ANNEXURE A

SCOPE OF WORK SIGNATURE

The scope of work will be verified and signed off by all parties involved:

Functional Responsibility	Names	Department/Designation	Date:	Signature:
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PART 3: SCOPE OF WORK

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C3.1: EMPLOYER'S WORKS INFORMATION

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C3.2: CONTRACTOR'S WORKS INFORMATION

1 Description of the *works*

1.1 Executive overview

Duvha Power station Fire Detection system at Unit 1, unit 2, EOD and new simulator rooms were affected during the C&I Refurbishment project The project to reinstall fire detection system and upgrade of panels was started and it was stopped due to the expansion of the scope of work.

The purpose of project was replace, relocate fire detection panels at Unit 1 control, unit 2 control, install new panels at unit 3, 4, 5, 6, admin building , HMD workshop, new EOD and simulator room and also repair fire detection system that was affected during the C&I Refurbishment project

Eighty percent of the scope of work was executed and twenty percent still outstanding due to the communication system work required to be executed first

The main function of FDS (Fire Detection System) is to detect fire and smoke and send the signal to the control panel The purpose of fire detection system is to provide or to give an early warning of fire to enhance the safety of the occupants, equipment and property. The system status is relayed to the fire panel located in each of the unit control rooms, HMD and Admin Reception. Fire detection system provides 24-hour surveillance of the conditions and its own system integrity for unit 1-6, the admin building and outside plant All the information relayed is available to the global repeaters panel located in EOD and EMD Workshop 2.

1.2 Employer's objectives and purpose of the works

The purpose of this project is to implement additional work and to complete all outstanding scope of work for the project The objective of this scope of work is to establish a reliable network for Fire Detection System interface

Additional Work:

- Supply and installation of fire detection system communication network equipment's
- Interfaced of unit 1&2 FDS with HVAC System (Fans and Dampers)
- Supply and install global repeater panel at old EOD. (This panel will be removed from old EOD to be installed at new EOD once old EOD has been done with civil refurbishment)

Outstanding work:

- Installation, Programming and Commissioning of EOD Human Interface Panel
- Installation, Programming and Commissioning of Fire Station Human Interface Panel.
- Interface of HVAC system with FDS (existing dampers)
- Network programming on the existing panels
- Training, Hand over, Drawings, Manuals of the installed panels

1.3 Interpretation and terminology

1.3.1 Definitions

1.3.1.1 Alarm Device

It's a device which can be used to warn occupants of a fire condition, either audibly or visually, such as sounders or strobes/beacons

1.3.1.2 Alarm Zone

A geographical subdivision of the protected premises, in which the fire alarm warning can be given separately, and independently, of a fire alarm warning in any other alarm zone (This is not necessarily the same zone as the detection zone)

1.3.1.3 Analogue Addressable System

A system where each detecting device, alarming device and any other input or output device can be individually identified, with their own unique address, at the control and indicating equipment

1.3.1.4 Automatic Fire Detection and Alarm System

A system that is able to automatically detect a fire at an early stage and automatically initiate the appropriate alarm response

1.3.1.5 Competent Person

Means a person who is qualified by virtue of his education, training, experience and contextual knowledge to make a determination regarding the performance of a building or part thereof in relation to a functional regulation or to undertake such duties as may be assigned to him in terms of these regulations

1.3.1.6 Control Room

A room housing computer equipment used to monitor and administer the equipment housed in the equipment Room

1.3.1.7 *Conventional System*

A system where devices are not assigned individual addresses and are not distinguishable from each other Devices are looped, and activation of any device on a loop produces an output associated with the loop at the control and indicating equipment (CIE)

1.3.1.8 Equipment Room

A room housing cubicles of electronic control and instrumentation equipment

1.3.1.9 Fire Detection and Alarm System

The term fire detection and alarm systems, in the context of this standard, includes systems that range from those comprising only one or two manual call points and sounders to complex networked systems that incorporate a large number of automatic fire detectors, manual call points and sounders, connected to numerous inter-communicating control and indicating panels

1.3.1.10 Fire Detection Panel

A permanent panel used for the termination, controlling, powering, operating, monitoring, indicating, testing, programming, etc of different fire detectors, alarms and other input / output units

1.3.1.11 Fire Detector

A device which can detect the presence of a fire by any means, such as smoke, heat, combustion gases, radiation, light, etc (Not necessarily a smoke detector)

1.3.1.12 I/O module

Single Channel I/O module used for damper limits and pressure switches on the fixed fire protection system

1.3.1.13 Manual Call Point

A device which is manually activated to indicate that there is a fire and initiates an alarm

1.3.1.14 Server Room

A *room housing racks of computer equipment* either for the Control and Instrumentation DCS system or the IT department LAN system

1.3.1.15 Smoke

Particulate and aerosol products of combustion generated by a fire, whether this is of smouldering or open flame type

1.3.1.16 Smoke Detector

It's a device which can detect a fire by the identification of the presence of smoke particles in the air

1.3.2 Abbreviation

The following abbreviations are used in this Works Information

Abbreviation	Meaning given to the abbreviation
APS	Account Payable Services
BEE	Black Economic Empowerment
C&I	Control and Instrumentation
CIE	Control and Indicating Equipment
DC	Direct Current
DCS	Distributed Control System
EOD	Electrical Operating Desk
FDS	Fire Detection System
FDIA	Fire Detection Installers Association
FSIB	Fire Support Interoperability Board
LAN	Local Area Network
LCD	Local Control Display
LV	Low Voltage
HMD	Heavy Mechanical Department
HMI	Human Machine Interface
HVAC	Heating Ventilation Air Conditioning
I/O	Input output
JB	Junction Box
MV	Medium Voltage

UC	Unit Controller
UCR	Unit Control Room
PM	Project Manager
PPE	Personal Protective Equipment
S.A Q C C	Fire Detection and Gas Suppression Committee

2 Management and start up.

2.1 Management meetings

(1) 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 contractor
Risk register and compensation events	As and when required	Project Managers office	PM, System Engineer and contractor
Overall contract progress and feedback	Weekly on Monday at 08.30	Project Managers office	PM Contractors' Manager

(2) 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*

(3) Records of these meetings shall be submitted to the *Project Manager* by the person convening the meeting within five days of the meeting

(4) All meetings shall be recorded using minutes or a register prepared and circulated by the person who convened the meeting.

(5) 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) The *Contractor's* site manager must submit a daily log, which needs to be signed by the *Employer's Supervisor* / Project Manager daily

(2) The project manager will arrange for necessary documentations to allow component removal from Duvha P/S.

2.3 Health and safety risk management

(1) Refer to Safety, health and environmental procedure Appendix C.

2.4 Environmental constraints and management

(1) Refer to Safety, health and environmental procedure Appendix C

2.5 Quality assurance requirements -

(1) The *Contractor* complies with the Employer's Quality Requirements as specified in Eskom *Generation Standard GGS 0462*
(2) Appendix A to this Standard indicates the specific application thereof
(3) All quality control documentation (QCP) is submitted to the Project Manager on delivery

2.6 Programming constraints

(1) The *Contractor* submits a programme within 1 week of the component failure
(2) The program shall be in Microsoft Excel or Projects format (preferably 2003 version or lower)
(3) The programme indicates
    i. QC inspection dates
    ii. Deliveries

2.7 Invoicing and payment

(1) Within one week of receiving a payment certificate from the *Service 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 *Service Manager*'s payment certificate
(2) The *Contractor* shall address the tax invoice to CRM_FSS@eskom.co za and include on each invoice the following information

- Name and address of the *Contractor* and the *Service Manager,*
- The contract number and title,
- *Contractor*'s VAT registration number,
- The *Employer*'s VAT registration number 4740101508;
- Description of service provided for each item invoiced based on the Price List,
- Total amount invoiced excluding VAT, the VAT and the invoiced amount including VAT,

2.8 Insurance provided by the *Employer*

(1) Refer to the Contract Data Section 8 – Risks and Insurance.

2.9 Contract change management

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

2.10 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.

2.11 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 he deems it necessary

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

(1) The Contractor submits any drawing or documentation that will fulfil the requirements of this works

2.13 Other requirements of the *Contractor*'s design

Test and provide proof of fully functional FDS and provide Duvha Power Station with the monthly defect/component failure report

3 Procurement

(1) The Contractor shall comply with Basic Condition of Employment Act and Labour Relation Act for the use of labour in executing the works to give effect to the right to fair labour practices referred to in section 23 (1) of the Constitution by establishing and making provision for the regulation of basic conditions of employment, and thereby to comply with the obligations of the Republic as a member state of the International Labour Organisation, and to provide for matters connected therewith

3.1.1 BBBEE and referencing scheme

(1) The *Employer* formal Black Economic Empowerment (BEE) programme was first initiated in 1995 with the publication of its policy regarding procurement from Black Suppliers (ESKADAAT6) ESKADAAT6 has set the standard for BEE programmes within Eskom and across South Africa as a whole

(2) 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

(3) Eskom will concentrate its development efforts on black suppliers ninths manufacturing, construction and mining /extraction sector of the economy and provide

3.1.2 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 (Asgisa) 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) Asgisa 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

3.2 Subcontracting

3.2.1 Preferred subcontractors

(1) The Contractor shall make use of any supplier for sourcing of equipment, tools and material whatever that the contractor will use to execute works shall comply with the SABS

3.2.2 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 his/her according to CIDB

3.2.3 Limitations on subcontracting

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

3.2.4 Attendance on subcontractors

(1) The Contractor shall in writing inform the Employer's representative about the subcontractor intentions for site visit

3.3 Plant and Materials

3.3.1 Quality

Refer to Duvha quality manual - See Appendix A

3.3.2 *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.

3.3.3 Spares and consumables

(1) The *Contractor* shall provide any spares and consumables as they are required for this fault finding and solutions to the defective plant items
(2) The *Contactor* must supply a recommendation for spares holding based on the project requirements and the *Employer's* goals

3.4 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

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

Refer to Access Control document - see Appendix B

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

(1) Pedestrian crossing are make 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

3.4.3 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 Operating Supervisor) 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

3.4.4 Health and safety facilities on Site

(1) Refer to Health and Safety Specification document see attached Appendix C

3.4.5 Environmental controls on site

(1) Refer to Environmental Policy See Appendix C

3.4.6 Facilities provided by the *Contractor*

(1) The contractor should provide facilities they deem necessary in executing the work This must be discussed with the Project Manager prior to commencement of work.

3.4.7 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
(2) The availability of the PTW will be dependent on the plant accessibility and constraints

3.4.8 Performance tests after Completion

(1) The contractor to provide Duvha P/S with the necessary data pack

4 Engineering and the Contractor's design

4.1 Employer's design

The works include the design, supply, installation and commissioning of fire detection equipment's and communication network as it required achieving an operational and reliable fire detection system This works include removal of the existing/redundant fire detection equipment that will no longer be used and dispose it according to the environmental procedures ENVP0005 (see Appendix D)

4.1.1 Supply and installation of fire detection system communication network equipment's.

This objective of the scope of work is to establish a communication system for all fire detection panels, global repeater panels and fire detection system human interface. This works involves supplying, installation and commissioning of all required equipment as is stated on the table below.

	Description	Quantity	Responsible
1	6U Fixed Wall Mount Cabinet, 450mm deep	9	Contractor
2	Moxa Network Switch (EDS-408A-3S-SC)	9	Contractor
3	5m SC to SC Single Mode Fibre patch lead	9	Contractor
4	1m PVC trunking	20	Contractor
5	220V 5A Circuit Breaker	9	Contractor
6	4U-high 19" rack mounting kit with DIN rail (RK-4U)	9	Contractor
7	1U 12 way Ethernet Patch Panel	9	Contractor
8	1U Brush panel	9	Contractor
9	45W/2A DIN-rail 24 VDC power supply with universal 85 to 264 VAC or 120-370 VDC input, -10 to 50°C operating temperature (DR-4524)	9	Contractor
10	Cabinet wiring for 24V power	9	Contractor
11	220V Power cable (9 panels to be supplied by 220V, Need assistance from EMD on where to connect)		Eskom EMD
12	Trunk Ethernet cabling with wall plugs (from Fire panels to New Cabinet)	19	Eskom IT

4.1.2 EOD at Global Repeater panel

The high-level scope of work includes supplying, installation and commissioning of global repeater panel at old EOD

4.1.3 Install Computer (Human Machine Interface) at New EOD

The high-level scope of work includes supplying, installation and commissioning of fire detection system Human Interface panel at old EOD

4.1.4 Install Computer (Human Machine Interface Panel) at Fire Station

The high-level scope of work includes supplying, installation and commissioning of fire detection system Human Interface panel at old EOD

4.1.5 FDS AND HVAC Interfaces

Fire detection system at station is controlling the directly closing of the fire dampers, in case of fire at the zone affected by fire. The system should indicate the fire dampers and the zones
The current HVAC system has made provisions for interface with the fire detection system This provision must be made to include damper status at the HVAC BMS system at Unit Electrical Maintenance Department (EMD) workshop screen and New EOD HMI Panels

The existing fire detection system should indicate the specific fire dampers status (in open or closed position) at the fire panel
The objective to establish the interface between HVAC and Fire Detection system is to achieve the outcome as per FDS_HVAC philosophy

4.1.5.1 FDS _HVAC interface philosophy

The operational philosophy of FDS and HVAC is such that the fire detection signal at a specific zone will shut down the HVAC supply and return air fans, via potential free contacts

4 1 5 1 1 Unit 1 Equipment Room 22m level

In a fire condition inside the monitoring room (MDF room) - All the dampers supplying and returning from the room will close as follows·

- Shut down dampers number 5, 6, 7 and 8
- Do not shut down the air fan

4 1 5 1.2 Unit 2 Equipment Room

- Shut down dampers number 1, 2, 5 and 6
- Shut down the 2 supply air fan; and 1 return air fan

4 1 5 1.3 Commissioning room

- Shut down dampers number 3 and 4
- Do not shut down the air fan

NOTE ADDITIONAL SCOPE In this area there's 6 I/O's and additional 2 I/O's are required
A junction box in control room with 40 I/O (24V supply)
Configuration will be required

4.1 5 1 4 Unit 1& 2 Control Room

16m level – In a fire condition anywhere in the control room

- Shut down all five dampers
- Shut down the 2 supply air fan and 1 return air fan

Additional scope
- Smoke extraction fans to be monitored it should be kept closed
- Supply switch to be operated.
- The power supply to the smoke extraction fan is also required
- Re-wire the 'key switch' for smoke extraction fan (an existing key switch can be re-wired to FDS panel)
- The key switch requires a 24V supply
- Configuration will be required

4.1.5 1 5 Unit 1&2 Old Equipment Room 11 9m level

- Shut down two dampers – Unit 1 and 2 only one damper joined to Unit 1 fans.
- Shut down the 2 supply air fan , and 1 return air fan

4 1 5 1 6 Unit 1 LV and Battery Room 6 3m level

In a fire condition inside the LV room
- Shut down three dampers
- Do not shut down the air fan

4 1 5 1 7 Unit 1 MV room 0m level

In a fire condition in both the MV and LV room

- Shut down all dampers
- Shut down supply and return dampers
- Shut down the 2 supply air fan and 1 return air fan

- Supply key switches for all smoke extraction on all the floors

- Supply required damper I/O's modules

4 1 5 1 8 Unit 1 South (i e. PT&M offices, C&I Computer Section offices, etc) 22m level

In a fire condition:
- Shut down all dampers
- Shut down the 2 supply air fan , and 1 return air fan
- Offices shut down dampers
- Change room shut down dampers
- Battery room shut down 2 dampers

4.2 The control unit and sensors conforms to the following standards:

a) Control Unit EN54-2 (Draft 1996)
b) Smoke Sensors EN54-7 (1996)
c) Heat Sensors EN54-5 (1996)
d) Multi sensors ISO7240-15 (Draft 1996)
e) Manual call points EN54-10 (Draft 1996)
f) All input/output devices shall comply with EN 54-18 [24]
g) Fire alarm sounders and sirens shall comply with SANS 50054-3 [8]
h) Visual alarms will be provided in accordance with SANS 10139 [7] and shall comply with SANS 50054-23 [8]
i) Control and indicating equipment shall comply with SANS 10139 [7] and SANS 50054-2 [8]

4.3 Other requirements of the *Contractor*'s design

The contractor's technical team should have valid S A Q C C cards The contractor will be required to design and submit the fire detection layout for the affected areas and the designed need to be approved by the Employer before implementation

4.3.1 Operating Requirements

The operating minimum requirements are as follows

a) Highly descriptive alarms which pinpoint the error or event and various filter criteria, to enable and assist in operator intervention during abnormal conditions
b) The operator should able to monitor on the panel the current statuses of the buildings and sub-stations easily and accurately
c) Access to historical information for diagnostics after a critical event, for period up to 1 year.
d) Ergonomic design of HMI navigation and schematics in terms of readability and ease of use and efficient navigation
e) Reliable equipment of the fire detection system to minimise loss of monitoring over station buildings in events of power failures and electronic card failures

4.3.2 Maintenance Requirements

a) Access to Fire detection system operating system error messages
b) Monitoring of fire detection system statuses, error indications
c) Access to historical information to assist during event investigations
d) Alarms are detailed enough to assist maintenance in quickly diagnosing system errors.
e) Access to field device status where device are enabled for it
f) Integrated document management system for the fire detection database and drawings
g) Detailed procedures, Instructions, planned maintenance packages and Routine Services so that they can be loaded into SAP PM
h) Complete set of documentation on all equipment installed
i) Manuals for all equipment that is installed
j) Update the fire detection drawings for the installed sections
k) Wiring diagrams.
l) Cables schedules, containing cable types and lengths
m) Comprehensive training of the Technicians on the fire detection system
n) A list of recommended spares list that include quantities to be put on stock (minimum and maximum stock level)
o) Opportunity for C&I Maintenance involvement in the installation and commissioning of the equipment.

4.3.3 Engineering Requirements

The engineering department requires·

a) The fire detection system should assist in investigations and help to establish early warning of fires in the buildings.
b) The fire detection control system must supply and store status information on detected fire
c) An engineering station capability for the Fire detection system modifications.
d) Ability to integrate the installation of future additional fire detection devices into the existing fire detection system
e) Configurable user environment relating to displays
f) In addition, preference should be given to sensors and sensing methods that are environmentally friendly and that do not contain hazardous substances

4.3.4 Training Requirements

4.3.4.1 Operating Training

Operating philosophy training for the Panels should be provided to the unit controllers (18), Plant operators (18) and Training Personnel (2) The operators should be able to read and understand the system status displayed on the new panel i.e alarms, false alarms, faults, fire conditions, etc

4.3.4.2 Maintenance Training

The comprehensive training (Maintenance, faulty finding and operating philosophy) should be provide to the Maintenance Technicians 12 and Maintenance Training Personnel (2) The Maintenance personnel are the first line of maintenance to keep the whole system operating according to the intended performance requirements. They perform their activities with the existing design configuration (includes all hardware and software configuration) limits of the system This requires a good knowledge of how the system is configured, both hardware and software, and how to interpret the information, and take corrective action thereafter

Maintenance Training should include as a minimum

a) Hardware familiarization - includes the modules, and all other peripheral equipment supplied as part of the works
b) Hardware configuration and installation
c) Software configuration
d) Program storage and reloading
e) Network communication and configuration
f) Maintenance of hardware (both system hardware and test equipment)
g) Interpretation of system fault alarms and diagnostic information and the corrective action thereafter
h) Operator interface usage
i) Familiarization with documentation

4.3.4.3 Engineering Training

The Engineer of the system is the last line of maintenance on site, before the suppliers are contacted for help He ensures the long term plant health and availability of the subsystems and modules to ensure the intended performance throughout the system's life cycle
He must be well trained in all the Maintenance training functions as he monitors the performance of maintenance functions in sustaining the overall system performance He audits and reviews maintenance procedures (both for corrective and preventative activities), and plans system hardware and software modifications He therefore defines the design configuration limits of the system for both Maintenance and Operational personnel

A minimum of 4 engineering personnel (chosen by the Employer) should be trained on the functions listed below. On top of the maintenance training, engineering training includes a minimum of

a) A brief system design philosophy – lessons and improvements from previous products, including the operating and maintenance concepts
b) System Configuration and Documentation Control – including all necessary activities for system expansion/modification and software storage.
c) Development and testing of all software
d) Graphic display design, development and configuration
e) A system of monitoring system failure modes, effects and criticality to the business, for more proactive maintenance and lifecycle strategies
f) Network design, communication, configuration and expansion

4.3.5 Manuals

Provide the applicable manuals (Training manuals, OEM manuals and Drawings)

4.4 Design of Equipment

4.4.1 Fire Detection system

Fire Detection system is designed to provide an early warning utilising the most effective fire or smoke detection methods appropriate to the protected areas The control unit or panel continuously monitors the analogue status of all sensing devices, and initiate action/alarms when a fire or smoke condition is present

Fire detection system should be designed such that panels and line devices have self-monitoring system, which will report any malfunction immediately

4.4.2 Duvha Fire Detection System

The table below show the number and the location of the Fire Detection Panel at Duvha Power Station

Panel	Area
Panel 1	Unit 1
Panel 2	Unit 2
Panel 3	Unit 3
Panel 4	Unit 4
Panel 5	Unit 5
Panel 6	Unit 6
Panel 7	Admin Building and Western Areas
Panel 8	HMD Workshop and Eastern Areas
Panel 9	EOD Global Repeater Panel
Panel 10	EMD Workshop Global Repeater Panel
Panel 11	Admin Building 2ND Floor, IT Server Room
Panel 12	Unit 1 Archive Room

The panels that needs replacement are at unit 1, unit 2, unit 4 and EOD

4.4.2.1 Fire Detection Panel

A permanent panel used for the termination, controlling, powering, operating, monitoring, indicating, testing, programming, etc of different fire detectors, alarms and other input / output units Fire Detection panels are installed at Unit Control room in order for the Unit Controller to monitor and view any fire condition on the plants.

The central control unit (Panel) should be capable of communicating with all analogue addressable units or field instruments connected to the system

The panels should comprise of indicators and controls, for operator's response operation The following illuminated indicators should be provided on the panels

- Fire Alarm
- Fault alarm
- Zone number
- Power supply healthy or faulty
- System fault
- Device isolated or disabled
- Communication fault

There is to be no limits on the number of faults that can be simultaneously reported The Contractor should provide the documents and diagrams showing all protected areas, zones and types per zone All FDS control Panels to be provided with its own dedicated permanent power supply as well as a back-up power supply, according to SANS 50054-4 [8] Battery backup of 24 hours is recommended

Fire Detection Panel Specification and Features

a) Fully expandable from 2 to 8 loops via common plug in loop driver boards.
b) Full support of Apollo (Discovery, Xplorer S90 & XP95)
c) Advanced graphical LCD user interface with up to 1000 fire zones as standard, allowing full EN54 compliance without additional hardware or LED indication
d) 2 x 5 Amp power supply and charger to EN54 part 4
e) Dedicated RS232 serial port for direct PC or modem connection.
f) Dual, flash based microprocessor technology with on-board Real Time Clock
g) Optional on-board or remote printer.
h) Installer friendly 'Auto-learn' and 'Loop Detection' facility for trouble-free, commissioning
i) Fully on-site programmable via on-board alphanumeric keypad or PC configuration tools
j) Flash memory and the advanced graphical display enables the panels to be configured to operate in virtually any language with any character set and allows the installer's logo and company details to be applied to the LCD display
k) Robust, removable equipment chassis with plug-in connectors for simple fixing and cable termination When connected to the fault tolerant Ad-NeT network, the panel operates as a true peer-to-peer interface (with up to 1000 shared zones) with full cross panel reporting, control and cause and effect functionality

4.4.2.2 Field instruments or Fire Detector

- It must be possible to connect and mix automatic detectors, manual alarm call points and line modules within the same zone, independent of their operation principle These devices should be connected via a fully supervised two-wire circuit (class B wiring) or (class A wiring), for both power and communication between the device and the control panel

- All circuits are protected against electrical transients and electromagnetic interference. Electrical noise, such as high frequency pulses or electromagnetic influences emitted from other equipment does not lead to false alarms in a detector, manual call point or any other line element

- Each detector or field instrument should be uniquely identifiable by the control panel This should be achieved by pre-setting the detector address at the detector. Detector calibration, device identification and sensitivity shall be transmitted to the control panel The detector shall incorporate a self-test function, which must report the test result to the control panel The control panel must check the test result and display a maintenance signal if these are out of range The light emitting diode on the base of the detector should illuminates when the detector is "in alarm"

4.4.2.2.1 Optical smoke detector (Apollo XP95, Part No.55000-600)

The Optical Smoke Detector works using the light scatter principle to detector smoke The detector is an optical light scattering type sensitive to visible smoke and stable under all environmental conditions It is ideal for applications where slow-burning or smouldering fires are likely.

- Responds well to slow-burning, smouldering fires
- Well suited for bedrooms and escape routes
- Unaffected by the wind or atmospheric pressure

An optical smoke detector is an addressable analogue unit which mounts into a twist or lock plug-in-base. Detectors operate on a 2-wire circuit, for both power and two way communications between the detector and panel The detector sensitivity should be individually adjusted from the control panel Each detector should be uniquely identifiable by the control panel

The photoelectric optical smoke sensors comply fully with the general requirements for intelligent point sensors Optical smoke sensor should also comply with standard EN54-7

The detectors should be capable of operating within the following environmental limits

- Temperature operating range –20C to +60C
- Humidity operating range 0% to 95% RH (without condensation)
- Wind – not affected

The detector should be capable of protecting an area up to 100m2 at a height of up to 10 5m. The installation and siting of the sensors conforms to SANS 10139 Part 1 (2007), or similar Standards

Operating Principles

The XP95 optical smoke monitor has a moulded self-extinguishing white polycarbonate case with wind resistant smoke inlets Stainless steel wiper contacts connect the monitor to the terminal in the mounting base It has the indicator LED which is clear in standby and red in alarm Within the case there is a printed circuit board which on one side has alight proof labyrinth chamber with integral gauze surrounding the optical measuring system and on the other the address capture, signal processing and communications electronics

Electrical Description

The monitor is designed to be connected to a two wire loop circuit carrying both data and 17V to 28V DC supply. The unit should be capable of operating on a 24V DC supply The monitor is connected to the incoming and outgoing supply Connection is polarity insensitive

Environmental characteristics

The XP95 optical smoke monitor is unaffected by wind or atmospheric pressure and operates over a temperature range -20 to +60°C

4.4.2.2.2 Heat or Temperature Detector (Apollo XP95, Part No.55000-400)

The heat detector is an addressable analogue unit which mounts into a twist or lock plug-in-base The heat detector is a thermal sensing type which provides close tolerance performance under all rates of temperature rise conditions Detectors shall be able to operate on a 2-wire circuit, for both power and two way communications between the detector and panel All communication shall be under the control of the central control panel, which shall sequentially poll each detector every 5 seconds in turn and authorise communication The detector sensitivity should be individually adjusted from the central control panel It should be possible to measure and display the detector's sensitivity at the control panel Sensitivity should range between 58 to -82°C

The XP95 Heat Detector monitors temperature by using a single thermistor, which provides a count output proportional to the external air temperature The standard heat detector is classified as an A2S device and will report an alarm at 55°C The high temperature detector, classified as a CS device, will report an alarm at 90°C

The detectors are capable of operating within the following environmental limits.

- Ideal in environments that are dirty or smoky under natural conditions
- Well suited for warehouses, loading bays and carparks
- Unaffected by wind or atmospheric pressure

The monitors are designed to be connected to a two wire loop circuit carrying both data a 17V to 28V DC supply Each detector is suitable for protecting an area up to 50m2 at a height of up to 9 0m The installation and siting of the sensors should be carried out in accordance with standards SANS 10139

4.4.2.2.3 Manual call points (Apollo XP95, Part No.55200-905)

A device which is manually activated to indicate that there is a fire and initiates an alarm Manual call points are installed at all fresh air exits from all buildings and all storey exits of buildings having more than one floor All manual call points are red in colour and mounted at 1400mm from the floor and one should not walk more than 45m without finding a manual call point Any manual call point outdoors is an external waterproof call point Due to the inherent problem of malicious damage to call points, all manual call points fitted with a plastic protective cover

The manual call point are of pleasing, streamlined appearance permitting its use as a semi-flush or surface mounted unit, must bear the legend "FIRE - BREAK GLASS", and must be moulded in red plastic

The manual call point consists of a base and insert, and must be able to accept a transparent snap on cover Removal of a call point does not cause disconnection of wiring, and does not interfere with the remaining devices on the line.

The breaking of the glass releases an alarm The glass is of such a type that when broken, no sharp edges, which could inflict injury, are produced For analogue addressable systems, a built-in lamp (L E D), automatically confirm its actuation A re-settable plastic element may also be used

The alarm contacts are of self-cleaning design to prevent failure after a prolonged period of inactivity in unclean environments Contacts are wired for failsafe operation It should be possible to test the call point without destroying the glass or removing the cover It should possible to reset the alarm call point with a special tool only.

The manual call point housing accommodates, as an option, a sealed electronic circuit for an individual address system as would be required for an analogue addressable system A waterproof version satisfying the requirements of IP-66 and capable of operating at a continuous relative humidity of 100%, is made available by the manufacturer.

Specifications·

- Operating voltage 16 to 26VDC
- Max contact load 0 1 A/1W
- Terminals for wire C S A 0 2 to 2 5mm
- Ambient temperature -100C to +750C
- Humidity Max 95%RH
- Protection category IEC IP-30
- Number of contacts Changeover

Manual call points (MCP) shall comply with SANS 50054-11 [8] for "Type A" operation

4.4.2.2.4 Void detectors (Apollo XP95, Part No.55000-600)

This is an optical detector the only difference it's in the applications that these detectors will be installed underneath the ceiling or underneath the floor

4.4.2.2.5 Remote indicators (Apollo XP95, Part No.AI672)

Remote indicators are used to connect the void detectors status to be visible Remote indicator is a light-weight, compact, red LED indicator use in fire detection and fire protection system It should be compatible with the Apollo range and also have a anti-tamper screw to protect against unauthorised removal.

4.4.2.2.6 Sounder strobes

Combined fire sirens/strobe lights are installed at strategic locations around all buildings to warn persons nearby that a fire condition has occurred The volume level is a minimum of 65db The sounder strobes part number AS9961 Fire alarm sounders and sirens shall comply with SANS 50054-3 [8] Sounders shall generally be used for the warning of most occupants in most areas, wherever possible
The actual sound pressure levels shall be in accordance with SANS 10139 [7], but shall not fall below the figures given below.

Location	Min dB (A)	Max dB (A)
General Areas	65	120
Stairways	60	120
Areas of limited extent (within a general area)	62	120

Sound pressure levels shall be calculated initially, but must also be tested in all areas of the site upon completion Additional sounders might be required in some areas to reach the required sound pressure levels

4.4.2.2.7 Dampers Interfaced with FDS

The information is gathered from the limit switches on the damper actuators, relayed via 3-channel I/O module to the Fire Panel

4.4.2.2.8 Interface Units (Input/out Module or control points)

The input /output module are used to interface the fire dampers with fire detection system The address of an input/output unit is set on the seven segment unit DIL switch located on the device. There two types of the modules· There is a single channel and three channels input/output modules All input/output devices shall comply with EN 54-18 [24]

Single Channel input/output unit (Part Number Apollo XP95 IO9501)

Twelve terminals are provided-four for the loop connections (incoming and outgoing), two for supply positive two for supply negative, one for the relay pole, one for the normally open contact, one for the normally closed contact and one the logic signal level

24 V DC is required to activates the inputs and 24 V DC power supply is required to operate the I/O unit Maximum input resistance of 100 ohms and Maximum input capacitance of 200 nF

Three Channel input/output units

26 terminals are provided-four for the loop connections (incoming and outgoing), four for the power supply in and out and three sets of six each providing the relay pole, normally open contact, normally closed contact, the logic input, supply out voltage and 0 volt out.

24 V DC is required to activates the inputs and 24 V DC power supply is required to operate the I/O unit Maximum input resistance of 100 ohms and Maximum input capacitance of 200 Nf

4.4.2.2.9 PH30 fire cable

New fire resistive cables complying with SANS 10139 and tested to EN 50200 rated for 30 minutes or more should be used throughout the installation These cables may be fixed to the surface with steel clips and steel conduit Check for more information on heading number 6

4.4.2.2.10 Junction box

Junction box should be an IP56 PVC housing opaque lid part number 686.206 Check for more information on heading number 6

4.4.2.2.11 Bosal conduit

All the cables form the control panel to detectors or field instrument should be covered with steel cable conduit with 20mm Check for more information on heading number 6

4.4.2.2.12 *Steel cable ties*

The cable conduit should be mounted on the wall using the stainless steel Cable tie, W 4.6mm L 201mm

4.5 Wiring and cabling installation

(1) All cables shall be sized according to the design of the system This must take into account all electrical and mechanical characteristics, such as voltage drops, current carrying capacity, impedance and mechanical protection This is often dependant on the type and make of the equipment, as well as the specific environments in which they are installed This shall be the responsibility of the contractor
(2) Cables with "standard" fire resistance shall be used for general use These cables shall have a rating of PH30 when tested according to BS EN 50200 [23] The competent fire system engineer needs to specify the required cables to be provided to the risk areas
(3) Cables with "enhanced" fire resistance shall be used where certain systems are required to operate for longer than normally required These cables shall have a rating of PH120 when tested according to BS EN 50200 [23]
(4) Note FR20 shall not be used for FDS wiring
(5) Mixture of cable types is not permitted Cables shall only be supplied from one manufacturer for the entire system to avoid known impedance problems caused by mixing different manufacturers cables
(6) Fibre optic cable is recommended for the communications medium between fire panels because it is immune to electromagnetic interference, can pass through hazardous areas without the risk of spark and provides high speed network connectivity
(7) Alternatives to hardwiring of systems may be considered, but only if necessary These shall comply with the EN 54 standard
(8) Cables only enter panels from the bottom, never from the top.
(9) Where the wiring enters control panels, etc , the wires of each conduit / cable are neatly and carefully bunched together and secured by means of plastic cable straps.
(10) Saddles are positioned at intervals no greater than 1000 mm All cables are armoured when not running inside conduit
(11) All cables are colour coded or numbered consistently and continuously throughout the work
(12) Painting of conductors is not acceptable under any circumstances
(13) Cable spacing is maintained by cable ties accepted by the Project Manager, every 300 mm in horizontal and vertical runs of trays
(14) Single cables run from a tray follow the building or structure members and are supported every 300 mm Where necessary additional steel angles or channels are installed to support the cables
(15) Cables are installed with radii of bends not less than the minimum recommended by the cable manufacturer or eight times the outer diameter, whichever is the larger
(16) Trailing cables may be installed with radii of bends not less than eight times the outer diameter of the cables
(17) When cables are installed in positions exposed to areas with pedestrian traffic, vehicle traffic or maintenance activities, and could be subject to damage, they are provided with mechanical protection in the zone from floor or ground level to three metres above the floor

(18)All cables are installed in locations remote from sources of heat. Where, out of necessity, cables are installed in the vicinity of radiated heat source, they are adequately protected by a heat resistant barrier and are of a heat resistant type approved by the Project Manager
(19)All debris and foreign matter is removed from the cable trays and trenches prior to installation of the cables, and on completion of the work, the Contractor thoroughly checks all cable trays and trenches and again removes all accumulated dirt and debris On completion of the cable installation, the Contractor ensures that all covers are in place on the trenches and trays where applicable
(20)During installation of the cables, extreme care is exercised to avoid kinking or bending which may damage the cable insulation or sheath. Cables that are accidentally damaged during installation are repaired or replaced to the satisfaction of the Project Manager In no case is a cable, on which the outer sheath has been punctured, installed
(21)Signal and control cables are not laid until the cables are safe from damage that may be caused by construction operations
(22)All conductors on vertical runs of cable tray are supported independently of the terminal connections
(23)Cables are installed in the trays in logical order such that they will lie flat on the tray with no crossovers
(24)Cables entering or leaving a tray are routed to prevent possible mechanical damage due to abrasion
(25)The Contractor is responsible for storage of all cables and suitably protects it from weather and damage during storage and handling
(26)
(27)Wiring is multi-core and conforms to SABS 1411 (1996) and SABS 1574 (1992)
(28)Use can be made from the existing cabling. Any additional cabling required is included in the prices
(29)The number of cables in any one conduit does not exceed the number permitted by the SABS Code of Practice 0142
(30)Cables only enter panels from the bottom, never from the top.
(31)Where the wiring enters control panels, etc , the wires of each conduit / cable are neatly and carefully bunched together and secured by means of plastic cable straps
(32)All cables are colour coded or numbered consistently and continuously throughout the work
(33)Painting of conductors is not acceptable under any circumstances
(34)Cable spacing is maintained by cable ties accepted by the Project Manager, every 300 mm in horizontal and vertical runs of trays
(35)Single cables run from a tray follow the building or structure members and are supported every 300 mm Where necessary additional steel angles or channels are installed to support the cables
(36)When cables are installed in positions exposed to areas with pedestrian traffic, vehicle traffic or maintenance activities, and could be subject to damage, they are provided with mechanical protection in the zone from floor or ground level to three metres above the floor.
(37)And again removes all accumulated dirt and debris On completion of the cable installation, the Contractor ensures that all covers are in place on the trenches and trays where applicable
(38)During installation of the cables, extreme care is exercised to avoid kinking or bending which may damage the cable insulation or sheath Cables that are accidentally damaged during installation are repaired or replaced to the satisfaction of the Project Manager In no case is a cable, on which the outer sheath has been punctured, installed
(39)Signal and control cables are not laid until the cables are safe from damage that may be caused by construction operations
(40)All conductors on vertical runs of cable tray are supported independently of the terminal connections
(41)Cables are installed in the trays in logical order such that they will lie flat on the tray with no crossovers
(42)Cables entering or leaving a tray are routed to prevent possible mechanical damage due to abrasion
(43)The Contractor is responsible for storage of all cables and suitably protects it from weather and damage during storage and handling

4.6 Cable Routing

(1) Low voltage cables (less than 50 V) in conduits are separated from circuits of higher voltages These services are not run in the same conduit
(2) Signal cables parallel to any power cables are routed at least 1000 mm from such power cables in the plant and cross the power cables at right angles where necessary

4.7 Cable Termination

(1) Cable ends are properly crimped with pin lugs and securely connected in terminal blocks
(2) Solder less crimping lugs are used.
(3) The terminals used in junction boxes are of non-brittle plastic,
(4) Only compression glands to suit the cable and boxes are used Termination of armoured cable in all power and control equipment is made in IP21 armoured cable glands

4.8 Panel Wiring

(1) Crimping connector size is determined by the wire size
(2) Every wire is identified by numbered at each end
(3) All panel wiring is neatly laid in trucking to a maximum capacity of 80% of trimming capacity
(4) All exposed wiring is neatly looped in accordance with accepted practice
(5) Terminals are of the Clip-on polyamide feed through type or equivalent approved by the Project Manager
(6) Each terminal has a space for numbering
(7) Connection is made to terminal strips on one side only, leaving the other side clear for field connections
(8) Not more than one wire is connected to one side of any terminal.
(9) Wiring passing through a terminal carries a terminal number on both ends

4.9 General Specifications

1 All the old fire detectors, cable and cable conduits should be removed
2 Existing parts that are still to be used must be left as is
3 All removed cables to be disposed-of (As per the area and standard specified by the employer) Otherwise contractor to submit a valid and approved certificate of disposal
4 Labelling is according to the Eskom standard ENS0002 Rev7 (see appendix E)
5 Routing of cables- All cabling must be secured on conduit and should not have joints (i.e Where old cables are short it must be replaced or install a Junction Box (JB))
6. Plastic conduit are not suitable for the fire detection system
7 Component's design life span should be +- (10-15) years.

5 List of drawings

5.1 Drawings issued by the Employer

This is the list of drawings issued by the *Employer* at or before the Contract Date and which apply to this contract

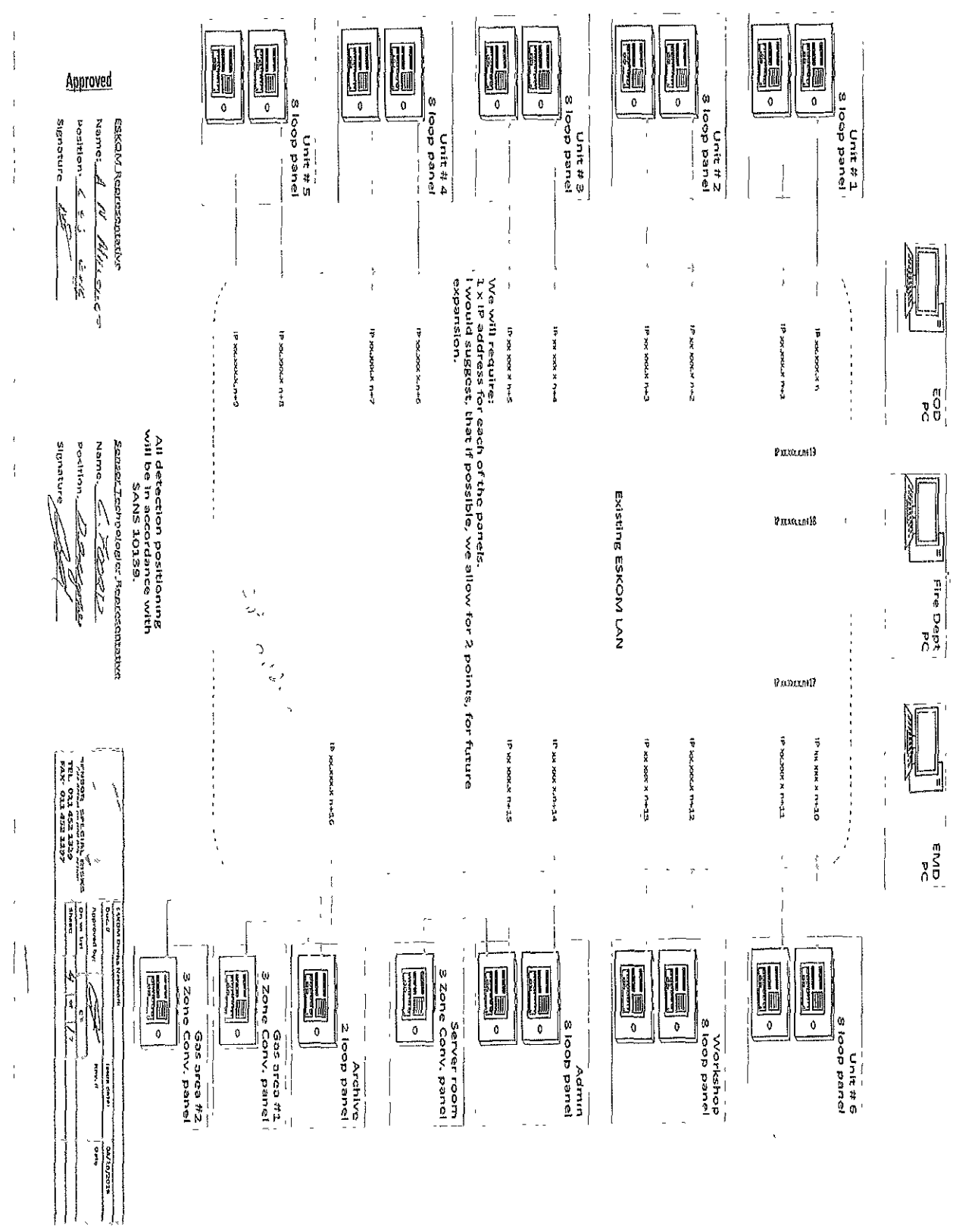
Note Some drawings may contain both Works Information and plant Information

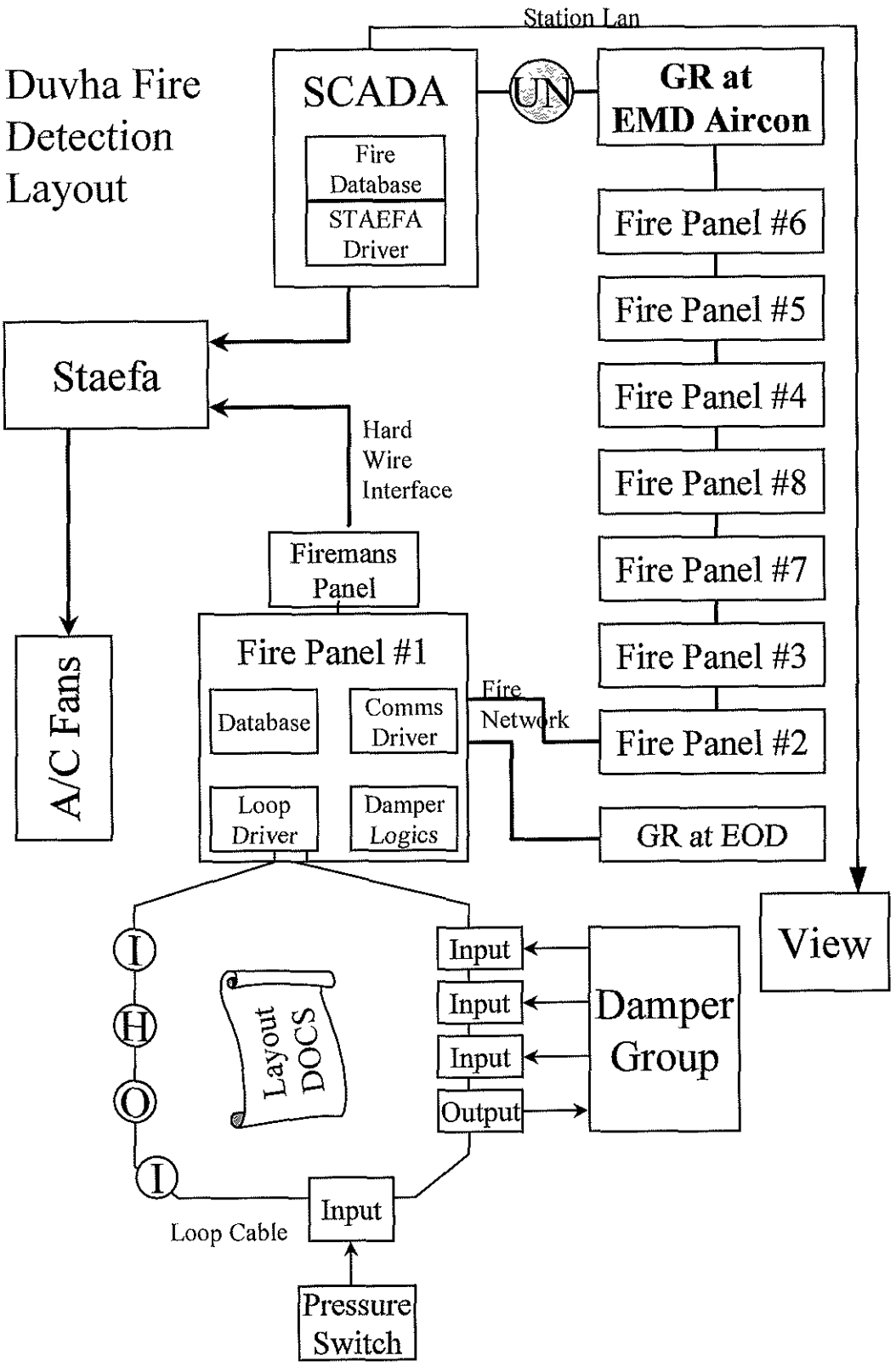
The drawing numbers and manuals listed below are for all Duvha Fire Detection System

Drawing number/Doc Number	JB AKZ no	Title

E5076/7 8.6 1		Fire Protective Equipment FDS, System Description Volume 1
E 57/57000		Refurbishment Control Suite Unit 1&2
E 57/57001		Refurbishment Equipment Rooms unit 1 to 6
E 57/57001		Refurbishment EOD Control Room
E 57/57003		Refurbishment Unit 4 Simulator Suite
E 57/13153		Refurbishment Unit 1 Aux Bay Equipment Room

5.2 Duvha Fire Detection System Layout


EOD PC
Fire Dept PC
EMD PC
Existing ESKOM LAN
Unit # 1 8 loop panel
Unit # 2 8 loop panel
Unit # 3 8 loop panel
Unit # 4 8 loop panel
Unit # 5 8 loop panel
Unit # 6 8 loop panel
Workshop 8 loop panel
Admin 8 loop panel
Server room 3 Zone conv. panel
Archive 2 loop panel
Gas area #1 3 Zone Conv. panel
Gas area #2 3 Zone conv. panel
We will require:
1 x IP address for each of the panels.
I would suggest, that if possible, we allow for 2 points, for future expansion.
All detection positioning will be in accordance with SANS 10139.
Approved
ESKOM Representative
Name:
Position:
Signature
Sensor Technologies Representative
Name:
Position:
Signature


Duvha Fire Detection Layout
Station Lan
SCADA
Fire Database
STAEFA Driver
UN
GR at EMD Aircon
Fire Panel #6
Fire Panel #5
Fire Panel #4
Fire Panel #8
Fire Panel #7
Fire Panel #3
Fire Panel #2
Staefa
Hard Wire Interface
Firemans Panel
A/C Fans
Fire Panel #1
Database
Comms Driver
Loop Driver
Damper Logics
Fire Network
GR at EOD
View
I
H
O
I
Layout DOCS
Input
Input
Input
Output
Damper Group
Input
Loop Cable
Pressure Switch

5.3 Drawings to be provided by the Contractor

Drawings provided by the contractor after contract date includes the following:

- Updated Fire Detection system layout of the following areas
  - Unit 1 Control room
  - Unit 1 Equipment room
  - Unit 1 LV room
  - Unit 1 MV room
  - Unit 2 Control room
  - Unit 2 Equipment room
  - Unit 2 LV room
  - Unit 2 MV room
  - Unit 4 New Simulator room
  - New EOD Control Room

- Drawings to be submitted to the Project Manager as part of the works

6 Fire Detection Equipment Part Numbers

Item No.	Equipment description	Part Numbers
1	Optical Smoke Detector Apollo XP95	55000-600
2	Heat detectors Apollo XP95	55000-400
3	Manual call points Apollo XP95	55200-905
4	Remote indicators	AI672
5	Sounder strobes	AS996I
6	I/O Module or control points Apollo XP95	IO950I
7	Junction box	IP56 PVC Housing opaque lid Part # 686 206
8	Steel cable ties	Stainless steel Cable tie, W 4 6mm L 201mm
9	Fire Control Panel (Techno switch)	TC4800

7 References

- Fire Detection and Life Safety Design Standard 240-56737448
- Inspection, Testing and Maintenance of Fire Detection Systems Standard 240-56737654
- Maintenance Execution Strategy for Fire Detection System 03A ENS0053

8 Appendices

8.1 Appendix A Supplier Contract Quality Requirement

QM-58 Supplier
Contract Quality Req

8.2 Appendix B Access Control Visitors Appointment

Access Control
Visitors Appointment

8.3 Appendix C (SHE Requirements)

32-726 (0) SHE
Requirements forthe

8.4 Appendix D (ENV0005- Procedure for waste management (Environment))

Microsoft Word
Document

8.5 Appendix E (AKZ Plant labelling standard)

Microsoft Word
97-2003 Document