contracts he places or uses to carry out the works or any other works in Employers premises.
 - (34)Personal Protective Equipment and Safety Equipment Inspection, training and competency records and documentation.
 - (35)Employment contracts for all sub-*Contractor* or labour-only contracts.
 - (36)Compliance to a Safety System, such as NOSA or any other system that is similar in nature.
 - (37)Records of all incidents or accidents, and vehicle accidents, incurred during execution of this works or any other works in the Employers premises.
 - (38)Records of all man-hours, including sub-*Contractors* or labour-only contracts, the *Contractor* spends on the Employers premises.
 - (39)Written Safe Work Procedures for all hazardous tasks the *Contractor* executes on the Employers premises.
 - (40)A Fall Protection Plan for all elevated work the *Contractor* does on the Employers premises.
 - (41)Environmental plan and awareness training.
 - (42)Induction training records of his staff by himself/herself.
 - (43)Minimum wage compliance for the different skills and to which Bargaining Council compliance is made to and proof of membership, if any.
 - (44)Risk Assessment of this type of works
 - (45)Proof of authorisation/accreditation from Department of Labour and or other Statutory Body for this type of works, if applicable
 - (46)Emergency Evacuation and Rescue Plan for the hazardous tasks related to the works.
 - (47)The *Contractor* shall appoint a person, qualified and competent in accordance with the SHEQ requirements, as the liaison with the Eskom safety officer/delegated person for all matters related to health and safety, this person is contactable 24hours a day.

- (48) The *Contractor* shall comply with the following:
- i. Form 74 – SHE specification.
 - ii. Eskom Safety, Health, Environmental and Quality Policy: 32-727
 - iii. Eskom Life Saving Rules, Directive: 32-421
 - iv. Eskom Procedure on Smoking: 32-36
 - v. Eskom Incident Management Procedure 32-95 Rev 3
 - vi. Eskom Plant safety regulations 36-681.
 - vii. Eskom Integrated Risk management and Standards 32-391
 - viii. PGZ 45-24 HAZOP study guidelines
 - ix. Eskom Standard SAS0012 Safety, Health & Environmental Specifications For *Contractors*
- (49) The *Contractor* shall comply with the health and safety requirements contained in this Works Information.

2.4 Environmental constraints and management

- (1) The *Contractor* shall comply with Eskom Duvha Waste Procedure ENVP0005.
- (2) The *Contractor* is responsible to keep the work area clean of any rubble.
- (3) The Employer will provide special colour coded bins for refuse disposal. The Employer will empty these bins.
- (4) The *Contractor* ensures that all workers under his control strictly adhere to the correct use of refuse bins. Refer to Duvha Waste Procedure ENVP0005 for refuse bin colour coding.
- (5) For the full duration of the Works, the *Contractor* is responsible to keep the work area clean of any rubble, and to place all refuse into the bins provided.
- (6) Removal of scrap and waste, including concrete/ash/refractory material to a location within the Duvha Power Station security gates and/or the ash dams must be included in the Price Schedule or Bill of Quantities. This must be inclusive of labour and equipment i.e. forklifts spades, shovels, transport.

2.5 Quality assurance requirements

- (1) All work is carried out under the supervision of an experienced supervisor.
- (2) The *Contractor* complies with the Employer's Quality Requirements as specified in Eskom Generation Standard QM58.
- (3) All quality control documentation (QCP) is submitted to the Project Manager within 7 days of Contract date.

2.6 Programming constraints

- (1) The *Contractor* submits a programme within 1 week of the Contract Date.
- (2) The program shall be in Microsoft Projects format
- (3) The programme indicates
 - i. The hour duration of each activity,
 - ii. The working calendar (number of work hours per day, days per week),
 - iii. The exact quantity of people per day
 - iv. All phases and interfaces

2.7 Contractor's management, supervision and key people

- (1) The *Contractor* shall provide a site Supervisor or Project Manager to supervise, monitor, control and coordinate all activities during the execution of the works
- (2) *Contractor* shall also provide the following staff:
 - i. Quality control supervisor
 - ii. Site Safety representatives
 - iii. Design and Testing Engineer

2.8 Invoicing and payment

- (1) Within one week of receiving a payment certificate from the Project Manager in terms of core clause 51.1, the *Contractor* provides the Employer with a tax invoice showing the amount due for payment equal to that stated in the Project Manager's payment certificate.
- (2) The *Contractor* shall address the tax invoice to Eskom Holdings SOC Ltd and include on each invoice the following information:
 - i. Name and address of the *Contractor* and the Project Manager;
 - ii. The contract number and title;
 - iii. *Contractor's* VAT registration number;
 - iv. The Employer's VAT registration number 4740101508;
 - v. Description of service provided for each item invoiced based on the Price List;
 - vi. Total amount invoiced excluding VAT, the VAT and the invoiced amount including VAT;

2.9 Insurance provided by the *Employer*

- (1) Refer to the contract data.

2.10 Contract change management

- (1) The *Contractor* or the *Project Manager* formally notifies each other of any event which may lead to a change in agreed terms as per NEC 3.

2.11 Provision of bonds and guarantees

- (1) The form in which a bond or guarantee required by the conditions of contract (if any) is to be provided by the *Contractor* is given in Part 1 Agreements and Contract Data, document C1.3, Sureties.
- (2) The Employer may withhold payment of amounts due to the *Contractor* until the bond or guarantee required in terms of this contract has been received and accepted by the person notified to the *Contractor* by the Project Manager to receive and accept such bond or guarantee. Such withholding of payment due to the *Contractor* does not affect the Employer's right to termination stated in this contract.

2.12 Records of Defined Cost, payments & assessments of compensation events to be kept by the *Contractor*

- (1) The *Contractor* may keep records of payment and assessments of compensation events if deemed necessary.

2.13 Project Execution Methodology

2.13.1 General Requirements

- (1) The *Contractor* is responsible for carrying out all activities and supplying everything to provide the works.
- (2) This includes clarification and co-ordination with the *Employer's* engineers, other equipment manufacturers/suppliers and the Project Manager.
- (3) All documentation submitted by the *Contractor* is in an adequate state of completeness.

2.13.2 Engineering Design

- (1) Engineering design is defined as being all activities required to translate the *Contractor's* scope of works, into a fully functional automation system.
- (2) All Engineering design activities are executed by the *Contractor* in active co-operation with the *Project Manager*.
- (3) Design freeze documents is as specified in the VDSS.
- (4) The engineering design activities are phased to suit the Accepted Programme
- (5) A plant walk is performed including, but not limited to:
 - i. Verification of location and suitability of hardware installation points
 - ii. Verification of location and suitability of cable routing paths.
- (6) *Contractor* shall submit the Investigation findings to Eskom for review/comments.
- (7) As a minimum, Engineering design consists of the development, technical clarification and acceptance of the following:
 - i. Engineering programme
 - ii. Index and master register of documents
 - iii. Documentation synopsis
 - iv. OEM best practices
 - v. Loop Diagrams
 - vi. Cabinet Layout Diagrams
 - vii. Cable Routing Diagrams
 - viii. Cable & Termination schedules
 - ix. Engineering and maintenance procedures
 - x. Network Topology Diagrams
 - xi. Network installation philosophy
 - xii. Switch configuration diagrams
 - xiii. Cabling concept
 - xiv. Power distribution philosophy
 - xv. Test procedures
 - xvi. Bill of Materials (make, model, rating, quantity etc...)
 - xvii. Equipment operating manuals and data sheets
 - xviii. Signal coding philosophy
 - xix. Commissioning procedures
- (8) The *Contractor* identify any discrepancies that would lead to shortcomings in the design and makes the *Employer* aware of such discrepancies and provides recommendations, where applicable. The *Contractor* takes action on such discrepancies.

2.13.3 Supply, Installation, Configuration and Testing

2.13.3.1 General

- (1) This stage consists of the supply, installation, configuration 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) Erection and installation of the relevant equipment does not begin until the engineering documentation for the section of the plant concerned has been accepted by the Project Manager
- (3) Quality inspections and tests are carried out by the *Contractor* after erection to prove the compliance of the installation with the Works Information and the engineering design freeze documentation.
- (4) Erection and installation is only considered complete once the quality inspections and tests for the installation concerned have been accepted by the Project Manager
- (5) The Employer reserves the right to appoint representatives to inspect all parts during erection and to be present at any of the quality inspections and tests
- (6) The Project Manager is free to specify hold and witness points during the installation and testing stages of the project.
- (7) The *Contractor* gives fifteen working days advance notice to the Project Manager of holds and witness points.

- (8) The *Contractor* confirms hold and witness points at least seven working days prior to the test activity.
- (9) The *Contractor* provides all test equipment for any inspections and tests.
- (10) The Zone methodology requires that the equipment be installed and commissioned in the following order
 - i. Head units
 - ii. High occupancy areas
 - iii. Low occupancy areas.

2.13.3.2 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.

2.13.3.3 Factory Acceptance Test (FAT)

- (1) All equipment is comprehensively factory tested prior to shipment. This shall be in accordance with Eskom standard, 240-64720986 _Emergency Preparedness Public Address System – For Large Area Deployment in **Appendix E**. The *Employer* has the right to appoint a representative or representatives to inspect all parts during manufacture and to be present at any of the tests Specified:
 - a. The proposed factory acceptance test procedure, together with test dates, is prepared by the *Contractor* and submitted to the *Project Manager* for review and acceptance during the detailed engineering stage as per **Appendix F** – Vendor Document Submittal Schedule.
 - b. The final test procedures are prepared by the *Contractor* and submitted to the *Project Manager* for acceptance as per *agreed period* prior to the scheduled test date. The *Contractor* shows these dates in the Accepted Program.
- (2) *Contractor* to provide a notice period of at least 60 days for the *Employer*.
- (3) During FAT, the *Contractor* shall demonstrate that the Eskom premises' PA system meets the requirements of this Specification and the detailed engineering design freeze documentation.
- (4) The FAT shall be done at the *Contractor's* manufacturing facilities and all activities shall be coordinated by the *Contractor*.
- (5) The *Contractor*, the *Employer*, and Other Project contractors shall attend the FAT.
- (6) The *Contractor* shall provide all facilities and simulation at the FAT venue such that testing of the PA system's functionalities can be done.
- (7) The *Contractor* shall ensure that all PA system hardware and software is available and operational in time for the individual tests.
- (8) The *Employer* determines if any further testing is required in addition to that specified, such as that of any new technologies being used.
- (9) The *Contractor* shall prepare a detailed test procedure in preparation for FAT and submit same to the *Employer* for approval.
- (10) 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.
- (11) 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.
- (12) The *Contractor* shall submit the Final FAT Report to the *Employer* for approval.
- (13) FAT Completion shall be achieved upon approval of the Final FAT Report by the *Employer*.
- (14) Only after the approval of the FAT report can the equipment be shipped to Site.

2.13.3.4 Site Integration Test (SIT)

- (1) SIT is done to ensure the correct performance of the control systems and equipment, and ensure compliance with the Works Information before commissioning of plant commences.
- (2) The proposed site integration test procedure, together with test dates, is prepared by the *Contractor* and submitted to the Project Manager for review and acceptance during the detailed engineering stage as per 13 Appendix F: Vendor Document Submittal Schedule (VDSS).
- (3) The final test procedures are prepared by the *Contractor* and submitted to the Project Manager for acceptance at least 10 working days prior to the scheduled test date. The *Contractor* shows these dates in the Accepted Program.
- (4) The *Contractor* provides all the test equipment for testing the individual systems. Records are to be kept of each SIT in a log book defining the test to be under taken, time and date of the commencement of the test, duration of the test, criteria that need to be met and results entered of the tests. These records are submitted to the Project Manager.
- (5) In the event of an error of any test (hardware/software) the fault is logged and analysed. The Project Manager determines if the item is of a minor nature, the *Contractor* is allowed to rectify the fault and the item re-tested for the full duration. Major faults such as power supply failures, system stall, bus failure, etc. terminates the SIT. The *Contractor* rectifies the fault and re-starts the SIT after proving the rectified piece of equipment by carrying out the appropriate diagnostic tests. When the test is successful, the system is classified 'ready for use'. The PA system is then deemed ready for cold commissioning.
- (6) The PA system must have passed the FAT test.
- (7) The SIT only begins once the following has occurred:
 - i. Cabinets and PA system equipment have been installed in the final location and connected to permanent power supplies.
 - ii. All available interfaces to 3rd party systems have been implemented.
- (8) The SIT is carried out before plant commissioning commences to ensure:
 - iii. Correct performance of the zone amplifiers
 - iv. Compliance with the Works Information and the engineering design freeze documentation
- (9) As a minimum, the SIT testing and inspection activities provide by the Contractor shall consist of site integration and site acceptance activities defined in IEC 62381.
- (10) The *Contractor* prepares a detailed SIT procedure.
- (11) *Contractor* shall provide the list of test equipment with valid SANAS calibration certificates to the Project Manager for approval.
- (12) As a minimum, the proposed SIT procedure identifies the following:
 - i. Major test activities
 - ii. Comprehensive list and description of all 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
- (13) In the event of an error in any test (hardware or software) the fault is logged, analysed and resolved.
- (14) The *Contractor* is allowed to rectify the fault and retest for the full duration on condition that the Project Manager finds the fault to be minor.
- (15) Major faults such as incorrect configuration, lack of communication or major faults as determined by the Project Manager may lead to the termination of the SIT.
- (16) The *Contractor* rectifies the fault and re-starts the SIT after proving the compliance and performance of the rectified piece of equipment by carrying out the appropriate diagnostic tests.
- (17) A Final SIT Report is 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
- (18) The *Contractor* submits the Final SIT Report to the Project Manager for acceptance.
- (19) When all tests are successful and the Final SIT Report is accepted by the Project Manager, the system is classified as 'ready for use'. The system is then deemed ready for commissioning
- (20) Refer to Eskom Standard 240-64720986_Emergency Preparedness Public Address System For Large Area Deployment.

2.13.4 Commissioning

2.13.4.1 General

- (2) Commissioning is defined as bringing into service all items of the works and meeting the functional requirements and performance criteria of the Works Information.
- (3) *Contractor* shall submit the detailed commissioning test procedures to the Project Manager for approval.
- (4) Commissioning includes all testing and verification of the stated performance criteria with:
 - i. Works Information.
 - ii. The engineering design freeze documentation
- (5) The *Contractor* provides sufficient personnel for the satisfactory and timely commissioning of equipment
- (6) The *Contractor* co-operates fully with the Project Manager or Representative(s) in the commissioning of various zones.
- (7) The *Contractor* provides all the test equipment for the commissioning of the zone amplifiers, network equipment and infrastructure
- (8) The *Contractor* certifies that equipment is in a suitable and safe condition for use before it is placed in service.

2.13.5 "As Built" Documentation

- (1) 'As Built' documentation is supplied by the *Contractor* to the *Project Manager* upon completions of works.
- (2) 2 hard copies and 2 soft copies of As Built documentation is provided by the *Contractor* as part of the works.
- (3) Acceptance of the 'As Built' documentation is a pre-requisite for the completion of the works

- (4) The documents are reviewed by the *Project Manager* for correctness and conformance to the accepted design.
- (5) Soft copies must be in Microsoft Office 365 format as specified in the VDSS.
- (6) Drawings must be in Bentley Microstation or similar compatible CAD format as specified in the VDSS.
- (7) All documentation and drawings must be in English.

3 Engineering and the *Contractor's* design

3.1 Detailed general requirements

3.1.1 Overall System Requirements

- (1) The PA 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 PA system provided shall be configured, designed, engineered, installed and commissioned using this specification, OEM best practices and industry best practices.
- (3) PA shall have self-diagnostic to detect failure and bring it to the attention of maintenance teams.

3.1.2 General System Requirements and System Architecture

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

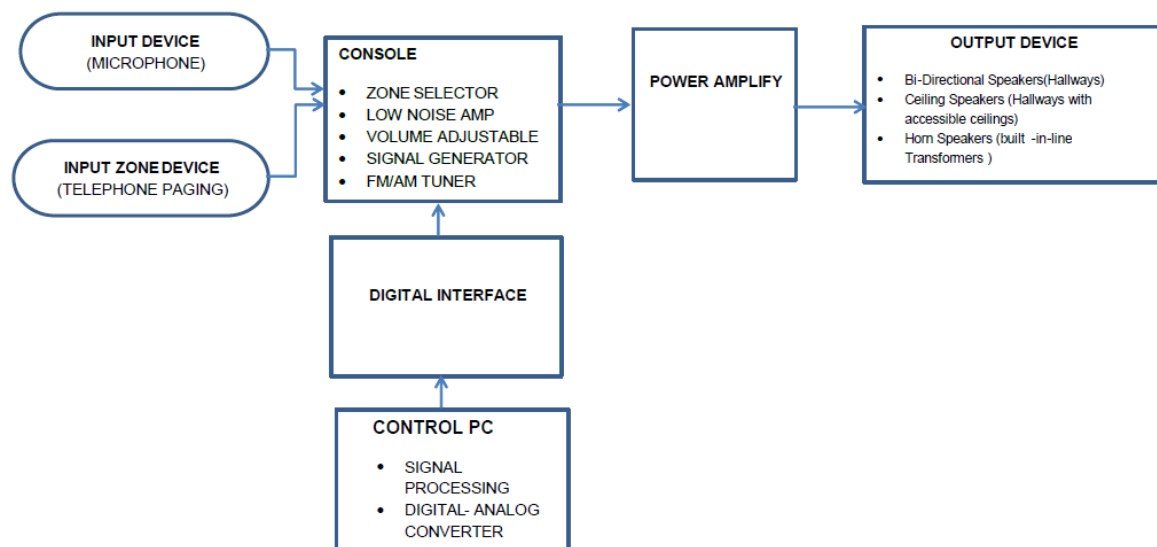


Figure 2: PA Simplified System Architecture

- (2) The PA 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 PA system shall be zoned to suit the specific site as shown in **1.2.2 Loudspeaker Zones**.
- (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). The de-centralised zones shall have their local audio output / inputs, battery surveillance capability, battery charging capability, and speaker line surveillance capabilities.
- (9) 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 Consolidated Building Management Systems (CBMS) and/or Distributed Control Systems (DCS) especially for alarming system failures.
- (10) All system components shall be modular and of the 19" rack-mount type.
- (11) 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.
- (12) 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.
- (13) Operational tasks must be performed by menu buttons with visible displays and LED statuses.
- (14) 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.
- (15) 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.
- (16) The system audio channels for general broadcasts (paging, announcements, 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.
- (17) The system shall provide for priority settings to assign different levels of management and permissions of the system.
- (18) The system shall be capable of accommodating A-B speaker wiring configuration.
- (19) The system shall be capable of handling of emergency broadcasts and paging announcements, simultaneously in different zones. However emergency conditions "all-call" takes priority over all broadcasts as defined in Section **3.3., Call Stations / HMI**.
- (20) 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.
- (21) 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.
- (22) 42U or 25U racks or cabinets with the appropriate IP ratings to suit the installation location environmental conditions shall be used.
- (23) 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.
- (24) Restoration software is supplied to read back and analyse recordings.
- (25) 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.

3.2 Employer's design

- (1) *Contractor* to make use of existing fibre as in **Appendix B** that is provided by the *Employer* for the PA system where applicable.
- (2) *Contractor* to determine and make use of the free issue items provided by the *Employer* where applicable such as terminal equipment.

- (3) All necessary documents/appendices provided by the employer is listed in **3.3.1 General requirements for the Works.**
- (4) Power supply also provided by the *Employer*.

3.3 Parts of the works which the *Contractor* is to design

- (1) The *Contractor* provides the whole of the *works* as defined in this Works Information except where explicitly stated as otherwise.

3.3.1 General Requirements for the *Works*

- (1) Duvha Public Address System Upgrade Project requirements are detailed in the Works Information and following Works Information appendices:
 - i. Appendix A: Calculation Data Spread Sheet
 - ii. Appendix B: Existing Fibre Optic Layout
 - iii. Appendix C: Limits of Supply and Services (LOSS)
 - iv. Appendix D: List of Applicable Standards
 - v. Appendix E: Applicable Eskom Drawing Templates
 - vi. Appendix F: Vendor Document Submittal Schedule (VDSS)
- (2) The *Contractor* designs, supplies, installs and commissions a de-centralised system of distributed power amplifiers and speakers for all the areas as indicated in Appendix A: of the project.
- (3) The *Contractor* is responsible for the de-commissioning of all the existing terminal equipment as indicated in Appendix C Limits of Supply and Services (LOSS) that has been identified in their assessment as non-re-usable equipment.
- (4) The design, installation, testing and commissioning is in accordance with SANS 7420-19.
- (5) The *Contractor* as part of the works provides a detailed design report prior to execution of the works during the detail design scope freeze as stipulated on the VDSS for review by the Employer.
 - i. All the documents required to be submitted by the *Contractor* during the design freeze shall be supplied as part of design data pack.
 - ii. The detail design report shall be in line with Eskom detail design report template (240-49910707) attached in Appendix D: List of Applicable Standards.
- (6) All terminal equipment installations are required to comply with Emergency Preparedness Public Address System – For Large Area Deployment Standard, 240-64720986 in Appendix D: List of Applicable Standards.
- (7) All terminal equipment installed in the hazardous classified areas shall comply with the Duvha Power Station Classification of Hazardous Areas, 0044 593 in 11 Appendix D: List of Applicable Standards.

3.3.2 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.

3.3.3 Microphones Consoles

- (1) Microphones consoles are to be located at predefined locations which are the EOC, EOD or Administration Reception desks.
- (2) The microphones consoles must provide for a minimum of 14 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.

3.3.4 Tones (Pre-Recorded Messages)

- (1) The system's detailed design shall ensure that the PA system can be pre-recorded as follows:
 - a. The system shall accommodate for a minimum of 32 tones and / or pre-recorded messages or a combination thereof.
 - b. The tones / pre-recorded messages shall not be stored on a rotary disc (CD/DVD).
 - c. The tones/ pre-recorded messages shall not be run off the removal media.

3.3.5 Computers and Servers

- (1) Physical Specifications of computer equipment supplied are as per the requirements of the specific premises.
- (2) The *Contractor* installs Anti-malware software & security patches/updates for all operating systems that form part of their scope of supply.
- (3) Server cabinets to be cooled by means of air cons.
- (4) 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 PA 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 PA system.
 - e. 19" Rack mounted.
 - f. Redundant case fans.
 - g. Must be industrial machines that are rated for 24/7 use.
 - h. Adapted to the indoor environmental conditions it is installed at in the EP centre.

3.3.6 Network Equipment and Security

- (1) The PA system shall ensure it provides for the following as a minimum:

- a. Identity – identification of network users, hosts, application, data and services so that only legitimate users can access the network.
- b. Compliance to all Eskom Cyber Security Standards as detailed in Appendix E (Design Standards, Guidelines and Codes).
- c. Any connection/interface to other networks or system to be separated by means of a firewall.

3.3.6.1 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 from the server.
- (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) 24VDC shall be the preferred voltage level to be used throughout all networks.

3.3.6.2 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 Consolidated Building Management Systems (CBMS) 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 and shall be installed on the central server.
- (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 alarmed in due time through the use of the network management system.

3.3.7 Time Synchronisation

- (1) Time synchronisation for all the relevant components of all PA 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.

3.3.8 System Manager

- (1) PA 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 of the PA 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 Consolidated Building Management Systems (CBMS) and/or Distributed Control Systems (DCS).
- (7) Equipment housing shall be as per 240-64720986 Emergency Preparedness Public Address System.

3.3.9 User Management System

- (1) A user management system shall be provided for.
- (2) The user management system shall have the functionality to allocate roles to users for access purposes.
- (3) 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.
- (4) Usernames with passwords shall be used as a login for access to any workstation, server or network switch and access will be role-based.
- (5) The user management system shall require passwords to be changed at regular intervals.
- (6) Rules shall be applied for the allowable password format.
- (7) A transparent, deep-structured authorisation concept with groups and roles shall be defined and documented such that access to the resources is organised.
- (8) The rights structure for user groups and users to directories and software packages shall be documented in a comprehensible manner.

3.3.10 Terminal Equipment Functional Requirements

- (1) Power Amplifiers
 - i. 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 90% of rated load, to allow for future additional loudspeakers.
 - ii. LED's shall be provided on the front panel of each amplifier to indicate power on, amplifier fault and over temperature.

- iii. Power amplifiers to be fan-less but must still have adequate cooling to ensure the amplifiers run at optimum temperatures.
- iv. 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.
- v. Each power amplifier is equipped with a slot for various input modules.
- vi. 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.
- vii. Amplifier frequency response shall cover the following range 50Hz to 20kHz ± 3 dB to within 5% variance
- viii. 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.
- ix. 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.
- x. The system continuously monitors amplifiers and loudspeaker lines for fault conditions. In the event of a fault condition, corrective actions will be automatically taken by the system to ensure the system remains operational.
- xi. The monitoring functions, as a minimum, include:
 - Detection of open circuit loudspeaker lines on each connected zone.
 - Detection of short circuit loudspeaker lines on each connected zone.
 - Detection of earth leakage faults on loudspeakers on each connected zone.
 - Detection of microphone capsule failure
 - Power amplifier failure detection
- xii. 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 microphone.
- xiii. Equipment housing shall be as per 240-64720986 _Emergency Preparedness Public Address System – For Large Area Deployment in 11 Appendix D: List of Applicable Standards.

(2) Loudspeakers

- i. The *Contractor* implements the applicable type of loudspeakers for all the zones as listed in Appendix A and B. The following types of speakers are to be used:
 - a) Ceiling mount speakers
 - Ceramic connecting terminal with fuse-able links
 - Rated power of 6W (100V Line)
 - Sound pressure level of ± 90 db at 6W, 1m/1kHz
 - Approximate frequency response of ± 50 Hz – 20kHz
 - b) Wall mount speaker
 - Ceramic connecting terminal with fuse-able links
 - Rated power of 6W (100V Line)
 - Sound pressure level of ± 95 db at 6W, 1m/1kHz
 - Frequency response of ± 100 Hz – 20kHz
 - c) Bi-Directional Speaker
 - Ceramic connecting terminal with fuse-able links
 - Rated power of 12W (100V Line)
 - Sound pressure level of ± 97 db at 10W, 1m/1kHz
 - Frequency response of ± 150 Hz – 15kHz
 - d) Outdoor Horn Speaker

- Oval aluminium structure with polyurethane resin paint to ensure weather proofing and corrosion resistance
 - IP 66 Rating for dust and weather proof characteristics
 - Rated power of 15W (100V) Line
 - Sound pressure level of +/-113db at 10W, 1m/1kHz
 - Frequency response of +/-500Hz – 7kHz
 - Should a mast be required to be installed to comply with the requirements, it should not exceed a height of 14m.
- ii. The sound pressure level shall be at least 10dB above the ambient SPL of each area as indicated in Appendix A: and stipulated in SANS 7420-19. The *Contractor* is responsible to take sound level measurement for all the areas using a calibrated decibel meter to validate the chosen sound level in Appendix A: .
- iii. The distance between the centres of the loudspeakers is not greater than.
- a) 6 m for unidirectional loudspeakers,
 - b) 12m for bidirectional loudspeakers

(3) Volume controls

- i. Each loudspeaker zone is fitted with a volume control unit that cannot be controlled via local/accessible volume controls. Only to be adjustable from the central control panel.

(4) Visual warning devices

- i. 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.

(5) Other General Requirements

- i. 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.
- ii. Noise level assessments in each zone and sub-zones shall be done as part of detailed design and again during acceptance testing.

3.3.11 Field Cabling & Associated Infrastructure

- (1) The design, supply, installation, termination, labelling, testing and commissioning of all cables, power supply cables, control system communication bus cabling with associated cable racking, trunking/conduits, trenching is required to comply with Eskom Standard Document: 240-56227443_Requirements for Control and Power Cables for Power Stations Standard as found in Appendix E.As part of the works the *Contractor* supply and install PH120 as the minimum speaker cabling as highlighted in 240-64720986 _Emergency Preparedness Public Address System – For Large Area Deployment in 11 Appendix D: List of Applicable Standards.
- (2) All cabling is required to be suitably protected against mechanical damage, chemicals, dust build-up and heat.
- (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) The *Contractor* makes use of existing cable racking and routes as far as possible. Where not possible the *Contractor* will advise the *Employer* on the best racking routes.

- (7) The *Contractor* provides for all trunk cabling, field cables and any power cabling required as part of the *works*.
- (8) The *Contractor* provides 10% spare installed capacity in all multi-core cables, rounded up.

3.3.12 Earthing and lightning protection

- (1) The *Contractor* is responsible for the correct earthing, lightning and electrical protection concept for reliable and safe operation of the terminal equipment. This shall be in accordance to Eskom standard, Document: 240-56356396_Earthing and Lightning Protection Standard in 11 Appendix D: List of Applicable Standards.
- (2) Surge protection is included in all the circuits to protect the amplifier from damage due to the effects of lightning.
- (3) All field control and instrumentation cables as well as data link cables shall be earthed
- (4) All metal instrument casings are properly earthed (grounded) to the earth mat to avoid any electromagnetic interference

3.3.13 System Interface

- (1) The *Contractor* ensures that all the terminal equipment (speakers) and distributed power amplifiers are interfaced to the PA System Manager.
- (2) Interfaces to 3rd party systems such as the Fire Detection System (FDS), Consolidated Building Management System (CBMS), Distributed Control Systems (DCS) etc. shall be investigated by the *Contractor* and proposals made to the *Employer* on available interfacing protocols for alarming and system failures.

3.3.14 Electrical cabling and Power supply.

- (1) The *Contractor* provides for the design, supply, installation, and commissioning of UPS in accordance with the Eskom specification 240-53114248_Thyristor And Switch Mode Chargers, AC/DC To DC/AC Converters And Inverter/Uninterruptible Power Supplies Standard. The *Contractor* ensures schedule A & B are submitted as part of the design works.
- (2) The *Contractor* is responsible for the sizing of the UPS based on the UPS load calculation in Appendix G: UPS Load Calculations. As part of the works the *Contractor* is responsible to demonstrate the cheaper design alternative by performing cost-benefit analysis between the use of centralised UPS supplied from 220VAC that will supply all the zone amplifiers via very long cables or dedicated UPS for each zone.
- (3) The *Contractor* is responsible for verification of the load calculations in Appendix G: UPS Load Calculations.
- (4) The *Contractor* provides for the design, supply, installation, commissioning and connection of electrical cables as indicated in Appendix C: Limits of Supply and Services (LOSS)
- (5) The detailed design submitted by the *Contractor*, as part of the works, contains the calculations for the actual power consumption and size of control cabling to be used to supply various areas to the Employer for verification and acceptance.
- (6) The *Contractor* adheres to 240-56227443 requirements for Control and Power Cables for Power Stations Standard
- (7) Where available the *Contractor* makes use of existing structures to route power cables.
- (8) Where racking is required the *Contractor* adheres to 240-56227443 requirements for Control and Power Cables for Power Stations Standard.

3.3.14.1 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 D. 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.

3.3.15 Requirements related to Safety

- (1) No individual PA 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 PA systems and the protection of the electronic equipment against damaging transients. Refer to Eskom Earthing and Lightning Protection Standard listed in Appendix D.

3.3.16 Requirements related to Availability and Reliability

- (1) No individual PA system fault or two concurrent faults shall instantaneously cause a failure of the complete system.
- (2) No individual PA system fault shall cause the loss of a call station.
- (3) Failure of any microphone shall not inhibit operation of the PA system.

3.3.17 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.

3.3.18 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 PA systems behind the interface shall be consistent across all PA systems and functional areas covered by the PA system.
- (3) Uniformed signal descriptions and abbreviations complying to the Eskom Plant Labelling and Abbreviation Standard () listed in Appendix D, shall be used throughout the PA system.
- (4) The PA system software and database(s) are fully integrated and seamless.

3.3.19 Life Expectancy

- (1) 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.

3.3.20 Expandability Requirements

- (1) The PA 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.

3.3.21 Standardization

- (1) The purpose of standardisation of the PA system 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) Computers and servers (make, model and 19' rack mounting)
- (3) 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)
- (4) Network equipment (make and model):
 - a. Switches and hubs
 - b. Fibre optic cable (type of cable terminations)
 - c. Cubicles and enclosures (make, size, construction and colour)
- (5) All similar plant and equipment provided for the complete PA 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:
 - a. HMI (make, model, and size):
 - i. Screens.
 - ii. Input Devices.
 - iii. Computer.
 - iv. Desks.
 - v. Microphone Consoles.
- (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 PA system performance.
- (9) Also standard product from OEM should be supplied – only proven OEM solutions are acceptable.

3.3.22 Limits of Supply and Services (LOSS)

- (1) The design, supply, installation and commissioning of newly installed terminal equipment and distributed power amplifiers including power cabling and associated racking as indicated in Appendix C: Limits of Supply and Services (LOSS).
- (2) The *Contractor* to also make provision for the interface of the PA system to the CBMS or DCS for alarming purposes.

3.3.23 Training

- (1) The *Contractor* provides training for the Employer's personnel.
- (2) The training to *Employer's* personnel to be given on site.
- (3) The Provision of detailed training manuals incorporating all aspects of the training that will be provided to the Project Manager for acceptance.
- (4) Initial training of Employer's personnel in the operation, calibration and maintenance of the works.
- (5) The *Contractor* provides formal theoretical training to the Employer's personnel in the operation, maintenance and general running of the works and equipment before commencing testing and commissioning of the works. The disciplines to be trained are operating (All shifts=10 personnel), control and instrumentation (C&I) maintenance (6 x personnel) and C&I engineering (2 x personnel).
- (6) The *Contractor* presents sufficient training interventions to accommodate all abovementioned personnel.
- (7) The following is considered to be the minimum requirements for such training:
 - a. Theory of processes
 - b. Plant and component description, layout and design
 - c. Alarms
 - d. System operation:
 - i. Normal operating procedures
 - ii. Routine test and inspection procedures
 - iii. Normal and emergency shutdown procedures
 - iv. Emergency and alarm conditions
 - e. Operational problems:
 - i. Troubleshooting
 - ii. Loss of supply (e.g. electrical power)
 - f. Dangers and precautions
 - g. Recommended settings (electrical, control and instrumentation)
 - h. Test and inspection plans (electrical, control and instrumentation)
 - i. Inspection and Maintenance Procedures (electrical, control and instrumentation):
 - i. During plant operation
 - ii. During shut down periods
 - j. Special tools and equipment:
 - i. Requirements
 - ii. Training
 - k. Fault Finding:
 - i. Items to inspect
 - ii. Typical observations and/or deviations
 - iii. Recommended corrective actions
 - l. Recommended spares (electrical, control and instrumentation):
 - i. Item description
 - ii. Part number/type
 - iii. Supplier
 - iv. Drawing designation
 - v. Quantity installed on plant
 - vi. Recommended stock

- m. During the testing, commissioning and handing over of the works, it is the *Contractors'* responsibility to provide practical training to the Employer's personnel in the operation, maintenance and general running of the works and Equipment. For this purpose the Project Manager reserves the right to allocate certain staff to the *Contractor's* team during erection and commissioning period. The *Contractor* declares the staff as competent, in writing, to operate and maintain the *Contractor's* plant and equipment prior to hand over or provide supervision for the period.

3.4 Testing and Commissioning

- (1) This is defined as bringing into service all items of the works as specified, meeting the requirements of the functional Works Information, as well as the PA system performance including all necessary testing and verification of the stated performance.
- (2) The equipment covered by the Works Information is installed and complete in all respects by the dates stated in the Accepted Programme.
- (3) The *Contractor* provides sufficient personnel for the satisfactory and timely commissioning of the equipment.
- (4) Before equipment is placed in service, the *Contractor* certifies that it is in a suitable and safe condition.
- (5) Prior to the time when cold commissioning commences, the Project Manager nominates a representative to coordinate the commissioning of all equipment forming an integral part of the plant being commissioned.
- (6) The *Contractor* co-operates fully with the Project Manager's Representative/s in the work of commissioning the whole of the plant for which the Employer supplies the portion of equipment specified.
- (7) The Employer uses the works, without taking over the works, before Completion for the commissioning, optimisation and capability testing of the works and associated plants.

3.4.1 Cold Commissioning

3.4.1.1 Functional Tests

- (1) The functional tests form part of the cold commissioning of PA system and include the checking of all measurement loops.
- (2) These tests are conducted in conjunction with the Employer's Representative/s.
- (3) Special care is taken to safety aspects, special function limits, and position indication.

3.4.2 Hot Commissioning

- (1) The *Contractor* notifies the Project Manager that cold commissioning is complete and requests the commencement of hot commissioning. Hot commissioning is where the system is placed into operation.
- (2) The commissioning activities are carried out in conjunction with the Employer's Representative/s. The *Contractor* is responsible for the hot commissioning of all the equipment forming part of the works to satisfy the requirements of the Works Information.
- (3) On completion of the optimization and testing phase the *Contractor* requests the commencement of operational acceptance tests (OAT) from the Project Manager.
- (4) The *Contractor* produces a detailed operational acceptance test procedure twenty working days in advance for acceptance by the Project Manager. This is shown on the Accepted Program.

3.4.3 Completion

- (1) On completion of all tests the Employer runs the works for an unbroken period of 72 hours without hardware or software malfunctions. During this period any or all functions may be exercised. In the event of any hardware or software fault, the *Contractor* remedies the fault and the 72 hour test shall be restarted.

- (2) A test certificate is provided by the *Contractor* for entire PA system installation. The format of this certificate must be accepted by the Project Manager.

3.5 Procedure for submission and acceptance of *Contractor's* design

3.5.1 Design Freeze Milestone

- (1) The *Contractor* cannot commence any of the installation work until the detailed design is complete and accepted by the Employer. This shall be indicated as a milestone in the Project Execution Programme.
- (2) All design documentation must be completed before design freeze as per 13 Appendix F: Vendor Document Submittal Schedule (VDSS).
- (3) A detailed implementation plan must be completed and accepted by the Employer before the design freeze. Should the Employer not respond within the reply period (7 working days or agreed reply period as per NEC3 ECC contract guideline) the plan submitted by the *Contractor* shall be deemed as the accepted plan.
- (4) The field work cannot commence without official access from the Employer.

3.5.2 Commissioning Completion Milestone

- (1) Commissioning is complete when all plant forming part of the works is returned to service.

3.5.3 Project Completion Milestone

- (1) The *Contractor* updates the design freeze documentation package with any changes made during commissioning.
- (2) The *Contractor* submits as-built documentation to fulfil the project complete milestone as per 13 Appendix F: Vendor Document Submittal Schedule (VDSS).

3.6 Other requirements of the *Contractor's* design

- (1) The *Contractor* follows the existing Duvha PS plant codification and Labelling philosophy as per document ENS0002 Rev 9 - AKZX Plant Location Coding.
- (2) The *Contractor* follows the existing Duvha PS modifications philosophy.
- (3) The *Contractor* follows the existing Duvha PS documentation control philosophy.
- (4) The *Contractor* provides a list of equipment which needs to be removed during the works.
- (5) The *Contractor* to assess onsite equipment and provide inventory list upon site visit of what will be reusable as part of the design.

3.7 As-built drawings, operating manuals and maintenance schedules

- (1) All documentation shall be provided as per 13 Appendix F: Vendor Document Submittal Schedule (VDSS).
- (2) The *Contractor* provides good quality operating and maintenance manuals prepared by suitably experienced personnel.
- (3) The maintenance manuals explicitly state the maintenance requirements for each piece of equipment.
- (4) Two copies of the first draft manuals as well as all "as built" drawings are submitted to the Project Manager for review and acceptance.
- (5) Manuals are in English and each manual is complete with the Power Station's name, contract number and index.
- (6) The *Contractor* also provides an electronic copy of these documents on Microsoft Word for Windows.
- (7) The manuals should indicate the level of responsibility of the operating personnel for each action in the procedures.
- (8) Included in these manuals are the following:

- i. EN54 and/or ISO 7240 compliance certificates, data sheets for terminal equipment.
 - ii. Electrical diagrams.
 - iii. General arrangement and installation drawings and instructions in Eskom drawing template found in 12 Appendix E: Applicable Eskom Drawing Templates.
 - iv. Operating procedures and instructions for normal and emergency conditions
 - v. Maintenance procedures and instructions for specific plant and equipment.
 - vi. All drawings required for component location, dismantling and re-assembly for maintenance.
 - vii. Equipment details such as make, model, type, and specifications
 - viii. Detailed parts lists and ordering instructions pertaining to storage of spare parts or to their shelf life.
 - ix. Exploded view type drawings clearly detailing the part and uniquely identifying it, technical descriptions of the equipment and component parts.
 - x. Troubleshooting and fault finding guide.
 - xi. Safety procedures and instructions
 - xii. All special tools and equipment required for maintaining and operating the works.
- (9) The maintenance manuals are separated into electrical and C&I volumes.
- (10) The manuals are designed such that they can be clearly understood by technical, maintenance and operating personnel.
- (11) The technical manuals include complete detailed descriptions, as-built drawings, diagrams, illustrations, schedules and data for use by Employer's technical staff to evaluate performance, trace faults, adjust, maintain and fully understand the plant and plant equipment and to allow satisfactory training of junior staff in conjunction with the operating manuals.
- (12) The operating manuals are set out in simple terms in ordinal, tabular or pictorial form to provide factual and concise descriptions of:
- i. What an alarm condition implies and how it is corrected.
 - ii. What problems can occur and how they are overcome.
 - iii. A routine visual plants inspection procedure.
- (13) The operating manuals are intended for daily use and therefore shall be separated from the technical and maintenance manuals. Bold print, diagrams, illustrations, etc. shall be used. Materials shall be suitable for heavy duty, preferably covered with protective transparent material, and be in loose leaf form to allow substitution and addition of pages.
- (14) The maintenance instruction manuals shall include schedules to cover plant inspection procedures, fully detailed maintenance programmes for plant and plant equipment services at daily, monthly, three monthly, six monthly, yearly and any other necessary intervals, and contain manufacturer's and supplier's detailed maintenance, diagrams, sectional drawings giving part numbers, descriptions, etc.

4 Procurement

4.1 People

4.1.1 Minimum requirements of people employed on the Site

- (1) The *Contractor* supplies and ensures that his employees wear the correct PPE according the risk assessments performed on the specific tasks to be carried out.
- (2) The *Contractor* ensures that everyone entering Duvha Power Station under his supervision is medically, physically and psychologically fit to enter Duvha Power Station.
- (3) The medical examination, at the *Contractors* cost, is carried out by a Registered Professional Occupational Health Practitioner and the examination shall include the following tests:
 - i. Eye Test, Blood Pressure,
 - ii. Heart Function,
 - iii. Hearing Test and
 - iv. Lung function.

4.1.2 BBBEE and preferencing scheme

- (1) Eskom's policy is to maximise purchases from Black or Black Empowering Enterprises (BEE's) whether Black Woman-owned, small or Large Black or Black empowering suppliers. The purpose is to promote entrepreneurship in black communities and give black business access to the mainstream of business opportunity.
- (2) Eskom will concentrate its development efforts on black suppliers in the manufacturing, construction and mining /extraction sector of the economy and provide

4.1.3 Accelerated Shared Growth Initiative – South Africa (ASGI-SA)

- (1) The *Contractor* complies with and fulfils the *Contractor's* obligations in respect of the Accelerated and Shared Growth Initiative - South Africa in accordance with and as provided for in the *Contractor's* ASGI-SA Compliance Schedule IT 1.2 ASGI-SA requirements.
- (2) Eskom is committed to the Accelerated and Shared Growth Initiative for South Africa and its prime objectives of higher growth, more jobs and less poverty.
- (3) Eskom's most significant contribution is through its core business of supplying competitively priced electricity.
- (4) The capacity expansion programme and Eskom's focus on operating efficiency are central to our effort to provide the power that will drive accelerated growth.
- (5) ASGI-SA is not only about economic growth, but ensuring the growth is shared. To contribute to this objective, Eskom will leverage its build programme and associated activities for optimum developmental impact.
- (6) The *Contractor* shall keep accurate records and provide the *Project Manager* with reports on the *Contractor's* actual delivery against the above stated ASGI-SA criteria.
- (7) The *Contractor's* failure to comply with his ASGI-SA obligations constitutes substantial failure on the part of the *Contractor* to comply with his obligations under this contract.

4.2 Subcontracting

4.2.1 Preferred subContractors

- (1) The *Contractor* shall make use of any supplier for sourcing of equipment, tools and material as long as long as a fully function PA system with the TOA SX-2000 system manager is obtained.
- (2) No subcontracting is allowed to affect the SANS 7240 / EN 54 certification or workmanship quality.

4.2.2 Subcontract documentation, and assessment of subcontract tenders

- (1) The *Contractor* shall submit the proposed contract data for each subcontracting for acceptance to the Project Manager
- (2) The *Contractor* shall prepare subcontracting document as according to NEC contract.
- (3) The *Contractor* must inform the Employer's representative when intending to subcontract some of the works from the contract scope.
- (4) The *Contractor* shall not subcontract a *Contractor* that has lower or higher level accreditation than him/her according to CIDB.

4.2.3 Limitations on subcontracting

- (1) The *Contractor* shall not subcontract more than 25% of the contract scope

4.2.4 Attendance on subContractors

- (1) The *Contractor* shall in writing inform the Employer's representative about the subContractor intentions for site visit.

4.3 Plant and Materials

4.3.1 Quality

- (1) All work is carried out under the supervision of an experienced supervisor.
- (2) The *Contractor* complies with the Employer's Quality Requirements as specified in Eskom Generation Standard QM58. The *Contractor*, when using materials that are required to comply with a standard specification
- (3) Shall, if so ordered, furnish the Engineer with certificates showing that the materials do so comply.
- (4) Where so specified, materials shall bear the official mark of the appropriate standard.
- (5) Samples ordered or specified shall be delivered to the Engineer's office on the Site.
- (6) Unless otherwise specified, all proprietary materials shall be used and placed in strict accordance with the published instructions of the relevant manufacturer.
- (7) All quality control documentation is submitted to the Project Manager within 7 days of Contract date.

4.3.2 Plant & Materials provided "free issue" by the *Employer*

- (1) The Employer will provide power supply, water and land for the storage of equipment and material.
- (2) The *Contractor* shall supply all the necessary equipment and material required to execute the Works.
- (3) Should the *Contractor* require using of any of the Employer's Equipment, including compressed air, electricity, water supply and crane age, it must be specified in the Works Information supplied by the *Contractor*.
- (4) The Employer does not guarantee continuity of supply of any of these items required in point 3.

4.3.3 *Contractor's* procurement of Plant and Materials

- (1) The *Contractor* shall make use of SABS approved plant and material.
- (2) Test certificates shall be given to the *Project Manager* of the project.
- (3) The *Contractor's* material should comply to the Eskom Standards as a minimum.

4.3.4 Spares and consumables

- (1) The *Contractor* shall not provide any spares as it is built into the design.
- (2) The *Contractor* must supply a recommendation for spares holding based on the project requirements and the *Employer's* goals.

4.4 Tests and inspections before delivery

- (1) The *Contractor* does not bring to the working area those plant and material which the works information states are to be tested or inspected before delivery until the supervisor has notified the *Contractor* that they have passed the test.

4.5 Marking Plant and Materials outside the Working Areas

- (1) All plant and materials outside working areas are to be marked "for *Contractor*" until such time that they are tested and installed at the site/plant.

5 Construction

5.1 Temporary works, Site services & construction constraints

5.1.1 *Employer's Site entry and security control, permits, and Site regulations*

- (1) The *Contractor* applies for access permits for all works exceeding four (4) weeks via the Project Manager, who will co-ordinate this.
- (2) The *Contractor* applies for *Contractor's* Permits for all his employees and/or sub*Contractors* at the Security gate, at least 24 hours prior to entry of the Duvha Power Station Security Area. .
- (3) The *Contractor* completes the specific form in the Duvha Power Station *Contractors* Safety Manual, listing all of the personnel that he intends using on site.
- (4) The completed list, identified with the *Contractor's* name, contains the following information:
 - i. Employee Name
 - ii. Employee ID Number
 - iii. Eskom Safety Co-ordinator signature
 - iv. Eskom Project Manager signature
 - v. Validity Date
- (5) No permits are issued to personnel who have not attended safety induction.
- (6) The *Contractor* photocopies the first page of the ID book of every one of his employees; reduced to the size 65%.
- (7) This completed list, together with the photocopies of the ID books is delivered to Protective Services for the preparation of the *Contractor's* Permits.
- (8) The *Contractor* allows at least 24 hours for the preparation of the security permits, before he collects the permits from the Protective Services offices.
- (9) The *Contractor's* personnel are required to be in possession of a *Contractor's* Permit at all times inside Duvha Power Station.
- (10) All *Contractors'* permits are submitted back to Protective Services when the workers leave the site after completion of the works. Failure return the permits will result in a R50,00 penalty for each non returned permit.
- (11) The *Contractor* compiles detailed Tool Lists (obtainable from Protective Services) of all tools and equipment to be taken on site before arriving at the power station.
- (12) Authorised copies of these lists are retained to be used again when the tools and equipment is removed from site.
- (13) The *Contractor's* visitors and all personnel conform to the security arrangements in force at Duvha Power Station.
- (14) Application forms for visitors are filled in by the *Contractor's* Site Manager and approved by the Project Manager, and submitted to the Employer's Protective Services office one day prior to the visit.
- (15) Visitors will not be allowed on site if the necessary forms are not in the possession of security staff.
- (16) The Chief Security Officer may, with valid cause, remove any of the *Contractor's* personnel from the site, either temporarily or permanently. He may deny access to the site to any person whom, in the opinion of the said Chief Security Officer, constitutes a security risk.
- (17) No unauthorised vehicles will be allowed on site. Only *Contractor's* vehicles with displayed Contract Vehicle Permits disks will be allowed on site. Contract Vehicle Applications are directed to the Project Manager for consideration and approval.
- (18) The *Contractor* is restricted to the Site. The *Contractor* is forbidden to enter any other areas, and ensures that his employees abide by these regulations.
- (19) Parking inside the power station is strictly forbidden, except for loading purposes.
- (20) No recruiting of casual labour may be done on Eskom premises, including the area outside the Power Station Security Gate.
- (21) Security personnel may search any premises, property or person within the security area of Duvha Power Station
- (22) No Photographic equipment will be allowed within the security area of the Power Station without obtaining permission.

- (23) Application forms for such permission is available from the Protective Services offices.
- (24) Any person found in possession of such equipment will be prosecuted in terms of the National Key Point Act
- (25) The *Contractor* shall comply with SHE Specification 74 and Eskom Standard 36-681: Plant Safety Regulations.

5.1.2 Restrictions to access on Site, roads, walkways and barricades

- (1) Pedestrian crossing are made on the road they should be used when crossing the road
- (2) Inside the plant walkways are clear makes they should be used when walking inside the plant to keep safe on any object that might fall.
- (3) Barricades are provided where there are open trenches and around the sumps and manholes.
- (4) The *Contractor* shall occupy only such ground as is necessary to carry out the works.
- (5) All fences and other structure that have been damaged or interfered with by the *Contractor* shall be restored to be a condition at least equivalent to their original condition

5.1.3 People restrictions on Site; hours of work, conduct and records

- (1) The LAR is for the person in charge of the plant to maintain control over activities taking place on his plant that are not covered by the Plant Safety Regulation and Operating Regulations for High Voltage Systems.
- (2) Activities that are allowed to be carried out under the LAR must not require a permit and must satisfy the following criteria:
- (3) They must not involve danger to the person carrying out the activity;
- (4) No plant isolations must be required;
- (5) The activity must be performed by a skilled person and there must be no risk of a production loss;
- (6) The duration of the activity must be less than 24 hours
- (7) The Supervisor accompanies the *Contractor* during the first instances of working under a LAR on a specific plant area.
- (8) It is very important that the person who plans to do an activity on a plant under the LAR informs the person in charge of the plant (ASS on the panel or PPO at WTP) of what will be done.
- (9) This means verbally telling the person in charge of the plant what will be done and not just signing the LAR book. The LAR book is also signed.
- (10) It is also important that as soon as the activity is completed the person, who was doing the activity, notify (verbally) the person in charge of the plant that conditions are back to normal and that the LAR has been signed off. Just signing the LAR book is not sufficient.
- (11) For more information please refer to Plant Safety Regulation C11.

5.1.4 Health and safety facilities on Site

- (1) The *Contractor* provides a First Aid service to his employees and sub-*Contractor*. In the case where these prove to be inadequate, like in the event of a serious injury, the Employer's Medical Centre and facilities will be available.
- (2) Outside the Employer's office hours, the Employer's First Aid Services will only be available for serious injuries and life threatening situations. The Employer shall be entitled, however, to recover the costs incurred, in the use of the above Employer's facilities, from the *Contractor*.
- (3) The *Contractor* to ensure that qualified and competent First Aiders and Emergency Care staff is permanently on site and at actual construction site for emergency situations, as and when they arrive.
- (4) The *Contractor* or his staff shall not move the injured party from the incident position and site unless the person's/persons' life is in danger or the person is moved by a qualified and trained Emergency Care Worker.

5.1.5 Environmental controls, fauna & flora, dealing with objects of historical interest

- (1) No fauna or flora will be collected or removed from any farm by any visitor without written permission of the landowner, in which case cognizance will be taken of appropriate provincial legislation pertaining to fauna and flora.
- (2) Under such cases Eskom Holding's ethical policies and guidelines will be strictly applied.

5.1.6 Title to materials from demolition and excavation

- (1) The *Contractor* has no title to an object of value or historical or other interest within the site
- (2) The *Contractor* shall notify the Project Manager when such an object is found and the Project Manager will instruct the Contract how to deal with it.
- (3) The *Contractor* does not move the object without instruction.

5.1.7 Publicity and progress photographs

- (1) Should publicity and progress photographs be required an application shall be made via the Project Manager.

5.1.8 Contractor's Equipment

- (1) Any equipment brought to site by the *Contractor* must be declared on entry to security personnel
- (2) Said equipment will be issued a permit, which will be required to remove the equipment from site

5.1.9 Equipment provided by the Employer

- (1) Should the *Contractor* require using of any of the *Employer's* Equipment, including compressed air, electricity, water supply and crane age, it must be specified in the Works Information supplied by the *Contractor*.
- (2) The *Employer* does not guarantee continuity of supply of any of items in point (1).
- (3) The *Employer* shall be entitled to withdraw use of the said Equipment, should proper maintenance and cleanliness not be ensured.
- (4) In the event of point (3), the *Contractor* shall be obliged to provide the necessary Equipment at his own cost.
- (5) The *Contractor* is responsible for the repair, replacement or correction as necessary of all pieces of tools and equipment supplied by the *Employer* which are damaged and / or lost whilst in the *Contractor's* custody and control.
- (6) The *Contractor's* site manager must ensure that any one of his employees or Sub-*Contractor*, operating hoist equipment belonging to the *Employer*, is authorised by an Accredited Company and retraining is done annually.
- (7) Arrangements for training courses can be made via Duvha Power Station Maintenance Training but the *Contractor* will absorb costs.
- (8) A copy of this accredited and valid training certificate must be given to the *Employer's Supervisor*, who will then arrange access for usage.

5.1.10 Site services and facilities

- (1) The *Employer* will provide the *Contractor* access to toilet facilities free of charge.
- (2) The *Contractor* or any of his employees or Sub *Contractors* will not be allowed to use the *Employer's* dining facilities, unless a specific agreement has been made between the *Contractor* and Eskom Catering and Accommodation Services (ECAS).
- (3) The *Contractor* or any of his employees or Sub *Contractors* may buy take away meals from the fast foods outlet on site.
- (4) The *Contractor* provides a First Aid service to his employees and Sub *Contractors*. In the case where these prove to be inadequate, like in the event of a serious injury, the Employer's Medical Centre and facilities will be available.

- (5) Outside the *Employer's* office hours, the *Employer's* First Aid Services will only be available for serious injuries and life threatening situations.
- (6) The *Employer* shall be entitled, however, to recover the costs incurred, in the use of the above *Employer's* facilities, from the *Contractor*
- (7) For the full duration of the works, the *Contractor* is responsible to keep the work area clean of any rubble, and to dispose all refuse to a registered dumpsite. There is no such dumpsite available at Duvha Power Station.
- (8) All waste introduced and/or produced on Eskom's premises by the *Contractor* for this Contract, must be handled in accordance with the minimum requirements for the Handling and Disposal of Hazardous Waste in terms of Government Legislation as proclaimed by the Department of Water Affairs and Forestry Act 1994 Ref.: ISBN0621 - 16296-5.

5.1.11 Facilities provided by the *Contractor*

- (1) The provision of accommodation for *Contractor's* personnel shall be the responsibility of the *Contractor*

5.1.12 Underground services, other existing services, cable and pipe trenches and covers

- (1) A survey must be carried out to determine if any underground cabling and services will hinder the design and execution of the project.
- (2) If no up-to-date drawings are available for such purposes as in point (1), the onus falls on the *Contractor* to perform an on-site survey.
- (3) Any cables identified during the survey must be marked on the drawing.
- (4) If during execution of the project any damage to identified or unidentified underground cabling and services occur, the cost of repair will be for the *Contractor*.

5.1.13 Control of noise, dust, water and waste

- (1) The *Contractor* ensures that all necessary notices and barricading are set up to ensure safety of people working in the area of the works.
- (2) All necessary precautions should be made to minimise impact of dust or noise.

5.2 Completion, testing, commissioning and correction of Defects

5.2.1 Work to be done by the Completion Date

- (1) On or before the Completion Date the *Contractor* shall have done everything required to Provide the Works except for the work listed below which may be done after the Completion Date but in any case before the dates stated.
- (2) The Project Manager cannot certify Completion until all the work except that listed below has been done and is also free of Defects which would have, in his opinion, prevented the Employer from using the works and Others from doing their work.

	Item of work	To be completed by
	As built drawings of 2.13.5	Within 5 days after Completion
	Performance testing of the <i>works</i> in use as specified in paragraph 5.2.5 of this Works Information.	See performance testing requirements.

5.2.2 Commissioning

- (1) Refer to Section 2.13.4

5.2.3 Take over procedures

- (1) During take over, the *Contractor* is responsible to demonstrate to the relevant parties the completed works.
- (2) If any concerns are raised during the demonstration, the onus falls on the *Contractor* to address and correct.
- (3) If any concern as per point (2) was part of the works, the final signoff will be postponed until such concerns have been addressed.
- (4) Commissioning and Take Over shall comply with Eskom procedure for Completion of Power plant Projects commissioning ,Take over from *Contractors* and Handover to the Generation Business-32-365

5.2.4 Access given by the *Employer* for correction of Defects

- (1) If the *Contractor* is required to correct any defect, a Permit To Work (PTW) will be issued based on the defect which is to be corrected.
- (2) The availability of the PTW will be dependent on the plant accessibility and constraints.

5.2.5 Performance tests after Completion

- (1) The performance of the system will be verified and tested during normal production cycles.
- (2) If any defect or deviation from the required performance is identified, it will be treated as a defect and applicable clauses will apply.

6 Plant and Materials standards and workmanship

6.1 Investigation, survey and Site clearance

- (1) Investigation of the site must be conducted in order to gather any information required to complete the requirements of Section 3.3
- (2) A site survey must be carried out in order to ensure the ergonomics aspect of the design is not limited by physical plant equipment or material.

6.2 Electrical & mechanical engineering works

6.2.1 General

- (1) Refer to Appendix D for 240-56227443 Requirements for Control and Power Cables for Power Stations Standard for Electrical cabling requirements.

6.3 Process control and IT works

6.3.1 General

- (2) All equipment is available in South Africa as commercially- off- the-shelf (COTS) products.
- (3) All equipment is to conform to TIA-1005.

6.3.2 Control & Instrumentation Requirements

6.3.2.1 Unit Network Cabinet

- (1) Refer to Appendix D: 240-64720986 – Emergency Preparedness Public Address System For Large Area Deployment.

6.3.2.2 Copper Patch Panels

- (1) Copper patch panels are fitted with 8P8C (RJ45) Keystones as defined in TIA-568.
- (2) 8P8C Keystones are wired according to the T568A standard.

6.3.2.3 Fibre Optic Ethernet Cabling

- (1) All fibre optic cabling is 50/125um Multimode cabling operating at 850nm.
- (2) All fibre optic cables excluding fibre pig tails are terminated in patch panels and not in splice boxes.
- (3) Fibre optic patch leads and pigs tails should be protected by sleeves and/or conduits where connected between Fibre optics patch panels and zone amplifier cabinets.
- (4) Fibre optic cabling installation conforms to TIA568-C.3

6.3.2.4 Copper Ethernet Cabling

- (1) All copper Ethernet cabling is Category 5e or Category 6.
- (2) No segment of copper cabling exceeds 50m in length.
- (3) All copper cables entering a network cabinet are terminated onto a patch panel.
- (4) The field end of a copper cable may be fitted with an 8P8C jack as defined in TIA568.
- (5) All 8P8C jacks are wired according to the T568A standard unless a crossover cable is required.
- (6) Copper cable installation conforms to TIA568-C.2

6.3.2.5 Trunking

- (1) Boxed trunking is provided for all network cabling
- (2) The boxed trunking used for network cabling is dedicated to the network cabling and is not used for any other cabling

- (3) Any new trunking should be installed such as to prevent dust, ash or water collecting within the trunking.
- (4) Trunking is specified such that it fulfils the requirements of TIA568-C.2, TIA568-C.3 and TIA1005

6.3.2.6 Cabling and Wiring

6.3.2.6.1 General

- (1) The design, supply, installation, termination, labelling, testing and commissioning of all wiring and cabling is provided
- (2) All cables as a minimum are insulated with flame-retardant, halogen-free PVC outer sheath
- (3) Internal cores of all multi-core cables must be colour coded
- (4) The routes for power supply cabling, network cabling and the trunking is of a consistent and integrated design, that takes into account different cabling and racking routes for common modes of failure and the redundancy concepts of the automation system design
- (5) The cable routes are designed such that equipment can be removed for maintenance without causing damage to the cables.
- (6) All cables and wires provided are secured with suitable cable glands, straps or clamps
- (7) All cables terminating in cubicles are such that, maintenance is achieved easily on faulty cables; thus the number of cables per access way is restricted to facilitate this.
- (8) Durable cable numbering /labelling is provided for all cables entering the cubicles, the numbering /labelling is such that maintenance on cables is easily achieved
- (9) Conduit and trunking to conform to standard 240-64720986 – Emergency Preparedness Public Address System for Large Area Deployment.
- (10) All wire terminations to use appropriate lugs.
- (11) Any termination to conform to standard 240-64720986 – Emergency Preparedness Public Address System for Large Area Deployment.
- (12) Cabling shall comply with Eskom standard 240-56227443 Requirements for Control and Power cables for Eskom Power stations and 240-64720986 – Emergency Preparedness Public Address System for Large Area Deployment.

6.3.2.6.2 Cable Schedules

- (1) Accurate records are kept in Cable Schedules by the *Contractor* for all cabling forming part of the Works.
- (2) The cable schedules are provided inclusive of origin, target, type, size and termination details.
- (3) Termination schedules are provided for all cables

6.3.2.6.3 Cable Management

- (1) A cable stock schedule is kept by the *Contractor* to record all cables delivered to and removed from Duvha site.
- (2) The installed cabling is reconciled with the cable stock schedule.

7 List of drawings

7.1 Drawings issued by the Employer

(1) A List of drawing will be issued once a contract has been signed.

Drawing number	Revision	Title

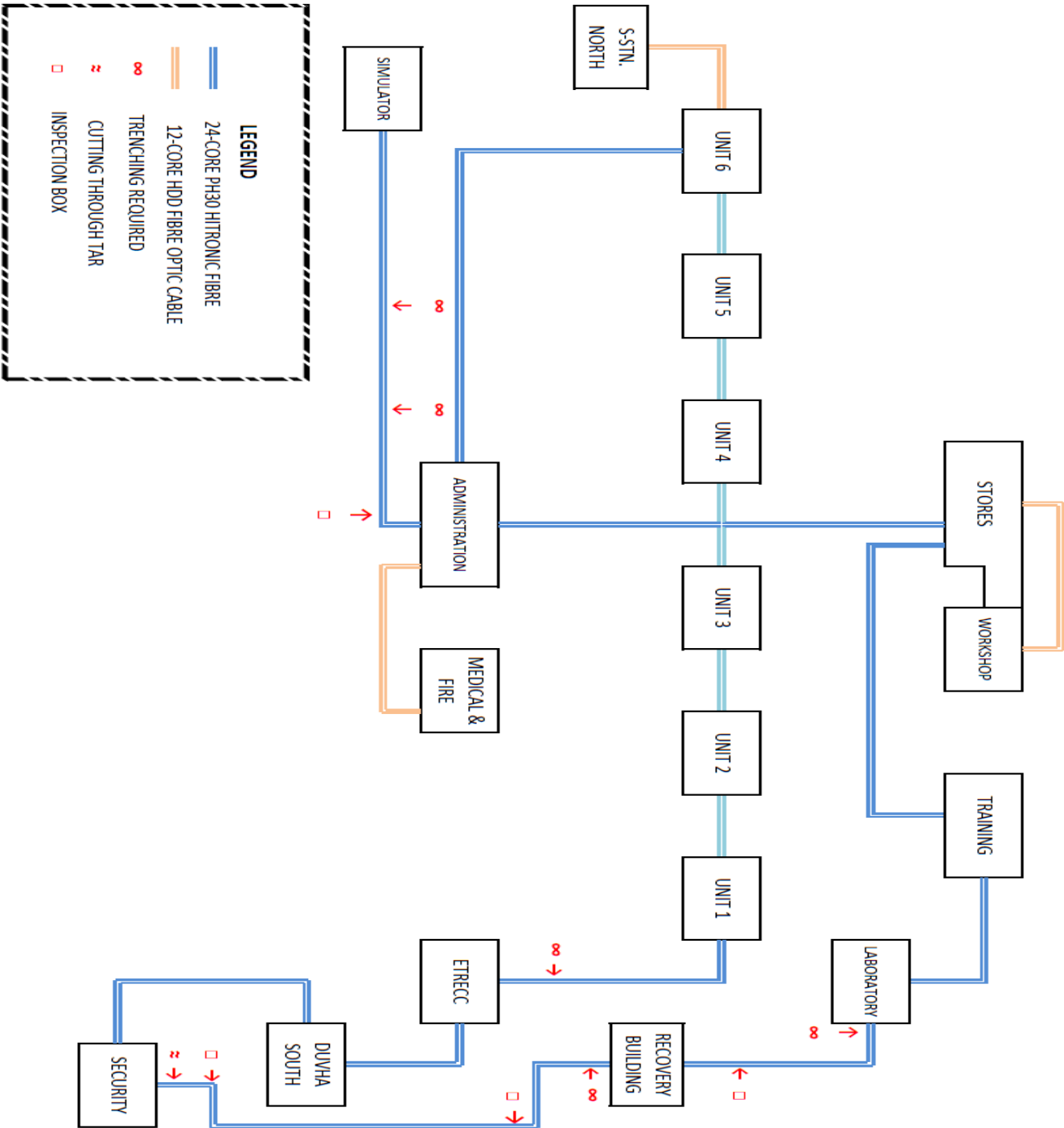
8 Appendix A: Calculation Data Spread Sheet

- (1) The *Contractor* responsible for verification of SPL for each zone for accurate loud speaker design selection in conjunction with 240-64720986 – Emergency Preparedness Public Address System for Large Area Deployment.
- (2) The calculation sheet contains the various zones, speaker location and quantities, amplifier loads and cabinet equipment.



Appendix A-Calculation Data Spread Sheet REV 0.zip

9 Appendix B: Existing Fibre Optic Layout



10 Appendix C: Limits of Supply and Services (LOSS)



Appendix C-Limits of Supply and Services (LOSS).zip



12 Appendix E: Applicable Eskom Drawing Templates



Appendix E-Applicable Eskom Drawing Templates.zip

13 Appendix F: Vendor Document Submittal Schedule (VDSS)



Appendix F-Vendor Document Submittal Schedule (VDSS).zip

C3.2 ***CONTRACTOR'S*** WORKS INFORMATION

This section of the Works Information will always be contract specific depending on the nature of the *works*. It is most likely to be required for design and construct contracts where the tendering *Contractor* will have proposed specifications and schedules for items of Plant and Materials and workmanship, which once accepted by the *Employer* prior to award of contract now become obligations of the *Contractor* per core clause 20.1.

Typical sub headings could be

- a) *Contractor's* design
- b) Plant and Materials specifications and schedules
- c) Other

This section could also be compiled as a separate file.
