Eskom	***Works* Information**	**Generation**

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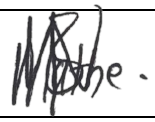
Reviewed By: Bonginkosi Mathe **Auxiliary Mechanical Engineer**		2022/10/06
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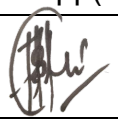
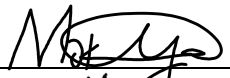
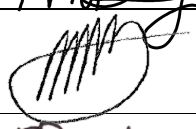
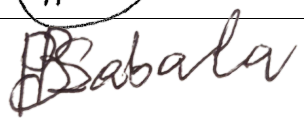
Approved By: Thabo Gininda **Operating Manager**		10/10/2022
Approved By: Monyane Mokoena **Maintenance Manager**		2022.10.12
Authorised By: Lindokuhle Ngobese **Engineering Manager**		2022.10.12
Accepted By: Perry Msabala **Project Manager**		2022.01.03

PART 3: SCOPE OF WORK

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	This cover page	1
C3.1	*Employer*'s Works Information	
C3.2	*Contractor*'s Works Information	
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C3.1: EMPLOYER'S WORKS INFORMATION

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1 DESCRIPTION OF THE *WORKS*

1.1 EXECUTIVE OVERVIEW

This document contains the works information for Matla Power Station upgrade of the S5 PLC and SCADA to the latest technology on the market, UPS, switchgear and Battery Charger systems at Slurry Plant, which is currently obsolete. This project will also cover the safety upgrade of the Low Voltage switchgears, interfacing of the PLC to the switchgear and updating of obsolete control circuitry of feeders, the limited civil scope and HVAC implementation to comply with the standards applicable.
The primary concern is the risk to production and degradation of safety of the plant and personnel due to obsolescence. The risk exposure has been highlighted by the subsequent increasing failure rate of the control system and arc flash incidents on the switchgear. The objective of this project is to perform the necessary replacements to eradicate obsolescence and safety upgrades that will increase the plant safety, reliability and availability.
It is required that the upgrade project be done with minimal disruptions to current operations, and a thorough changeover strategy and procedures be put in place to facilitate the migration from the old to the new control system in the shortest possible time, the changeover is to be executed within three days per-cubicle.

This technical specification report developed by the engineering team for the purpose of providing the technical information required for the works information.

1.2 *EMPLOYER*'S OBJECTIVES AND PURPOSE OF THE *WORKS*

The purpose of the works is to upgrade the PLC, SCADA, networks, UPS and Battery Charger systems and also LV Switchgear and controlgear Assemblies at Slurry Plant. The technology upgrade and modifications must retain the Operating and Control philosophy.
At Matla Power Station the function of the Slurry Plant is to receive, mix and dispose of both Pulverised Fly Ash (PFA) and Bottom Boiler Ash (BBA) to a remote ash dam.

The PFA is conveyed pneumatically from the six (6) generating units to bulk storage silos at the Slurry Plant. Airslides then convey the PFA to the PFA mixers where it is slurried. The BBA is slurry pumped from the generating units to Hydrobins where the water is decanted. Conveyors are utilised to transfer the BBA from the Hydrobins to mixers, which also introduces the BBA to the slurry pumps' suctions.
The ash slurry is then pumped to the ash dam with three (3) pump trains, each consisting of five (5) pumps in series (Running with only 4).
The Slurry plant is controlled remotely from the Slurry plant control room. The plant is controlled through multiple (9) Siemens S5 115U and 150U PLCs and the plant status is viewed and monitored on the Citect SCADA system version 5.5. The S5 PLC's were installed at Matla Power Station in the 1980's. The OEM no longer supports the S5 technology and the spares are impossible to obtain due to the system being obsolete for number of years. Recently some of the I/O modules have become problematic causing erroneous readings

from instrumentation in the field as well as failure to control certain sections of the plant. The system reliability is in dire state and need replacements as soon as possible.

The LV switchgear and controlgear assemblies installed at Matla's Slurry plant are the Siemens 8PU 011 switchgears, the switchgear assemblies are form 3b subdivision by design. Ageing has also resulted in numerous components no longer being available and non-standard equipment having to be used when failures are experienced.

Therefore the *Contractor* replaces all switchgear functional units.

The basis for the supply of engineering deliverables is in form of documentation relevant to the different activities as stated in the Appendices below:

#	APPENDIX	DESCRIPTION
1	Appendix A	Matla Power Station Slurry Plant_VDSS
2	Appendix B	Matla Power Station Slurry _Cable Schedule
3	Appendix C	Matla Power Station Slurry Plant_ IO Block Diagrams
4	Appendix D	Matla Power Station Slurry Plant_ LOSS Diagrams
5	Appendix E	Matla Power Station Slurry Plant Project Standards
6	Appendix F	Matla Power Station Slurry _Plant Control and Operating Philosophy
7	Appendix G	Matla Power Station Safety, Health, Environment and Quality
8	Appendix H	Slurry Substation Layouts
9	Appendix I	Compliance and Deviation schedule
10	Appendix J	Technical Schedule A and B (Part 3B)
11	Appendix K	Switchgear Schedule
12	Appendix L	Technical Schedule A and B (Part 3A)

1.3 INTERPRETATION AND TERMINOLOGY

Available	It is the when a system, component or equipment is in the up state, i.e. in service, operational and able to perform as required.
Balance of Plant (BOP)	It consists of a power plant's auxiliary plant systems that are required to support the power island(s), e.g. fuel processing systems, cooling systems, water treatment, material handling, etc. The specific set of plant systems that form the balance of plant is dependent on the applicable power plant's configuration and design.

Control System	The control system consists of the Operating system, Engineering system, Process automation system, Protection Automation System, Operating & Engineering Network, network management system, User Management system and interfaces to 3rd Party systems that are specific to a particular plant
C&I Equipment Rooms	The room that are used to house the control systems
HMI	The Human-Machine interface used for operation and monitoring of the plant.
HVAC	Heating, ventilation, and air conditioning are the technology of indoor and vehicular environmental comfort. Its goal is to provide thermal comfort and acceptable indoor air quality
SCADA	SCADA is an acronym for supervisory control and data acquisition, a computer system for gathering and analysing real time data. SCADA systems are used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation.
Power Supply Cabling	All the cabling required to power the field equipment
Trunking	A rigid structure supporting a number of cables
Factory Acceptance Test (FAT)	It is an activity that demonstrates that the control system complies with its specification(s).
Functional Logic Diagrams	Logic diagrams are diagrams in the field of logic, used for representation and to carry out certain types of reasoning.
Field Equipment	Instrumentation, cold junction boxes and junction boxes
OEM	The OEM refers to the original equipment manufacturer
OPC	Open Platform Communications is a series of standards and specifications for industrial telecommunication. The OPC server is a software program that converts the hardware communication protocol used by a PLC into the OPC protocol. The OPC client software is any program that needs to connect to the hardware, such as an HMI. The OPC client uses the OPC server to get data from or send commands to the hardware.
Operator Workstation	The primary interface of the operating plant via which the HMI is accessed with the number of operating display units.
PLC	A programmable logic controller (PLC) or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, or robotic devices, or any activity that requires high reliability control and ease of programming and process.

	It is a type of control system; one that is used in the automation industry for simple and/or sequential control applications. The main elements of a PLC are the microprocessor-based controllers and input/output (I/O) cards. It is a standalone automation system usually dedicated to the control and protection of small auxiliary plant systems. It does not contain an operator or communication network within itself and is usually interfaced to other systems (e.g. a SCADA system or DCS) when remote operating capability is required.
Supplier	It is the company, agent or entity that supplies the applicable technology or product

The following abbreviations are used in this Works Information:

Abbreviation & Acronyms	**Description**
AC	Alternating Current
ATPV	Arc Thermal Performance Value
BBA	Boiler Bottom Ash
C&I	Control and Instrumentation
CM	Change Management
CoE	Centre of Excellence
CRA	Concept Release Approval
DCS	Digital Control System
DRA	Definition Release Approval
DRP	Design Review Procedure
ECM	Engineering Change Management
EDWL	Engineering Design Work Lead
ERA	Execution Release Approval
EMC	Electromagnetic Compatibility
FAT	Factory Acceptance Test
FRA	Finalisation Release Approval
HVAC	Heating, ventilation and air conditioning
JB	Junction Box
kPa	Kilo Pascals'
LPS	Low Pressure Services
MTTR	Mean-Time-To-Repair

OEM	Original Equipment Manufacturer
OPCR	Outside Plant Control Room
OPC	Open Platform Communications
PS	Power Station
PARICS	Participate, Accountable, Responsible, Inform, Consult, Sign-Off
PCM	Process Design Manual
PECM	Project Engineering Change Management
PFA	Pulverised Fly Ash
PLC	Programmable Logic Controller
PLCM	Project Life Cycle Model
PIS	Plant Information System
QCP	Quality Control Plan
RACI	Responsibility, Accountability, Consult and Inform
RAID	Redundant array of independent disks
ROC	Required Operating Capability
SANS	South African National Standards
SAT	Site Acceptance Test
SIT	Site Integration Test
SHE	Safety, Health & Environmental
SRD	Stakeholders Requirements Definition
AC	Alternating Current
DC	Direct Current
LV	Low Voltage
CT	Current transformer
VT	Voltage Transformer
SAS	Substation Automation System
IED	Intelligent Electronic Device
AFC	Approved for construction
OBL	Outside battery limits

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:

Table 1: Project Meetings

Title and purpose	Approximate time & interval	Location	Attendance by:
Risk register and compensation events	Weekly on Tuesday's and Thursday's at 08:00	*Employer's* Project Manager Office	*Employer*, *Contractor*, *Supervisor*, and Quality inspectors.
Overall contract progress and feedback	Bi-weekly via Ms Teams during the planning stage and daily when on site and work is being conducted. Site meetings are held at 08:00	*Employer's* Project Manager Office	*Employer*, *Contractor* and *Supervisor*

(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. 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. Such minutes or register 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

2.2.1 DOCUMENT VERIFICATION AND VALIDATION

The *Contractor* to verify the loop and wiring diagrams supplied by the *Employer* by doing proper plant walks and they will mark-up and produce the updated versions. The drawings will be supplied to the *Contractor* after contract award

2.2.2 DOCUMENT MANAGEMENT

(1) All documents supplied by the *Contractor* shall be subject to Eskom's approval.

(2) The language of all documentation shall be in English.

(3) The *Contractor* shall include the Eskom's drawing numbers in the drawing title block. This requirement only applies to design drawings developed by the *Contractor* and his Subcontractors.

(4) Drawing numbers will be assigned by the *Employer* as drawings are developed.

2.2.3 DOCUMENT IDENTIFICATION

(1) Eskom will submit the Vendor Document Submission Schedule (VDSS) as per Appendix A of the works info to the *Contractor*.

(2) The VDSS is revisable and changes must be discussed and agreed upon by all parties.

(3) Changes in the VDSS can be additional documentation to be submitted, changes in submission dates or corrections in documentation descriptions, document numbers, etc.

2.2.4 DOCUMENT SUBMISSION

(1) All project documents must be submitted to the delegated Eskom Representative with transmittal note according to Project / Plant Specific Technical Documents and Records Management Work Instruction 240-76992014.

(2) In order to portray a consistent image it is important that all documents used within the project follow the same standards of layout, style and formatting as described in the Work Info

(3) The *Contractor* is required to submit documents as electronic and hard copies and both copies must be delivered to the Eskom Representative with a transmittal note.

(4) In addition, the *Contractor* shall be provided with the following standards which must be adhered to:

i. Project Handover Documentation Management Procedure (240-66920003).
ii. Project Documentation Deliverable Requirement Specification (240-65459834).
iii. Technical Documentation Classification and Designation Standard (240-54179170).

2.2.4.1 SHAREPOINT TRANSMITTAL

(1) The *Contractor* shall submit all documentation to the Eskom Representative as well as the Project's Documentation Centre in the following media:

i. Electronic copies shall be submitted to Eskom Documentation Centre through SharePoint transmittal site that will be provided during contract award.
ii. Hard copies shall be submitted to the Eskom Representative accompanied by the Transmittal Note.

2.2.5 DRAWINGS FORMAT AND LAYOUT

(1) The creation, issuing and control of all Engineering Drawings will be in accordance to the latest revision of 240-86973501 Engineering drawing Standard.

(2) Drawings issued to Eskom will be a minimum of four hardcopies and electronic copies. The *Contractor* is required to submit electronic drawings in Micro Station (DGN) format, and

scanned drawings in pdf format. No drawings in TIFF, AUTOCAD or any other electronic format will be accepted.

(3) Drawings issued to Eskom may not be “Right Protected” or encrypted.

2.2.6 ENGINEERING CHANGE MANAGEMENT

(1) All design changes shall be performed in accordance to the latest revision of the Eskom Project Engineering Change Management Procedure (240-53114026) and the *Employer* shall ensure that *Contractor* is provided with latest revisions of this procedure.

(2) Any uncertainty regarding this procedure should be clarified with the *Employer*. All design reviews will be conducted according to the Design Review Procedure (240-53113685).

2.2.7 PLANT CODING

1) Eskom KKS Key Part Standard (240-109607736) shall be used to allocate codes to plant or system included in the *works*. Plant Coding shall be undertaken by the *Employer* and as such the *Contractor* shall make available the following documentation to code:

i. Electrical
   a. Single line diagrams
   b. General arrangements (GA) for the charger
   c. Cable schedules
   d. Room layout
   e. Schematic drawings
   f. Parts list

ii. C&I
   a. C&I architecture drawings
   b. C&I cubicles
   c. Cable block diagrams
   d. Cable schedules

2) The *Employer* will assign a coding technician who will interact with the *Contractor* in coding the plant.

3) It is also the responsibility of the *Contractor* to consistently apply the KKS codes throughout the rest of the technical documentation which shall include, but not limited to:

   i. Load schedules
   ii. Board parts lists
   iii. Cable block diagram
   iv. Termination diagram
   v. Alarm lists, loop diagrams
   vi. Signal lists

vii. Schematic diagrams
viii. Termination diagrams
ix. Logic diagrams, etc.

(4) The *Contractor* shall ensure that all documentation is coded (as per the codes assigned by the technician) prior submission to *Employe*r for review.

(5) Coding and labelling of components inside electrical and C&I panels shall be done by the *Contractor*.

2.2.8 PLANT LABELLING

(1) It is the responsibility of the *Contractor* to manufacture and install coded equipment's labels.

(2) Labels are manufactured and installed according to Eskom Plant Labelling Abbreviation Standard (240-109607332).

(3) The *Contractor* will label all coded equipment and labelling.

(4) The Coding technician will do a quality check on the adherence to the Coding and labelling standards before installation on plant.

2.3 HEALTH AND SAFETY RISK MANAGEMENT

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

(2) The *Contractor* shall comply with the health and safety requirements contained in Appendix G of this Works Information.

2.4 ENVIRONMENTAL CONSTRAINTS AND MANAGEMENT

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

(2) The *Contractor* shall comply with the Environmental Management Policy, signed by top management and in line with ISO 14001:2015 Standard

2.5 QUALITY ASSURANCE REQUIREMENTS

(1) The *Contractor* complies with the *Employer*'s Quality Requirements as specified in Eskom Generation Standard QM 58.

(2) All quality control documentation (QCP) is submitted to the *Project Manager* on delivery and these shall be reviewed and approved by the employer prior to acceptance.

(3) Employer's Engineer review and approve the QCP's prior to any work being carried out.

2.6 PROGRAMMING CONSTRAINTS

(1) The *Contractor* submits a programme within 1 week of the contract date.

(2) The program shall be in Microsoft Excel or Projects format (preferably 2010 version or lower)

(3) The programme indicates:

i. The hour duration of each activity
ii. The working calendar (number of hours per day, days per week)
iii. The exact quantity of people per day.

2.7 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;
vii. Add procedures for invoice submission and payment (e.g. electronic payment instructions)

2.8 INSURANCE PROVIDED BY THE *EMPLOYER*

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 *Contrac*tor by the *Project Manager* to receive and accept such bond or guarantee.

(3) 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 TRAINING WORKSHOPS AND TECHNOLOGY TRANSFER

2.12.1 GENERAL REQUIREMENTS

(1) The *Contractor* provides training on the equipment and systems included as part of the *works* to the various categories of the *Employer's* technical staff for the duration of the *works*.

(2) All training provided by the *Contractor* is customised for Matla Power Station and is directly applicable to the actual equipment hardware and software supplied for the *works*.

(3) Training is focused on the specific Matla Power Station Slurry Plant Control Systems' architecture, configuration, layout, equipment, software, hardware, and design that the *Contractor* provides for the *works*.

(4) Generalised training based on the *Contractor's* generic control system architecture, HMI and design philosophies is not acceptable.

(5) Training material and tools are not shared by trainees during the training.

(6) The training is provided as per the detailed training programme and prospectus accepted by the *Project Manager*.

(7) Maintenance staff are trained and authorised to perform certain maintenance activities such as replacement of defective components and general servicing during outages.

2.12.2 TRAINING CATEGORIES

(1) Practical hands-on training for each individual trainee forms an integral part of each of the courses in these categories:

i. Training of Maintenance staff.
ii. Training of Operators.
iii. Training of engineering staff.

(2) The elements of the training are described in the subsections below.

2.12.3 TRAINING OF ENGINEERING AND MAINTENANCE STAFF

(1) Engineering and Maintenance training includes, as a minimum:

i. Familiarisation with the documentation forming part of the *works*, including drawing configuration logic.
ii. Hardware familiarisation.
iii. Hardware configuration which includes the processing modules, communication modules, I/O modules, power supply monitoring modules, network modules and all other peripheral equipment supplied as part of the *works*.

iv. Hardware installation
v. Development, debugging and testing of all software.
vi. Software configuration and low-level programming.
vii. Graphic display design, development and configuration.
viii. System Configuration and Documentation Control, including all necessary activities for system expansion/modification, and software storage.
ix. Control System software reloading.
x. Graphic display configuration.
xi. Drawing and hardcopy report generation.
xii. Operator interface familiarisation including keyboard and display functions, controls, alarms and messages.
xiii. System hardware maintenance through use and interpretation of diagnostic routines and error codes of on-line and off-line diagnostic software for the detection of faulty modules.
xiv. Module problem report retrieval.
xv. Control System hardware maintenance training including the programmable logic controllers, I/O modules, network modules and all other peripheral equipment supplied as part of the *works*.

2.12.4 TRAINING OF OPERATORS

(1) Operator training includes, as a minimum:

i. Familiarisation with the documentation provided as part of the *works*, including drawing configuration logic.
ii. Graphic display, design and configuration.
iii. Operator interface familiarisation including keyboard and display functions, plant control, plant monitoring, navigation, alarms, messages, creation and use of operator configurable displays and operator assignable trends as well as retrieval and printing of plant logs.
iv. Process control and operating philosophies.

2.12.4.1 TRAINEE PARTICIPANTS

(1) The total number of participants to be trained is as follows:

i. Engineering : 12
ii. Operator : 12
iii. Maintenance : 10 (or More)

(2) The *Employer* bears the cost of salaries, accommodation, travelling expenses and other allowances of his personnel during the training, but all other training costs are borne by the *Contractor*.

(3) There shall be a minimum a minimum of two training sessions for each of the disciplines identified (e.g. engineering, operating and maintenance)

2.12.4.2 TRAINING DOCUMENTATION

(1) The *Contractor* provides all course material including manuals.

(2) The course material is in English and includes all third party documentation.

(3) Printed and soft copies of the training documentation are supplied for each trainee plus an additional 1 hardcopy master set and 1 soft copy.

(4) All training documentation provided by the *Contractor* is customised for Matla Power Station.

(5) The training documentation contains the specific Slurry Plant control System (PLC and SCADA) configuration, layout, software, equipment, and design provided by the *Contractor* as part of the *works*.

(6) Training manuals are continuously updated by the *Contractor* up to the date of issue of the Defects Certificate for the whole of the *works*.

3 ENGINEERING AND THE *CONTRACTOR*'S DESIGN

3.1 *EMPLOYER*'S DESIGN

This system monitors and controls the various ash and water flows to ensure that optimum use is made of the available water and effluent for transporting ash to the dam.

The Slurry plant is controlled remotely from the Slurry plant control room. The plant is controlled through multiple Siemens S5 115U and 150U PLCs all located in one equipment room, and the plant status is viewed and monitored on the Citect SCADA system version 5.5. In addition to control operations the control system protects the various parts of the system, by initiating alarms or operational signals, to advise the operator of malfunctions. In some instances, where equipment damage is likely, the controllers can shut the plant down automatically in the event of a failure.

The plant is designed to operate continuously and has duplicate and/or standby equipment that may be brought on-stream as the demand requires it.

The incoming BBA and PFA from the station are stored in Hydrobins and Silos respectively. The Hydrobin system is utilised to separate the BBA from the water that was used to quench and transport the BBA from the bottom of the boilers. Once the water has been decanted the BBA may be handled, using conveyor belts. The PFA is in the form of a fine powder and is transported pneumatically or by using air slides. In order to transport the two ash streams to the ash dam they are slurried with Ash Water Return (AWR) in a mixer system and pumped, via a set of pumps along a pipeline to the dam.

The slurry pump set comprises one variable speed and four-fixed speed slurry pump. High-pressure gland sealing water pumps are used to provide sealing water to the pump set; protecting the pump seals against the abrasive effect of the ash. Each system comprises three identical "trains". Each train consists of a silo, air slide, hydro bin, conveyor belts, mixer and slurry pump set (five pumps). These different components are inter-selectable between the three different systems to provide flexibility in terms of PFA and BBA routes e.g. Silo three (3) can be selected together with air slide two and Hydro bin 14 and mixer 1.

The Slurry Plant control system consists of the following: Nine (9) S5 PLC's (EYD 01, 10, 11, 20, 21, 22, 23 24 and 25) and Citect SCADA System (version 5.5). The SCADA system comprises of 2 redundant servers (with historian functions) 2 monitors and 2 redundant workstation PC's with 2 monitors for each workstation.

3.2 SYSTEM IDENTIFICATION (AS BUILT)

Slurry Plant automated by Siemens Simatic S5-115U PLC consists of the following:

Table 2: PLC CUBICLE I/O COUNT

EYD01 Cubicle	**EYD 10 CUBICLE: (BULK SILOS)**	**EYD 11 CUBICLE: (COMPRESSOR PLANT)**
115U CPU 944 3 x (32bit x 24VDC Digital Input) 6 x (16bit x 24VDC) Relay Output 4 x (8 Channels) Analog Input 3 x (8 Analog Output)	2 x 115U CPU 943 4 x (32bit x 24VDC 0.5A) Digital Output 6 x (32bit x 24VDC 0.5 A) Digital Input 2 x Communication processor 2 x Interface module 2 x 24V Power Supply	1 x115U CPU 943 1 x Comms module 1 x interface module 8 x (32 bit x 24VDC) Digital input 1 x (8 channels) Analog input 7 x (32 bit x 24VDC) Digital output 1 x 24V Power Supply
EYD 20 CUBICLE: (SUPERVISORY PLC)	**EYD 21 CUBICLE: (SLURRY PLANT PLC)**	**EYD 22 CUBICLE: (SLURRY PLANT PLC)**
CPU (2 x 924, 2 x 925, 2 x 926 and 2 x 927) 2 x Jumpering Module 4 x Memory Module 5 x Interface module 2 x Digital Output 2 x Communication processor	12 x Digital Input 6 x Digital Output 3 x Power Supply 3 x Interface module 4 x CPU (924, 925, 926 and 927) 1 x memory module 1 x Comms module	3 x Analog input 8 x Digital Input 6 x Digital Output 3 x Power Supply 3 x Interface module 4 x CPU (924, 925, 926 and 927) 1 x Memory module 1 x Comms module 1 x Jumpering module

EYD 23 CUBICLE: (SLURRY PLANT PLC)	EYD 24 CUBICLE : (SLURRY PLANT PLC)	EYD 25 CUBICLE : (SLURRY PLANT PLC)
3 x Analog Input	18 x Digital Input	15 x Digital Input
8 x Digital Input	15 x Digital Output	14 x Digital Output
6 x Digital Output	3 x Power Supply	3 x Power Supply
3 x Power Supply	4 x Interface module	4 x Interface module
3 x Interface module	4 x CPU (924, 925, 926 and 927)	4 x CPU (924, 925, 926 and 927)
4 x CPU (924, 925, 926 and 927)	2 x Memory module	2 x Memory module
1 x memory module	1 x Comms module	1 x Comms module
1 x Comms module		

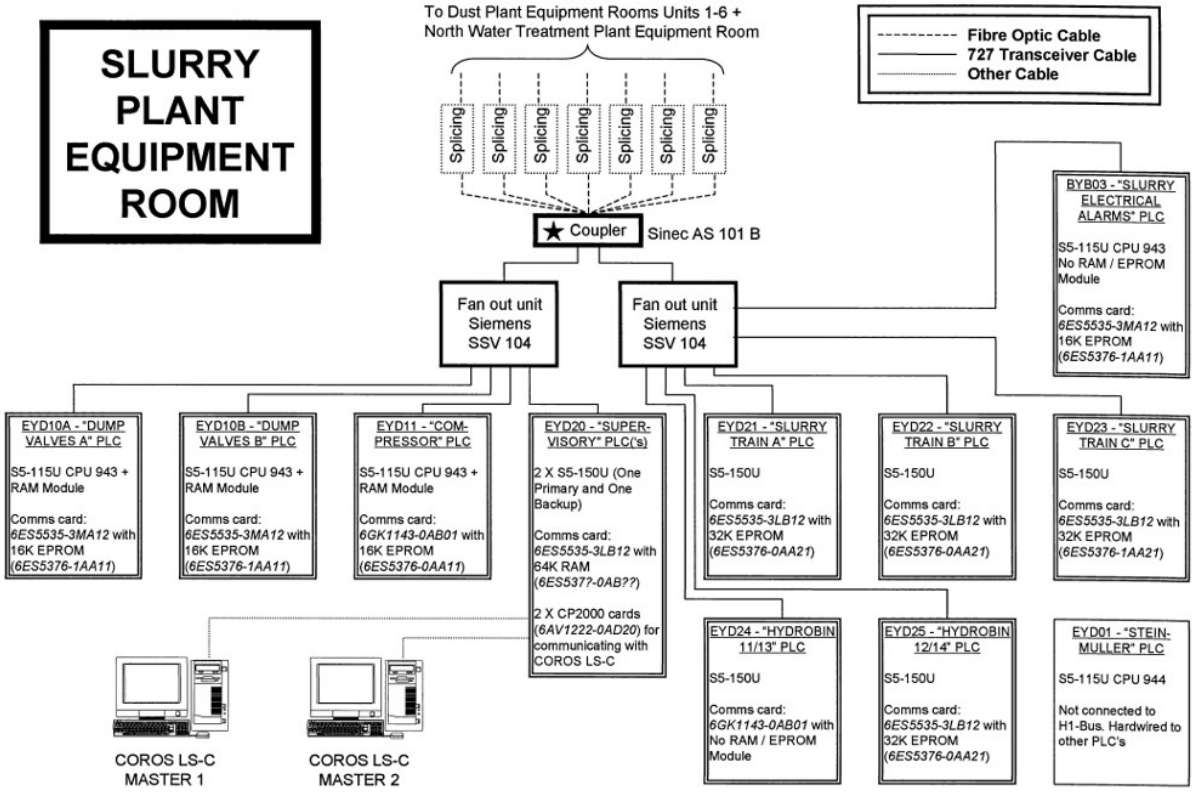

Figure 1: Existing Slurry Plant Network Layout

3.2.1 SWITCHGEAR, PROTECTION AND RETICULATION

Figure 2 shows the slurry plant electrical reticulation layout, as may be seen the 400V Ash plant boards feed from the 11kV Ash plant boards via a 1.6MVA 11kV/400V transformer (Dyn11) and the 11kV boards fed from station boards 1 and 2. The plant reticulation is designed to allow for either of the boards to also run from the bus section breaker as shown in figure 2 below. The load transfer from A and B boards are performed via a dead bus transfer which is manually operated.

The auxiliary control voltage on the switchgear boards shall be maintained with a Dip Proof Inverter which shall be maintained by the *Employer*.

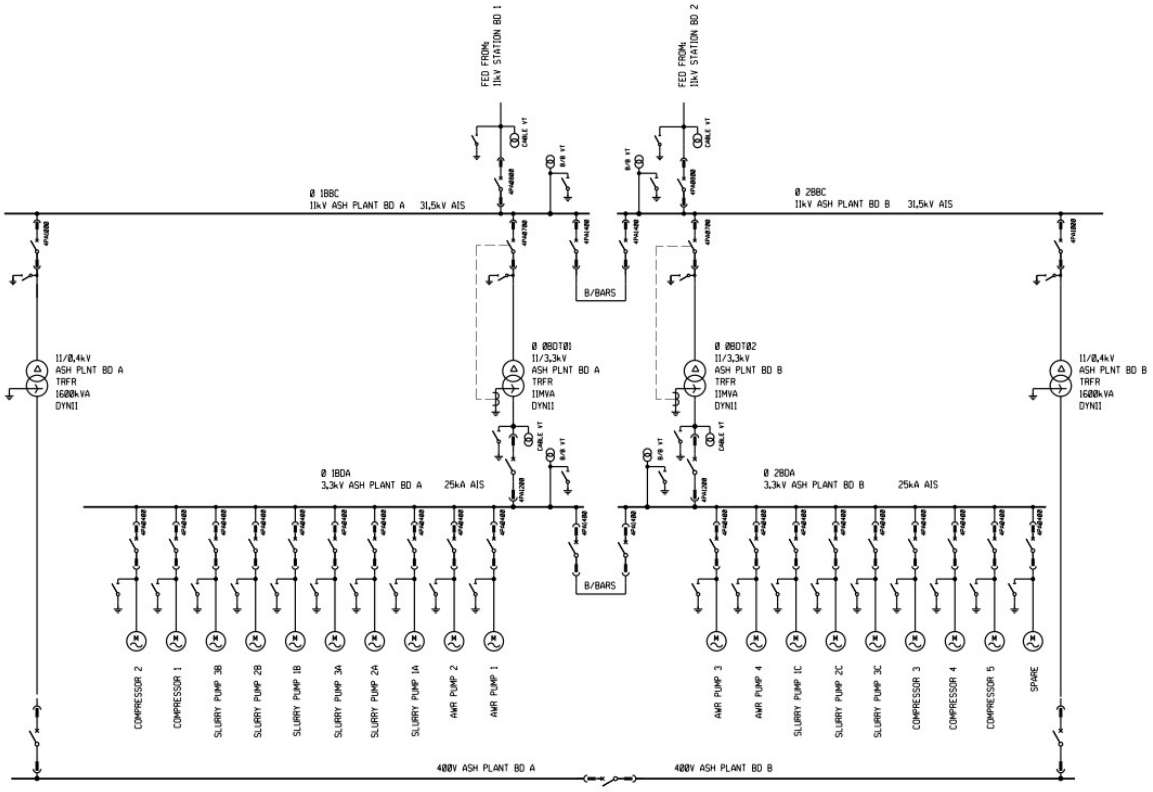

Figure 2: Slurry plant electrical reticulation layout.

The circuit breakers currently installed are the Siemens 3WN (fixed mount) circuit breakers and these are compliant with IEC 60947; it is proposed that these circuit breakers be replaced with Siemens 3WL breakers. Table 3 shows a high level comparison between the 3WN and 3WL circuit breakers proposed.

Table 3: LV ACB parameter comparison

Parameter	3WN1771-1WA88 circuit breaker	3WL circuit breaker
U_E	660V/ 690V	690/1000
I_{CN}	80kA	66kA
$I_{CW(1s)}$	80kA	55kA
I_N	3150A	3200
Size	III	Must match existing
Poles	3	3
Type	Withdrawable	Withdrawable
Breaking Medium	Air	Air

Since the panels were built to match the existing panels any new circuit-breaker installed will require the *Contractor* to perform pre-measurements in order to plan for all of the upfront modifications which may be required for fitting the circuit-breakers.

Figure 3 shows the electrical protection is scheme employed on the A and B board incomers, an assessment of the protection scheme and assessment of the protection setttings shows the scheme uses the following elements on a CAG 39 phase 1 relay:

1. Phase over current,
2. Earth fault protection.
3. DC fail protection alarm

It must be noted that this protection relay does trip the LV circuit breaker has a cross thrip to the 11kV feeder breaker this was implemented due to the high LV network fault levels and historicically low tripping reliability of LV circuit breakers.

Since the protection scheme is not compliant with with 240-56357424/240-143485806, the following modifications are proposed on the protection system:

1. Replacement of the CAG 39 and MCCG over current and earth protection relays with a modern SIPROTEC protection relay (7SJ) which are currently used on the refurbished units, this will assist with standardization, all components and relays shall be approved for use on Eskom generation plant 240-56227589.
2. The protection scheme shall use IEC 61850 to allow for automated load transfer. The load transfers shall be dead load transfer and this scheme shall be compliant with 240-56361454.
3. The load transfer shall be implemented via the protection relays from Ash plant board A to B and vice-versa,

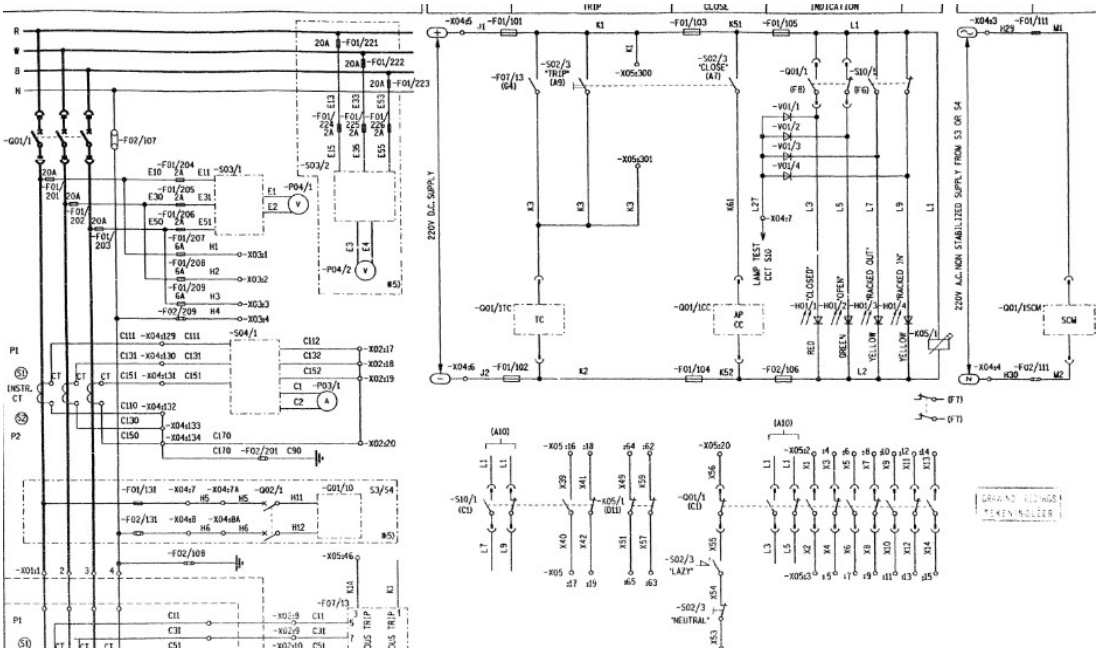

Figure 3: A and B board incomer electrical protection scheme.

The CT and VT will not be replaced as these are well suited to the existing switchgear based on the existing load flow and fault level studies.

The 220VDC for the switchgear control and tripping circuits currently feeds from the existing charger panels where the 220VDC is generated and this is distributed to all of the switchgear boards. The 220VDC chargers which were installed as part of the refurbishment shall be utilised to feed the switchgear tripping and control circuits. With the removal of the charger panels each of the individual panels shall have a dedicated feeder from the new 220VDC chargers.

Matla power station electrical and C&I refurbishment project will not be performing any work on these LV boards, future Slurry plant projects (Slurry plant upgrade and Slurry plant refurbishment project) were assessed to determined future load growth requirements and no significant changes noted.

The *Employer* will provide the following documentation/drawings:

i. Existing and Proposed Substation Layouts (e.g. UPS placement within the substation)
ii. Updated Single Line Drawings
iii. Updated Switchgear Schedules
iv. Protection and Functional Block diagrams
v. Relevant Eskom Specifications and Drawings
vi. Existing and proposed I/O Functional Block Diagrams

All *Employer* information and property made available to the *Contractor*, including the works done by the *Contractor* for the *Employer*, is confidential and may not be disclosed to others.

3.3 PARTS OF THE WORKS WHICH THE CONTRACTOR IS TO DESIGN

1) The *Contractor* engineers and designs a complete Control System based on the existing control philosophy and any changes, which may be required for Matla Slurry Plant as per the scope and requirements, identified in the sections below, according to OEM and industry best practices.
2) The field equipment remains the same i.e. (Instruments / actuators, Primary device / tapping point / impulse piping, Field cable, Junction box, Trunk cable & main cable racks etc.).
3) The *Contractor* undertakes all activities of engineering and design from system engineering through technical clarification, design freeze, production engineering, factory acceptance tests (FAT) and site integration testing (SIT) to installation and change over from the existing control and monitoring system to the new control and monitoring system (decommissioning and recommissioning). A maximum allowable down time of three days per-cubicle is allowed for the decommissioning and recommissioning activities.
4) As a minimum, the design addresses the following common scope in each substation/equipment room.
    i. Use the currently installed Cabinets that are on the adjacent existing PLC room at Slurry Plant
        - The *Contractor* to supply and install module racks and slots
        - The *Contractor* is responsible for marshalling and terminations
        - The *Contractor* is responsible for all Earthing connections

ii. Signals communicating via the network switches must be retained and must not be affected by the upgrade (i.e. Ash pumps, K-pumps, compressors)

iii. Replace all network switches

a. Requirements for retrofitting of LV Switchgear and controlgear assemblies's outgoing functional units (feeders):

- All circuits shall be made at the *Contractor's* factory to reduce execution time.
- Expected execution time for the modification is 8 hours i.e. the board shall be down for a period of about 8 hours for all changes to occur.
- Cables located in the fault free zone (unprotected live conductors) shall be brazed and phase segregated Cables in the fault free zone (Unprotected live conductors) shall be replaced with double insulated cables.
- Wiring terminals at the back of panel shall be IPXXB in accordance with SANS 60529.
- Arc flash barrier to be installed for incomer circuits on the supply (line) side of the SCPD.
- For feeder functional units, the arc flash barrier shall be on the supply (line) side of the SCPD.
- All functional units with plastic door hinges must be replaced with metal hinges.
- Panel door earth wire must be re-installed if not available.
- *Contractor to* provide a component list per functional unit and type of all components used for retrofitting.
- Standardisation must be accomplished by ensuring that circuits of the same power rating (for motor starters) have identical components up to breaker level.
- Circuits shall be designed as per minimum requirements below.
- All interlocks and interfaces on functional units must be reinstated.
- The *Employer* shall provide standard schematic circuits as a guide for the *Contractor.*
- Feeder circuits;
    i. All feeder circuit shall have MCCB as the SCPD (Short Circuit Current Protection Device) whose current rating shall be specified on the load schedule.
    ii. The shaft of the SCPD shall protrude to the outside of the functional unit door to allow for closed door operation.
    iii. Fixed functional unit doors with plastic hinges must be replaced with metal hinges.
    iv. Indicator lights and local control start and stop push buttons shall be located outside on the functional unit door.
    v. Current and voltage indications if required shall also be located on the outside of the functional unit door.
- Motor circuits;
    i. Motor starters shall incorporate isolation and switching facilities, overload and short-circuit protection, test and remote controls and indication as shown on the typical standard schematic diagrams to be provided by the Employer.
    ii. Protection coordination shall be type 2 coordination and evidence shall be provided to the EMPLOYER.

iii. All held-in contactors' coils including interposing relay contactors (ITP) coils shall be rated for 230V AC.
iv. Each motor functional unit shall have a running and stop indication in front of the functional unit.
v. A selector switch shall be provided to offer a selection between local and remote operation. This selector switch shall be installed in the functional unit.
vi. All functional units shall have X07 interface block for remote signal termination
vii. The shaft of the SCPD shall protrude to the outside of the circuit door to allow for closed door operation

- Essential supply devices
  i. All boards with motor circuits shall have DPI (Dip Proof Inverters) for transient undervoltage withstand.
  ii. . The DPI shall be installed at the supply point of the control voltage
  iii. . All switchgear with IEDs on the incomers shall have battery charger system rated for 220V to supply the IEDS, spring rewind, close and open coils of incomer or bus section circuit-breakers.

b. Replacement of the incomer and bus section circuit-breakers with none obsolete circuit-breakers Siemens 3WL circuit-breakers of the appropriate specifications;
   - The IEDs of the LV switchgear must be the same or have means to communicate (IEC 61850) with those IEDs used on the Station's MV switchgear to enable ease of integration to the existing network and facilitate standardisation.
   - The IEDs for the incomer circuits shall also be able of controlling the bus section circuit-breaker.
c. Protection and control schemes in accordance with the protection functional and interface block diagrams (Referenced Documents) and 240-56357424
d. Interlocking system in accordance with 240-56357424, 240-56227516 and applicable

5) The *Contractor* is responsible for verifying and identifying all scope requirements for the plant systems, as part of the *Contractor*'s engineering and design effort in order to meet the functional and performance requirements of the works.
6) The *Contracto*r is responsible for the design of the following as a minimum:

e. Switchgear functional units (feeders) in accordance with:
   i. 240-56227516 and SANS 61439
   ii. Technical Schedule A and B
   iii. Switchgear Schedules
f. Layout of the functional units and panel controls
g. Replacement of the incomer and bus section breakers with none obsolete breakers Siemens 3WL breakers of the appropriate specifications
h. Protection and control schemes in accordance with the protection functional and interface block diagrams (Referenced Documents) and 240-56357424

i. Interlocking system in accordance with 240-56357424, 240-56227516 and applicable

7) Other requirements of the *Contractor's* design;
   i. The Contractor shall use the information provided by the Employer in the form of load schedule and essential power supply size documents to specify the required Battery chargers for switchgear assembly. The Contractor must provide the specific battery charger ratings that will be suitable for the switchgear assembly circuits and IEDs.
   ii. Furthermore during the detail design phase the Contractor shall verify the load schedules with current plant, should there be no load schedule available or if the load schedules are missing some information, then the Contractor shall be responsible for compilation and/ or amendment of load schedules and then the Employer shall review.
   iii. The switchgear specific designs including all the protection requirements are to be incorporated into the final design of the schematic diagrams. All existing plant interfaces are to be considered and verified during the design.
   iv. The Contractor provides the Engineering Design System (EDS) to illustrate the engineering methodology that will be used to ensure conformance with the Employer's design requirements.

The Contractor shall provide an estimation of the amount of heat dissipated by the offered components.

3.4 PROCEDURE FOR SUBMISSION AND ACCEPTANCE OF CONTRACTOR'S DESIGN

3.4.1 DESIGN REVIEW PROCEDURE

The *Contractor* is the Design Authority as defined in the Design Review Procedure 240-75005287. The *Contractor* is responsible for executing the design and all associated works in the design procedure and conduct all the design reviews as specified in this procedure. The *Contractor* and the *Employer* are both responsible for conducting the following design reviews:

a. Design Freeze Review
b. Integrated Design Review
c. Construction Completion Review
d. Acceptance Testing Review

3.4.2 ENGINEERING CHANGE PROCEDURE

The *Contractor* takes note of the *Employer's* Engineering Change Procedure 240-53114002. An engineering change includes any proposed change originating from engineering, *Contractors*, project management or construction management.

The Engineering Change Procedure applies to the *Employer*'s personnel or *Contractor's* performing engineering or engineering related work where the quality of the engineering work performed is the direct responsibility of Eskom.

3.4.3 PROCESS FOR SUBMISSION OF DOCUMENTS

The *Contractor* submits all documents according to the accepted VDSS. The process for the submission of documents is described below:

a. The *Contractor* submits the documents/drawings to the Project Manager.
b. The *Employer's* Document Controller registers the documents.
c. The *Employer's* Document Controller will supply the documents/drawings to all relevant parties within the Employer's project team.
d. The *Employer*'s project team reviews the documents/drawings and will submit all comments or inputs to the Project Manager and the Project Manager submits to the *Contractor* for consideration.
e. If the *Employer* finds major deficiencies in the submitted documents/drawings, the *Contractor* revises the documents/drawings and resubmits to the Project Manager.
f. The *Employer* reviews the documents/drawings and if no major deficiencies are found, the *Contractor* organises a Design Review session to which employer shall be invited for review
g. The *Employer* and the *Contractor* conduct a Design Review.
h. If any fundamental errors were found in the designs or further actions are required, the *Contractor* record all concerns raised and revises the designs for resubmission to the *Employer* via the project manager.
i. The *Contractor* organises a Design Review session once all designs were revised according to the concerns raised by the *Employer*.
j. If no fundamental errors were found in the designs during the Design Review session, the *Contractor* compiles the Design Review minutes or report and submits it to the Project Manager.
k. The *Employer's* Document Controller registers the report.
l. The *Employer's* project team reviews the *Contractor's* report/minutes. If the report/minutes are not acceptable, the *Contractor* revises the report/minutes and resubmits to the Project Manager.
m. The Project Manager will accept the *Contractor's* design once the report/minutes are accepted by the *Employer's* project team.

3.4.4 TIME REQUIRED FOR ACCEPTANCE OF DESIGNS

Not later than one month after receipt, the Project Manager will return one copy of the drawing marked "Accepted"; "Accepted as Noted" or "Not Accepted", as may be appropriate. The notations "Accepted" and "Accepted as Noted" authorize the *Contractor* to proceed with the manufacture of the Plant covered by such drawings subject to the corrections, if any, indicated thereon. Where prints or drawings have been "Not Accepted" or "Accepted as Noted" the *Contractor* makes the necessary revisions on the drawings and submit further copies for acceptance in the same procedure as for the original submission of drawings. Every revision shows by number, date and subject in the revision block on the drawing.

3.5 OTHER REQUIREMENTS OF THE CONTRACTOR'S DESIGN

3.5.1 SYSTEM INTERFACE

The *Contractor* is responsible for all system interfaces which forms part of the Works. The *Employer* will provide the relevant information defining the system interfaces. The *Contractor* caters for all the identified interfaces and shall provide for any additional 15% capacity terminal interfaces.

3.5.2 EQUIPMENT LAYOUT

All panels are installed at least 800mm from the wall where possible and consideration shall be given to reuse existing panels. The *Contractor* shall ensure that all proposed equipment layout is approved by the employer prior to installation, the location of the UPS shall be close to the existing Siemens B40 8kVA UPS

The *Employer* will provide the existing and proposed substation layouts. The substation layouts can be seen in Appendix H. The *Contractor* is responsible for the as built substation layouts after the Plant is installed.

The *Contractor* is responsible for the final positioning of the Plant. The *Contractor* assesses any possible clashes with the existing structures and equipment in the substations. *The Contractor* notifies the Project Manager of any possible clashes before the Plant is delivered to site after detailed plant assessments are completed and approved in consultation with the *Employer.*

3.5.3 CURRENT TRANSFORMERS AND PROTECTRION RELAYS FOR MOTORS ABOVE 30KW AND CRITICAL MOTORS

The *Contractor* shall ensure that all motors which are above 30kW or larger and critical/ essential motors shall be fitted with approved current transformers which are compliant with 240-56357424. The protection circuits shall be in line with 240-56357424 and all protection relays used shall be 240-56227589 approved.
The *Contractor* specifies and supplies all the required neutral star side current transformers in accordance with 240-56357424.

3.6 DESIGN OF EQUIPMENT

3.6.1 GENERAL

The *Contractor* shall provide detailed schematic drawings including all of the component schedules for the proposed circuits along with relevant technical equipment type tests. The *Contractor* completes Technical Schedule A and B in Appendix 2 of Part 3A to provide guarantees on the offered Plant concerned.

The *Contractor* designs protection schemes that comply with 240-56357424 and 240-56227589 and Part 3B of this Works Information. The *Contractor* completes Technical Schedule A and B in Appendix Jof Part 3B to provide guarantees on the offered Plant.

3.6.2 RATING AND OPERATING CONDITIONS

a. The *Contractor* shall estimate the functional unit heating performance based on feeder circuit wattage losses and provide these to the employer. Consideration and or recommendations must be provided to ensure compliance with 240-56227516 as far as possible.
b. Ratings for switching devices are in accordance with 240-56227516.
c. Switchgear operating and service conditions are also stipulated in 240-56227516.

3.6.3 PANEL DESIGN AND CONSTRUCTION

The *Contractor* shall not be allowed to alter or modify the main switchgear busbar, new holes may be drilled to for all new terminations as required, where possible reuse of existing terminals would be preferred in order to minimize conductor loss. All work shall be in line with the requirement of 240-56227516. If is required that all functional units with exposed copper busbars or access to

3.6.4 CIRCUIT BREAKERS

Circuit breakerscircuit-breakers are provided as per Switchgear Schedules in Appendix of 240-56227516.

3.6.5 EARTHING DEVICES

The switchgear design includes busbar and cable earthing devices as an integral part of the associated functional unit as per Switchgear Schedules in Appendix K. The earthing devices are as per GGSS1201.

3.6.7 ACCESSORIES

Each functional unit is equipped with accessories to meet the design requirements and the accessories comply with 240-56227516.

3.6.8 DESIGN ACCEPTANCE AND TYPE TESTING

3.6.9 TYPE TESTING

The type tests and special tests are carried out on all types of functional units in accordance with 240-56227516, applicable sections of SANS 556-1 and

The *Contractor* provides the relevant certificates and test reports to prove the compliance with 240-56227516. The minimum requirements for applicable type tests applicable on LV Switchgear functional units shall be agreed upon between the employer and *Contractor* as per 240-56227516 . The *Contractor* shall be required to complete all applicable sections of 240-56227516

The Employer will accept the type testing before the *Contractor* starts with the manufacturing of the first functional unit replacement.

3.6.10 ROUTINE TESTS

Routine tests are done by the accredited test authority in accordance to 240-56227516. The performance of the functional units as well as the associated protection schemes is proven to comply with the technical requirements stipulated in this Works Information.

Two soft and hard copies of the final routine test reports for each functional unit of the Plant are provided by the *Contractor* not later than the delivery date of the Plant.

3.6.11 COMPONENTS ACCEPTANCE

All active components of the Plant that do not form part of the OEM's original design are subject to approval by the Employer. The component complies with the relevant requirements of this Works Information as a minimum.
Where required, the *Contractor* provides calculations to prove the component application, design and compliance to the requirements. The relevant schematic drawings are used for the acceptance of component application. Should the requirements not meet the component application design requirement, the additional cost is borne by the *Contractor.*

The *Contractor* provides original copies of the technical documentation of each component in a file complete with contents list as well as all calculations or justification per component. *The Contractor* submits two copies of files labelled Components Acceptance Application in this regard.

3.6.12 DETAIL DESIGN FREEZE

After Contract Award, the *Contractor* performs Detail Design in accordance to Employer's requirements presented by Typical Schematic Diagrams. The designs are agreed with the Employer to achieve Design Freeze status.
The *Contractor* submits the following data in neat hardcopies and softcopy files for acceptance by the Project Manager before the Design Freeze status can be declared as a minimum:

a. Technical Schedules A and B
b. Compliance Schedules
c. Engineering Change Register
d. Single Line Diagrams for Switchboards
e. General Arrangement Drawings
f. Substation Layouts
g. Switchgear Schedules
h. Protection Functional and Interface Block Diagrams
i. Schematic Diagrams for Protection and Control Systems
j. Component Schedules
k. Technical Manuals

l. Accepted Prototype for the functional unit.

The Employer will accept the following set of drawings, per board, before any manufacturing can take place:

a. General arrangement drawings for each switchboard;
b. Switchgear schedule for each board with reference to component schedule;
c. Schematic diagrams for each circuit (this must include all the wire numbers, termination numbers, termination strip numbers, fuse sizes and spare contacts);
d. Component schedule for each circuit on the ASSEMBLY;

3.6.13 DESIGN PROTOTYPE ACCEPTANCE

The *Contractor* designs, manufactures and tests one complete functional unit feeder as per Switchgear Schedule if the non OEM parts shall be used in order to demonstrate type 2 coordination and detailed test reports shall be provided after Contract Award. The prototype switchboard complies fully with this Works Information.

The prototype switchboard is designed and manufactured within six months of Contract Award.

The following data must be submitted before any manufacturing on the prototype switchboard can start:

a. List of components used on the prototype switchboard.
b. Technical Manuals.
c. Type Test Certificate of all active components. If evidence is available of type tests already made on similar component, this may, subject to the Project Manager's approval, be acceptable in lieu of the relevant tests.
d. Type Test Certificates and Reports
e. General Arrangement of the prototype functional units.
f. Schematic Diagrams of the prototype functional units..
g. Buswiring Diagrams of the prototype functional units..
h. Protection and Control Logic Diagrams of functional units if applicable
i. Component Schedule for each circuit used on prototype switchboard.

After the completion of the manufacturing of the prototype switchboard, they are tested in accordance with the required routine tests specified in 240-56227516. The test requirements are agreed between the Employer and the *Contractor*. All tests and results are documented and signed by the Project Manager and the *Contractor.*

A technical manual for each design prototype switchboard is required after the completion of the tests. The manual contains the information on the functional unit as listed above, the test reports as well as photos of the

construction, layout and wiring of the switchboard. This information is used as a reference for further manufacturing.

3.6.13 MANUFACTURING RELEASE

The prototype switchboard is tested or type-test certified, and accepted by the Project Manager before the manufacturing process of the functional unit retrofits can start.

The Employer accepts the set of drawings, per board for all functional units, as per all requirements of 240-56227516

3.6.14 SWITCHGEAR ROOMS

The following general requirements apply with regards to switchgear rooms:

a. The design layout indicating the recommended height, position with respect to switchgear location and size of the venting ducts is provided to the Employer for review.
b. The IP rating of the vents is IP41 in accordance with IEC 60529.
c. The cable entry openings do not jeopardise the integrity of the substation floor. The *Contractor* provides the details of the weight and dimensions of the switchboards offered to the Employer for review (which includes the centre of gravity).
d. Cable entry and arc ducting requirements is checked against the structural design of the rooms to avoid clashes with other structures.
e. The repositioning of lights inside the substations is performed by others. The lights are repositioned to suit the switchgear internal arc venting on the top of the switchgear. No light fittings are allowed within the pressure relief zone of the switchgear.
f. The *Contractor* provides an estimation of the amount of heat dissipated by each switchboard with the tender as per Appendix J of Part 3A. The HVAC system is provided by others.
g. The room floor plan drawings are provided as part of the Works under Referenced Drawings. The *Contractor* provides the Plant layout designs for acceptance by the Project Manager.
h. The *Contractor* liaises with others to confirm the final position of power and control cable entries, subject to acceptance by the Employer.

3.6.15 SPECIAL DESIGN REQUIREMENTS INTERPOSING RELAYS

The *Contractor* is responsible for supplying interposing relays at the correct voltage levels for the PLC. The 24V DC interposing relay will be used to control the breaker from the PLC. The requirement of the interposing relays is indicated on the Switchgear 240-56227516 and 240-56227589

3.6.16 PLANT INTERFACES

The *Contractor* is responsible for providing sufficient spare contacts as per the Technical Schedule A and B Appendix J in 240-56227516. These contacts would be used to trip the circuit breaker from pressure switches etc. as per the existing designs at the Power Station.

3.6.17 HVAC

The *Contractor* is to design, supply and install a packaged split for the removal of heat from the switchgear room . The *Contractor* is to estimate the heat produced ,based on the equipment installed and size the HVAC accordingly.

The HVAC is to be designed in line with the **240-70164623 Design Guideline for HVAC in the Eskom Coal Fired Power Stations**

HVAC requirements

- The HVAC system is to remove the heat generated in the MV LV switchgear room , Equipment room and the battery and charger room
- All the room will be positively pressurised to prevent dust ingress, the temperature will be maintained at 22^0C +- 2^0C unless otherwise required by the equipment manufactures.
- Fire dampers will be installed in the ducting to contain fire to an individual area.
- The roof will be insulated to reduce the heat load that has to be removed.
- 100% Redundancy

Site information
Heat transfer coefficients

- Roof that is being insulated at U value of 0.69 W/m^2 ºC
- Wall load heat transfer coefficient (U value) is 2.07 W/m^2 ºC

Site conditions

- Summer: 35ºC
- Winter: -5ºC
- Altitude: 1620m

Rooms Sizes (LxBxH)

- Equipment room: 5mx5mx3m (drawing 0.47/45200)
- MV LV Switchgear room: 25mx9mx3m (drawing 0.47/45200)
- Battery room: 6mx3mx3m

Heat loads
The estimates given below is for tender purposes only.

Equipment room: The heat load generated by the equipment is equal to the equipment rating i.e. a 100w card produces 100w of heat. The UPS is sized to power all the equipment within the room therefore the heat load is from the equipment is taken as the size of the UPS.

MV LV switchgear: 1000w heat is produce from a MV panel and 800w is produced from a LV panel. These figures were taken from the new switchgear installed in the units

UPS: It was assumed the heat produced by a 8KVA would be in proportion to the heat produced by a 15KVA UPS. The heat generated by a 15KVA UPS was available and it was assumed the 8KVA UPS would generate 8/15 of this heat.

Battery room: It is a assumed that the heat produced within the battery room is the same as the heat produced by the UPS

Load from walls and roof : the roof and walls exposed to the external environment are used calculate the heat load from the environment, the heat load transferred to the room through the internal wall is assumed to be negligible

Solar heat load: the solar heat load is assumed to be negligible and is not used in the estimate
Lighting: 90% of the power is generated as heat and dissipated to the room

MV LV room heat load

Switch gear:	59.89kW
UPS:	2.72kW
Walls and roof:	6.9kW
Lighting:	1.38kW
Total + 10% Safety:	74.98kW

Equipment room:

PLC cards:	8kW
Walls and roof:	0.63kW
Lighting:	0.23kW
Total + 10% Safety:	9.74kW

Battery and charger room

UPS	2.72kW
Walls and roof:	0.55kW
Lighting:	0.23kW
Total + 10% Safety:	3.35kW

Total Heat load +10% = 88.08kW

Proposed DX Packaged unit (for tender purposes)

- The system comprises of 2 x 100% DX package units, duct work with fittings such as elbows, fire dampers, sound attenuators and diffusers.
- Cooling capacity +-90 kW
- The DX packaged units will be installed on plinth on the east side of the MV LV switchgear room.
- Plinth dimensions +- 2.5m x5m
- Package unit weight +- 1000kg
- Electrical requirement +- 30kW
- Air flow +-5 m^3/s`
- Room pressurisation 20% of air supply

The *Contractor* is to route the supply air duct along the wall the MV LV switchgear room they will penetrate through the wall (on the south side) in to the ceiling space of the MV LV where it will run down the length of the building to the Equipment room, then to the Battery room. The return air duct will follow the same routing. The *Contractor* is to remove the existing ducting in the MV LV switchgear room .

Cooled air is enter the room from above, the diffusers must not be installed directly above the MV LV panels or the equipment panels.

The *Contractor* is to install fire dampers in the ducting, where the ducting goes from one room to another , to reduce the spread of fire and smoke. The HVAC system will be interfaced with the fire detection system to activate the fire dampers and shut off the supply of air.

One packaged cooling unit is operational, while the other one is on standby. The operational unis are to be changed over at fixed intervals to achieve equal running time and wear and tear on the system.

The temperatures of the rooms will be monitored in the control room as well as the status of the system

(run/standby/trip). The *Contractor* is to install a panel in the control room to display the temperature of all the rooms and the status of the system

The *Contractor* is to install insulation in the roof to reduce the heat load.

HVAC Interfaces
The HVAC will have the following interfaces

Civil

- Concrete plinth on the outside of the building (Eastern side) for the installation of the packaged HVAC units and the MCC panel for the HVAC panel
- Support of the ducting on the interior and exterior of the building.

C&I

- Control of the automatic switching between the two packaged HVAC units
- Interface with the control room to show:
    - Running status of the HVAC units ie- standby/running/trip
    - Room temperature.

- **Fire detection**
    - Interface to shut HVAC system off and close fire dampers in the event of a fire

Electrical

The contractor shall design, construct and supply a single MCC panel which shall be used for control of the HVAC system, the employer shall provide two bulk points of supply to achieve redundancy of supply for the HVAC plant, the MCC panel shall be outdoor rated, manufactured from 3CR12 and IP65 rated. The contractor shall also supply all asscociated cabling, racking, earthing and general lighting for the area specifically for the HVAC installation.

The MCC shall have operational indications, fault indications and the general plant status indications. The contractor shall ensure the installation is compliant with SANS 10142 requirements and relevant Eskom specifications.

3.7 EQUIPMENT REQUIRED TO BE INCLUDED IN THE WORKS

3.7.1 OPERATING AND MAINTENANCE TOOLS

The *Contractor* provides any special maintenance tools and equipment for the switchgear as per 240-56227516, *the Contractor* also supplies the necessary toolbox for the storage of the tools. The numbers of operating and maintenance tool sets are specified in Schedule A of 240-56227516

Any special tools or keys that may be required for maintenance or for adjustments are provided. Handling equipment is provided to facilitate the removal from the housing of the withdrawable devices weighing more than 25 kg unless the device carriage itself is designed for the duty.

3.8 WORKS AND THINGS FOR THE WORKS SUPPLIED BY THE EMPLOYER/OTHERS

SUPERVISOR AND RESPONSIBLE PERSON COURSE

The *Contractor* appoints two people to attend necessary training intervention or course provided by the *Employer* for authorisation to take out a work permit. No work will commence without an authorised supervisor and responsible person on site. The authorisation process will take at least three to four weeks.

3.8.1 CABLING

The instrumentation and power cabling where deemed necessary is provided by the *Contractor* and shall be fully compliant with 240-56227443 Requirements for Control and Power Cables for Power Stations Standard. The core drilling for cables, sealing the cable slots, disconnecting the existing equipment and cables, reconnecting the cables and repositioning the lights is the responsibility of the *Contractor.*

- The *Contractor* provides the detailed technical specification for all power cable plugs, terminations and lugs, all crimps for conductors above 4mm2 shall be hexagonal crimp and shall comply with 00.0/10341. The power cable plugs will be supplied by the contractor.
- The *Contractor* to re-use the existing instrument/trunk cabling that is currently installed on the existing PLC cubicles. A cable schedule is provided as per Appendix B and the *Contractor* is to investigate any other cabling that does not form part of the cable schedule and cater for it accordingly by tracing its whereabouts and allocating cabling numbering for it and if during implementation any cable is found to be causing shorts the *Contractor* will investigate and replace such a cable.
- The *Contractor* is responsible Earthing connections

3.8.2 VERMIN AND FIRE PROOFING

Where fire seals or vermin seals may be damaged by the *Contractor* these shall be replaced by the *Contractor* as part of the works completed.

3.8.3 REMOVAL OF EXISTING EQUIPMENT

The removal of existing PLC equipment including cubicles, all the old HMI, servers, network cabinet, operator desks and all other equipment and cabling that is not required shall be the responsibility of the *Contractor* after the installation and commissioning of the plant.

The *Employer* will determine the area and location where the removed equipment shall be stored. The *Contractor* to be advised by the *Project Manager* with regards to storage of all removed equipment.

3.8.4 PADLOCKS

The Employer will supply all padlocks. All pad lockable devices, doors etc., are capable of accepting the Employer's standard padlock as specified in 240-56227516. Sample of padlock used is provided by the Supervisor on request. Drawing 0.00/10344 shows the padlock in the closed position, adequate space is provided to insert the padlock into locking devices when in the open position.

3.8.5 CURRENT TRANSFORMERS

The *Contractor* is responsible for supplying all the required current transformers in the LV Switchgear.

3.8.6 LV SWITCHGEAR INTELLEGENT ELECTRONIC DEVICES

The *Contractor* supplies the IED's for the LV Switchgear as indicated as part of standard 240-56227516 including the protection scheme design for the LV Switchgear will be done by others.

3.9 AS-BUILT DRAWINGS, OPERATING MANUALS AND MAINTENANCE SCHEDULES

a. Language

All documentation, including reports, manuals, etc. is in the English language.

b. Type Test Reports

Type test documentation represents the design of the functional unit with respect to the configuration, type and rating. The information to be included in type test reports is in accordance with the applicable SANS standard. The report of the type tested functional unit and associated components reflects the equipment under consideration. The type test report is provided in full, containing all records of the tests conducted as well as the drawings.

c. Manuals

The technical, training, maintenance and operating manuals are provided for each type (e.g. for different ratings, voltage levels etc.) of a functional unit. Technical manuals include all technical data, information on the switchgear construction as well as the technical data and leaflets of each individual component used in the switchgear provided. Where generic manuals are provided, an addendum is provided indicating the applicable project specific components.

Manuals are of a good quality and cover the following as a minimum:

I. Technical descriptions of the equipment and component parts
II. General arrangement drawings
III. Installation instructions with drawings or pictures
IV. Operating and maintenance instructions for all components
V. Detailed parts lists (accompanied by exploded view type drawings clearly detailing the part and uniquely identifying it)
VI. Spare part ordering instructions

Any special instructions pertaining to storage of spare parts or their shelf life is included in the maintenance manual. All drawings requested for component location, dismantling and re-assembly for maintenance are included in the maintenance manual. All special tools required for operating and maintenance of the equipment are presented in a form of a schedule in the operating and maintenance manual, respectively. The content of the training manual is based on the content of the technical, operating and maintenance manuals.

3.9.1 DRAWING REQUIREMENTS

The *Contractor* provides drawings for the required equipment as per 240-86973501 .
The *Contractor* supply reproducible drawings according to the Vendor Document Submittal Schedule (VDSS) that is supplied by the Employer. The *Contractor* develops the following minimum requirements for the drawings:

3.9.2 DRAWING NUMBERING SYSTEM

The following Eskom drawing numbering system is proposed and the *Contractor* shall update the existing drawings for the installed switchgear and reproduce new drawings where these may not be available. The *Contractor* may assign his own drawing number as required to meet his document control system requirements: However final handover shall require all drawings to have the relevant Eskom drawing numbers

3.9.3 GENERAL ARRANGEMENT DRAWINGS

The *Contractor* provides general arrangement drawings completely dimensioned, showing:

a. Arrangement of equipment offered.
b. Plant, front view, and other elevation views.
c. Required clearances for opening doors and for removing circuit breakers.
d. Conduit or cable entrance locations for bottom entrance.
e. Instrument transformers (i.e. VT’s and CT’s) physical positions.
f. Position of control panels and associated relays and IED’s.
g. Position of earth switches.
h. Terminal blocks locations.
i. Earthing connections.

3.9.4 SCHEMATIC DRAWINGS

The *Employe*r provides typical functional protection and control block diagrams in the Referenced Documents of 240-56357424 and 19.EED/006, which will have to be used as guidelines for the development of schematic drawings for the protection, control and monitoring schemes. Schematic diagrams will show the following:

a. All protection and control devices and their contacts, each of which are labelled with its correct ANSI device function number, or reference.
b. Device terminal numbers, terminal block numbers and terminal numbers.
c. All internal interconnections, bus wiring, inter-panel wiring and connections to external equipment such as Control and Instrumentation (C&I) panel.
d. All control and protection switches
e. Power supply connections

3.9.5 WIRING DIAGRAMS

The *Contractor* provides detailed wiring diagrams to show the following:

a. Approximate physical locations of all items in each control panel.
b. All interconnecting wiring between control panels.
c. Identification of all terminals, terminal blocks, and wires by numbers.
d. Clear identification, by some distinguishing method, of all wiring which will be installed by the *Contractor.*

This will include, but not be limited to, leads from external current transformers, trip circuits from remote devices, auxiliary contacts to remote devices, incoming DC control power, and separate incoming AC power. This also includes spare auxiliary contacts and relay contacts which are wired to terminal blocks for future use.

3.9.6 OPERATING AND MAINTENANCE MANUAL

The *Contractor* provides Operating and Maintenance manuals as per the requirements stipulated in Technical Schedule A and B in Appendix A and B of 240-56227516. The manuals comply with 240-56227516
The procedures are provided by the original equipment manufacturer detailing descriptions of the maintenance work in accordance with BS 6626 and SANS 60947.The procedure covers the requirements for maintenance of the equipment over the design life.

3.9.7 MAINTENANCE SCHEDULE

The equipment offered must have a production lifetime for at least 10 years after Contract Award (this exclude production for spares only).
The *Contractor* provides a maintenance schedule as per 240-56227516. The maintenance schedule provided is for the switchgear life expectancy of 30 years. The *Contractor* also makes provision for maintenance spares during the life expectancy of the equipment.
The equipment of the same rating should be fully interchangeable to allow for low inventory and reduced down-times.

4 LIVE CHANGE OVER METHODOLOGY

The *Contractor* is responsible for the live changeover methodology.

4.1 Pre-Changeover Work

1) Pre-changeover work relates to any work to be undertaken on a system before changeover can be undertaken (for which the system must then be placed on "outage"). No plant-wide outage is planned for the Common Plant.
2) Prior to undertaking any pre-changeover work:
   i. The *Contractor* provides an overall changeover strategy based on a phased replacement, such that the systems (including the network and SCADA) are changed-over in sequence, in such a manner that the control system is available after each changeover.
      I. The *Contractor* submits the strategy for approval by the *Project Manager*
      II. The *Contractor* provides a changeover plan and commissioning plan, which is informed by the approved strategy, for each system
      III. The *Contractor* develops a risk assessment, mitigation and options to recover the process plant are clearly identified

The following list below is the highlighted activities to be completed in pre-changeover:

- UVG Cable tracing and marking must be completed
- Network must be installed and operational
- Fibre network installed and tested
- New cabinets (where required) installed (After SIT)
- All network cabinets installed (power, ground, GPS, new structure)
- Installation of fully functional control system hardware in the room of its final location
- Software loaded to Automation Processors
- Power supplies must be installed and operational
- Grounds installed in new cabinets
- HVAC must be in operational

3) It is the responsibility of the *Contractor* to engage with the Employer's operating (4) and maintenance team to ensure that:
   i. The strategy and plans are compiled to sufficient detail prior to commencing with any pre-changeover work.
   ii. All relevant stakeholders have been consulted to inform the strategy and plans prior to commencing with any pre-changeover work.
   iii. The plant system is available and mitigations are in place to initiate a changeover, once the pre-changeover work is completed.

iv. The *Contractor* is responsible for arranging all required resources for the change over and the management thereof.

5 PROCUREMENT

5.1 PEOPLE

5.1.1 MINIMUM REQUIREMENTS OF PEOPLE EMPLOYED ON THE SITE

(1) Only qualified and experienced people to be employed.

(2) 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) The *Contractor* must have at least 2 of Supervisory and Artisan staff authorized in Plant Safety Regulations and/or High Voltage Regulations. In order for any person to do work at the Power Station, this person should be authorized to take out a permit to work.

(4) The courses for the plant safety regulations will be presented free of charge to *Contractors* by the *Employer* and bookings must be done via the *Project Manager*.

(5) N.B Access to the switchgear/equipment rooms the *Contractor* to comply to the following prior to access being granted:

i. The *Contractor's* Supervisor to attend the Arc Flash Course (PSR Module 5) and pass the required test. The course will be offered by the *Employer* at no cost and Course dates will be announced after Contract Award.

ii. *Contractor to* ensure that all personnel working in the room wear special overalls due to the nature of equipment in the rooms.

Overall specification – Arch Flash PPE overall rated ATPV 12cal/cm^2 and Blue in Colour:.

5.1.2 BBBEE AND PREFERENCING 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 supplier's ninths manufacturing, construction and mining /extraction sector of the economy and provide support.

5.1.3 SUPPLIER DEVELOPMENT AND LOCALISATION

(1) Eskom Holdings SOC Limited ("Eskom"), as a State Owned Company, is required to drive and implement government's socio-economic initiatives.

(2) Eskom's Supplier Development and Localisation (SD&L) Programme, which is an essential component of its overall Transformation Programme, has as its primary objective the achievement of maximum and sustainable local development impact through leveraging Eskom's procurement spend in a manner that allows flexibility within the business in order to accommodate Government local development initiatives and policies.

(3) The SD&L programme seeks to maximise the following transformation objectives:

i. B-BBEE: The focal point of Eskom's B-BBEE Strategy is the sustainable development and empowerment of local black businesses, while continuing to uphold Eskom's core values. During the exemption phase, Eskom's stated policy was to give preference to level 1-4 B-BBEE contributors.

ii. Local Content: Means the target committed by *Contractors* as a percentage of the contract value that will be spent in South Africa. The total local content amount is calculated by adding rand value amounts as reported by suppliers in their quarterly report submissions.

iii. Industrialisation: Means any investment made by the supplier that results in building new and/or enhancing local capacity as well as increasing the export, thus enhancing industrialisation. The objective is to maximise Eskom and supplier spend to foster the establishment of new plants, expanding of existing plant and purchasing of machinery/equipment for local development.

iv. Skills Development: Eskom seeks to influence the development of skills through procurement spend, in order to contribute to the reduction of scarce skills and to build the country's capacity to compete globally.

v. Supplier Development: Means providing a platform to develop emerging suppliers, through first-tier and second-tier contracting, and opportunities for national and international suppliers using the joint venture mechanisms

vi. Job Creation: Means the number of jobs created by suppliers as a result of Eskom's contract. This contributes towards the achievement of localisation objectives of alleviating poverty through job creation.

vii. Corporate Social Investment: In terms of the integrated Socio-Economic Development (SED) policy approved in 2014, Eskom together with its Subsidiaries, *Contractors*, Suppliers and Service Providers are required to participate in Corporate Social Investments (CSI) initiatives / programmes that are aimed at maximising the direct beneficiation of the Local communities around areas where Eskom operates its plant.

5.2 SUBCONTRACTING

5.2.1 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.

5.2.2 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 *Employe*r'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.

5.2.3 LIMITATIONS ON SUBCONTRACTING

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

5.2.4 ATTENDANCE ON SUBCONTRACTORS

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

5.3 PLANT AND MATERIALS

5.3.1 QUALITY

(1) Refer to Matla quality manual in QM58 for compliance.

5.3.2 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* need to use any of the *Employer's* Equipment, including compressed air, electricity, water supply and crane, it must be specified by the *Contractor*. The *Employer* does not guarantee continuity of supply of any of these items.

5.3.3 *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) All warranties for the equipment, standard software and application software provided are included as part of the *works*.

(4) All warranties are in the name of Matla Power Station.

5.3.4 SPARES AND CONSUMABLES

5.3.4.1 MAINTENANCE SPARES

(1) The *Contractor* makes recommendations and supplies a spares list with a price per component at tender stage. The validity of this spares list is 12 months. The *Employer* reserves the right to purchase these spares within 12 months of the signing of the contract.

(2) The *Contractor* supplies a complete listing of the components supplied and installed with technical description, model number and other technical detail as required by the SAP system and provided by the *Project Manager*. This will be used to update or create technical specifications for spares by the *Employer* (in the SAP system) and facilitate ease of ordering spares when required.

5.3.4.2 COMMISSIONING SPARES

(1) The *Contractor* keeps sufficient spares to maintain the whole of the *works* up to the Defect date. If the *Contractor* is not planning to keep spares, a contingency plan should be put in place, and accepted by the *Project Manager*, to ensure that failures can be corrected with a minimal impact on the plant and process.

5.4 TESTS AND INSPECTIONS BEFORE DELIVERY

5.4.1 GENERAL

(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/engineer has notified the *Contractor* that they have passed the test.

(2) The Control System will undergo Factory Acceptance testing (FAT).

(3) 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.

(4) Arrangements for witnessing inspections are made through the *Project Manager*.

(5) A minimum of ten working days' notice is given by the *Contractor* for inspections and is shown in the Accepted Programme.

5.4.2 FAT

(1) During FAT, the *Contractor* demonstrates that the Control System meets the requirements of this Works Information and the detailed engineering design freeze documentation.

(2) The FAT is done at *a Contractor's assembly factory*.

(3) The *Contractor*, the *Project Manager* and the *Employer's* representative (s) witness the FAT.

(4) All Control System hardware is included in the FAT, including HMI, network switches, and servers.

(5) The *Contractor* provides all facilities and simulation systems at the FAT venue such that full testing of the control system logic can be done.

(6) As a minimum, the following tests and inspection are performed during the FAT:

i. Full testing of the PLC programme.

ii. System integrity and application tests

(7) The *Project Manager* determines if any further testing is required in addition to that specified, such as that of any new technologies being used.

(8) The *Contractor* prepares a detailed FAT procedure which is approved by the *Project Manager*.

5.4.3 FAT PROCEDURE

(1) The *Contractor* prepares a detailed test procedure in preparation for FAT.

(2) As a minimum, the proposed FAT procedure identifies the following:

i. Major test activities.

ii. Comprehensive list and description of the individual tests to be performed.

iii. How the tests are to be prepared and conducted.

iv. Test dates and durations.

v. Checklists - how the test results will be documented.

vi. Acceptance Criteria.

vii. How the identified discrepancies will be processed.

viii. Retesting requirements.

5.4.4 FAT REPORT & FAT COMPLETION

(1) A Final FAT Report is prepared by the *Contractor* that includes the following as a minimum:

i. Test procedures used during FAT

ii. Detailed Test results

iii. Discrepancies identified during the tests

iv. Resolution of the discrepancies

v. Retests conducted and results thereof

vi. FAT certificate

(2) The *Contractor* submits the Final FAT Report to the *Project Manager* for acceptance.

(3) FAT Completion is achieved upon acceptance of the Final FAT Report by the *Project Manager.*

6 CONSTRUCTION

6.1 TEMPORARY WORKS, SITE SERVICES & CONSTRUCTION CONSTRAINTS

EMPLOYER'S SITE ENTRY AND SECURITY CONTROL, PERMITS, AND SITE REGULATIONS

(1) Refer to Access Control Procedure 4421.

6.1.1 RESTRICTIONS TO ACCESS ON SITE, ROADS, WALKWAYS AND BARRICADES

(1) Pedestrian crossings are made on the road they should be used when crossing the road.

(2) Inside the plant walkways are clear; 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.

6.1.2 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:

i. They must not involve danger to the person carrying out the activity;
ii. No plant isolations must be required;
iii. The activity must be performed by a skilled person and there must be no risk of a production loss;
iv. The duration of the activity must be less than 24 hours.
v. The Supervisor accompanies the *Contractor* during the first instances of working under a LAR on a specific plant area.

(3) 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.

(4) 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.

(5) 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.

(6) For more information please refer to Plant Safety Regulation.

6.1.3 HEALTH AND SAFETY FACILITIES ON SITE

Refer to Health and Safety Specification document 32-727 and 32-520

6.1.4 ENVIRONMENTAL CONTROLS, FAUNA & FLORA, DEALING WITH OBJECTS OF HISTORICAL INTEREST

(1) Refer to Environmental Policy in 32-727 and 32-520

6.1.5 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.

(4) The *Contractor* has title to material from excavation and demolishing only as stated in the Works Information.

6.1.6 COOPERATING WITH AND OBTAINING ACCEPTANCE OF OTHERS

(1) The *Contractor* shall co-operate with others in obtaining and providing information which they need in connection with the *works*.

(2) The *Contractor* shall share the working area with others in executing the *works*.

6.1.7 PUBLICITY AND PROGRESS PHOTOGRAPHS

(1) Should publicity and/or progress photographs be required, an application shall be made via the *Project Manager*.

6.1.8 CONTRACTOR's EQUIPMENT

(1) The *Contractor*'s attention is drawn to the applicable regulation framed under the Machinery and Occupational Safety Act, 1983 (Act No. 6 OF 1983).

(2) When working in built-in areas, the *Contractor* shall provide and use suitable and effective silencing devices for pneumatic tools and other plant that would otherwise cause a noise level exceeding 85 Db(A) during excavation and other *works*.

(3) Alternatively the *Contractor* shall by means of barriers, effectively isolate the source of any such noise in order to comply with the said regulation.

6.1.9 EQUIPMENT PROVIDED BY THE *EMPLOYER*

(1) Should the *Contractor* require using any of the *Employer's* Equipment, including compressed air, electricity, water supply and crane, it must be specified by the *Contractor* during the kick off meeting. The *Employer* does not guarantee continuity of supply of any of these items.

(2) The *Employer* shall be entitled to withdraw use of the said Equipment, should proper maintenance and cleanliness not be ensured. In that event, the *Contractor* shall be obliged to provide the necessary Equipment at his own cost.

(3) 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.

(4) The *Contractor* 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. Arrangements for training courses can be made via Matla Power Station Maintenance Training but the *Contractor* will absorb costs.

(5) A copy of this accredited and valid training certificate must be given to the *Employer's* Supervisor, who will then arrange access for usage.

6.1.10 SITE SERVICES AND FACILITIES

(1) Potable Water Supply is available at the existing points.

(2) Electrical Power Supply requirements are as follows:

i. Power is available at the existing points.

ii. The *Contractor* provides his own portable 380V electrical distribution boards, and supply cables to and from the boards, for all his power supply requirements to execute the *works*.

iii. *Contractors*' Electrical Distribution Boards complies with OHSA as referred to in the Electrical Installation Regulations and the Electrical Machinery Regulations.

iv. Each board brought onto site must have a Certificate of Compliance issued by an accredited person.

v. The *Contractors'* Electrical Distribution Boards are installed at the *works* on a time negotiated with the *Project Manager*, prior to the possession date.

vi. The *Employer* connects distribution boards to a 380V three-phase AC power supply, only after the *Contractor* has submitted the valid Certificate of Compliance.

vii. All *Contractors'* Electrical Distribution Boards are earthed to the steel structure of the plant.

(3) The *Employer* provides the *Contractor* access to existing toilet facilities. The *Contractor* is to provide this facility should the existing facilities not be within reasonable distance from the working area.

(4) The *Contractor* are not 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).

(5) The *Contractor* may buy take away meals from the fast foods outlet on Site.

(6) The *Contractor* provides a First Aid service to his employees and subcontractors. 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.

(7) Outside the *Employer's* office hours, the *Employer's* First Aid Services are only available for serious injuries and life threatening situations.

(8) The *Employer* recovers the costs incurred, in the use of the above *Employer's* facilities, from the *Contractor.*

6.1.11 RESTRICTIONS TO ACCESS ON SITE, ROADS, WALKWAYS AND BARRICADES

(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.

6.1.12 PEOPLE RESTRICTIONS ON SITE; HOURS OF WORK, CONDUCT AND RECORDS

(1) The *Contractor* shall properly deal with and disposal of water to ensure that the *works* are kept sufficiently dry for their proper execution.

(2) The *Contractor* shall provide, operate and maintain in sufficient quantity such pumping equipment, well points, pipes and other equipment as may be necessary.

(3) The *Contractor* shall also provide temporally *works* as may be necessary to minimise damage, inconvenience or interference.

6.1.13 HEALTH AND SAFETY FACILITIES ON SITE

(1) The *Contractor* will be held responsible for any damage to known services (services that are within the site of the *works* and are known/shown on drawings or highlighted by *Employer*) and he shall take all the necessary measure to protect them.

(2) All *works* or protective measure shall be subjected to approval.

(3) In the event of service being damaged the *Contractor* shall immediately notify the authority concerned as well the *Project Manager* and the engineer.

(4) The *Contractor* shall not repair any such service unless instructed to do so by the *Project Manager.*

(5) The *Contractor* shall complete such an investigation well in advance, prior to the start of construction work in the said section and shall submit a report in good time to enable the engineer to make whatever arrangements that are necessary for the protection, removal or diversion of the service before any construction *works* commences.

(6) As soon as any underground service not shown in the in the drawing is discovered, it shall be deemed to be known service and the *Contractor* will be held responsible that the *Contractor* for any subsequent damage to it.

(7) If such service is damaged during the course of its discovery, the cost of rectifying the damage will be met by the *Employer* unless it is established that the *Contractor* did not exercise reasonable diligence and that the damage was avoidable.

(8) Where the authority concerned elects to carry out on site own account any alteration or protective measure, the *Contractor* shall co-operate with and allow such authority reasonable access and sufficient space and time to carry out the required work.

(9) Permanent alteration or permanent diversion of service necessitated by the execution of the *works* and authorized will be paid for in terms of the conditions of contract, but no such work will be paid for if it has not been previously inspected and if no proper written instruction was given.

6.1.14 ENVIRONMENTAL CONTROLS, FAUNA & FLORA, DEALING WITH OBJECTS OF HISTORICAL INTEREST

(1) Where underground cables and pipes are present in the area, care must be exercised to ensure that they are not damaged. In the case of damage to existing components, the *Contractor* will be held liable for replacement/repair thereof.

6.1.15 TITLE TO MATERIALS FROM DEMOLITION AND EXCAVATION

(1) The *Contractor* shall take all responsible measure to minimise any dust nuisance, pollution of stream and inconvenience to or interference with public as a result of the execution of the *works*.

(2) Remove all rubble and dispose to appropriate facility as according Matla waste management Procedure OMOP 4090

6.1.16 COOPERATING WITH AND OBTAINING ACCEPTANCE OF OTHERS

(1) The sequence of installation is as per the Execution Methodology provided by the *Contractor* and accepted by the *Project manager*.

(2) Installation of the relevant equipment does not begin until the detailed 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 installation to prove the compliance of the installation with the Works Information and the detailed engineering design freeze documentation.

(4) Installation is only considered complete once the quality inspections and tests for the installation concerned have been accepted by the *Project Manager*.

(5) The *Project Manager* is to specify hold and witness points during the installation and testing stages of the project.

(6) The *Contractor* gives fifteen working days advance notice to the *Project Manager* of holds and witness points.

(7) The *Contractor* confirms hold and witness points at least seven working days prior to the test activity.

(8) The *Contractor* provides all test equipment for any inspections and tests.

6.1.17 SITE INTEGRATION TEST (SIT)

(1) The Site Integration Testing (SIT) of the Control System is part of the *works*.

(2) The SIT only begins once the control hardware has been installed in the final location and connected to permanent power supplies.

(3) The SIT is carried out before plant commissioning commences to ensure:

i. Correct performance of the control hardware
ii. Safety of plant and personnel
iii. Compliance with the Works Information and the detailed engineering design freeze documentation

(4) The *Contractor* prepares a detailed SIT procedure

(5) As a minimum, the proposed SIT procedure identifies the following:

i. Major test activities
ii. Comprehensive list and description of the individual tests to be performed
iii. How the tests are to be prepared and conducted

iv. Test dates and durations
v. Checklists - how the test results will be documented
vi. Acceptance Criteria
vii. How the identified discrepancies will be processed
viii. Retesting requirements

(6) In the event of an error in any test (hardware or software) the fault is logged, analysed and resolved.

(7) 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.

(8) Major faults such as IO module failure or CPU failure or major faults as determined by the *Project Manager* may lead to the termination of the SIT.

(9) 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.

(10) 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

(11) The *Contractor* submits the Final SIT Report to the *Project Manager* for acceptance.

(12) 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.

6.1.18 HOOK UPS TO EXISTING WORKS

The *Contractor's* design and execution methodology and plan takes into consideration the running units constrain and mitigated accordingly.

6.2 COMPLETION, TESTING, COMMISSIONING AND CORRECTION OF DEFECTS

6.2.1 USE OF THE *WORKS* BEFORE COMPLETION HAS BEEN CERTIFIED

(1) The *Employer* may use any part of the *works* before completion has been certified. If he does so, he takes over the part of the *works* when he begins to use it except if the use is:

i. For a reason stated in the Works Information
ii. To suite The *Contractors* method of working

(2) The *Project Manager* certifies the date upon which the *Employer* takes over any part of the w*orks* and its extension within one week of the date.

6.2.2 MATERIALS FACILITIES AND SAMPLES FOR TESTS AND INSPECTIONS

(1) The *Contractor* and the *Employer* provide material, facilities and samples for test and inspection as stated in the Works Information.

6.2.3 COMMISSIONING

(1) The commissioning of the Matla Power Station Slurry Plant PLC and SCADA system is part of the *works*.

(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) The *Contractor* provides sufficient personnel for the satisfactory and timely commissioning of equipment.

(4) The *Contractor* co-operates fully with the *Project Manager* or Representative(s) in the commissioning of plant.

(5) The *Contractor* provides all the test equipment for the commissioning of the control hardware and will supply a commissioning procedure.

(6) The *Contractor* certifies that equipment is in a suitable and safe condition for use before it is placed in service.

(7) The commissioning activities are carried out in conjunction with the *Project Manager*.

(8) If a defect is identified in the equipment interfacing to, or external to the *Contractor's* scope the *Contractor* informs the *Project Manager* or Representative(s) immediately.

6.2.4 START-UP PROCEDURES REQUIRED TO PUT THE *WORKS* INTO OPERATION

(1) The *Contractor* shall carry out sufficient checks to satisfy himself that the materials used and the workmanship comply consistently with the specified requirements and the results of those checks shall, if so ordered , be made available to the Engineer.

(2) The Engineer may carry out such check as he deems necessary at any point or any depth or any layer, as the result of the Engineer's check shall be made available to the *Contractor*.

6.2.5 TAKE OVER PROCEDURES

(1) Takeover will be on or before the Completion Date the *Contractor* shall have done everything required providing the *works* and the Engineer has done all the necessary inspection and the approval of the *works* done.

6.2.6 ACCESS GIVEN BY THE *EMPLOYER* FOR CORRECTION OF DEFECTS

(1) The Supervisor issues the Defect certificate at the later defect date and the end of the last defect correction period. The *Employer's* right in respect of the defect which the supervisor has not found and notified are not affected by the issue of the defect certificate.

(2) The *Contractor* contacts the *Project Manager* to gain access to the site to correct defects.

6.2.7 PERFORMANCE TESTS AFTER COMPLETION

(1) The *Contractor* shall conduct operational acceptance test after commissioning in the presence of the *Project Manager* and the Engineer according to the QCP, the end user and functional requirements.

(2) The *Contractor* requests commencement of operational acceptance test from the *Project Manager.*

(3) The final OAT Report is prepared by the *Contractor*.

(4) The *Contractor* submits the final OAT Report to the *Project Manager* for acceptance.

6.2.8 TRAINING AND TECHNOLOGY TRANSFER

(1) The *Contractor* shall provide any associated transfer of technology and knowledge to the Employer as per requirements specified in section 2.12

6.2.9 OPERATIONAL MAINTENANCE AFTER COMPLETION

(1) Operational maintenance after Completion not part of the *works.*

7 PLANT AND MATERIALS STANDARDS AND WORKMANSHIP

7.1 INVESTIGATION, SURVEY AND SITE CLEARANCE

1) This activity is a pre-cursor to the Detailed Engineering, during which the *Contractor* conducts the necessary plant investigation work. The *Contractor* is to investigate all the existing loop drawings, and do plant walks to familiarise themselves with the plant.
2) The *Contractor's* plant investigation work is conducted on a Functional Group basis and then on a KKS basis, where applicable.
3) The scope of the plant investigation work includes, but is not limited to:
    v. Verification of the location and suitability of all process control and network equipment
    vi. Verification of control system loops and terminations
    vii. Verification of power requirements and terminations
    viii. Verification of the scope of work as defined by the *Works Information*
    ix. Verification and amending of all philosophies relevant to the scope of work.
    x. Cable tracing, verification and cable schedule updating

The *Contractor* is responsible for:

i. Clarifying the input documentation and scope of work to be performed.
ii. Identifying any discrepancies in the input documentation and making the *Employer* aware of such discrepancies. The *Contractor* provides recommendations, where applicable, and takes action to resolve such discrepancies.
iii. Collecting any process/plant data and information required for the *Contractor's* design to be completed.

4) The *Contractor* provides a pre-cursor method statement as part of the tender returnable for the live change over (live change over refers to switching from the existing PLC to the supplied installed new PLC). The method statement must consider that the maximum time to do the changeover is three (3) days per-cubicle. The final live change over method statement which will be utilised for the actual live changeover is provided and submitted to the project manager after the *Contractor* has investigated the plant for review and acceptance by the *Employer*.
5) The *Employer* provides drive schedules and instrument schedules once the contract is awarded.

7.2 STANDARDS

The *Employer* Standard Specification applicable to the *Works* are provided by the *Employer*. The *Employer* will submits revised/updated standards.The *Contractor* is to obtain his own copies of International and National Standard Specification documents.

It is the responsibility of the *Contractor* to report any conflict within this *Works* Information with any referenced standard, specification or technical guideline.

7.3 CONTROL AND INSTRUMENTATION WORKS

7.3.1 C&I SCOPE

1) Usage of new installed control system cubicles, and if required the *Contractor* to supply more cubicles
2) Operator workstation replacement- 6 operator screens and 3 workstations (2 screens per workstation).
3) The operator workstations to be located at the existing control room
4) Supply of operator workstation desks and chairs
5) Engineering Station equipment and furniture
6) Use the currently installed Cabinets that are on the adjacent existing PLC room at Slurry Plant
7) Replace all network switches
8) Supply and install network cables
9) Supply and install the SCADA system and the system to have a historian
10) Supply servers with server cabinets
    - Ensure that the servers are redundant
11) Supply and install network cabinets
12) Trunk cables from the junction boxes to the existing PLC to be used for the new control system
13) The scope excludes field equipment and JB's
14) Interface to radio link, units ash pumps and K-pumps
15) Removal of the old cabinets once the plant is up and running

7.3.2 GENERAL REQUIREMENTS

(1) The PLC is provided by the *Contractor* as part of the *works*.

(2) The *Contractor* design, Engineers,commission the Control System.

(3) The PLC consists of the following function groups as per the table (Table 4: Slurry Plant PLC Function Group Definitions) below:

Table 4: Slurry Plant PLC Function Group Definitions

Current PLC Cubicles	Function Grouping
EYD01	Steinmuller PLC – Marshaling
EYD 10A CUBICLE	Dump Valves
EYD 10B CUBICLE	Dump Valves
EYD 11 CUBICLE	COMPRESSOR PLANT
EYD 20 CUBICLE	SUPERVISORY PLC
EYD 21 CUBICLE	Train A
EYD 22 CUBICLE	Train B
EYD 23 CUBICLE	Train C
EYD 24 CUBICLE	Hydrobin 11 & 13
EYD 25 CUBICLE	Hydrobin 12 & 14
BYB03	Electrical Alarms

7.3.3 SLURRY PLANT PLC REQUIREMENTS

(1) The PLCs are to be located in the Slurry Plant C&I Equipment Room. All PLC's are located in the same room.

(2) The PLCs are fully programmable, micro-processor-based systems designed for use in process plant applications.

(3) The PLCs interface to the SCADA and Historian

(4) The PLCs are powered from the UPS.

(5) The PLCs complies with the requirements (for both software and hardware) specified in the PLC OEM programming, installation and operating manuals and equipment data sheets.

(6) The PLCs are housed in panels with an IP rating ≥65

(7) Each PLC has the following functions and/or components:

i. Redundant power supplies.
ii. Input/output modules for data acquisition & signal processing for the processing of signals from field equipment and interfaces.
iii. Data validation functions...
iv. Interfacing with Electrical switchgear.
v. Redundant Communication with the SCADA and Historian.
vi. Interrogation of field contacts using 24 V DC.
vii. Interfacing with analogue input measurements from the field based on two-wire 24 V DC, 4 - 20 mA signals.
viii. Redundant Internal power supply & distribution components.
ix. Redundant Processors

(8) All software logic diagrams are engineered and depicted according to the Control System Flowchart (CSF) format and not Ladder Logic or Statement Lists STL format.

(9) The software logic source code is clear, concise, has detailed comments and consistent variable names.

(10) Spare capacity on the I/O modules of 10% is provided.

(11) The CPU's capacity should not be utilised more than 50% which should leave it with another 50% of processing capacity for future use, and has redundancy should one fail, the other should take over

(12) The IP addressing used by each PLC is consistent across the PLC network.

(13) All interfaces between the PLCs and operator workstation are provided by the *Contractor.*

(14) The *Contractor* provides the necessary fibre cables to tie in the new control system into the SCADA network.

7.3.4 OPERATOR WORKSTATION (HMI/SCADA)

The operator workstation shall provide plant operators with all information, protection, and control facilities required to operate the plant safely, reliably and consistently.

(1) The new thin clients are placed on the existing control room desk at the slurry plant control room.

(2) The HMI is the human interface for operating and monitoring of the plant systems on the Slurry Plant.

(3) A multilevel password system is used to restrict the operating functionality of the workstations to authorised personnel only.

(4) The log in and log out functionality is seamless without requiring the shutdown or restarting of the HMI.

(5) No passwords or access control of any form is required by an operator to monitor any individual section of the plant.

(6) Each operating workstation functions independently from all other operating workstations forming part of the applicable workstation.

(7) Failure of any operating screen does not inhibit plant operation.

(8) The workstation is configured such that it supports on-line maintenance.

(9) Faulty screens and pointing devices can be replaced without re-initiating or re-booting the workstation.

(10) A fully functional HMI is provided. The functionality provided by the HMI includes – but is not limited to the following:

i. Operating functionality
ii. Indication
iii. Alarming
iv. Event viewing
v. Trending and reporting
vi. Access to historical data

The HMI presents an integrated and standardised set of displays and facilities which are designed to conform to ergonomic principles and modern power plant practice.

(11) Uniformed signal descriptions, standard abbreviations and consistency of wording are used throughout the HMI.

(12) Any incorrect operation is indicated to the operator by audible signal or suitable text message.

(13) All operator actions are logged and linked to the user's profile.

(14) Individual users have the ability to configure, save and restore their settings

(15) HMI graphic pages on the operating and overview screens.

(16) The performance related to the display of the graphical user interface is in accordance with 240-56355728 "Human Machine Interface Design Requirements Standard",

(17) All information available to the operator from the HMI is printable when required.

(18) All normal operations which include stopping, starting and restarting after a trip take place from the operator workstation.

(19) The HMI graphics on the Operator Workstation represents the actual plant layout.

(20) The operator workstation has an alarm log page showing chronologic alarms and trips.

(21) The operator workstation has events log page showing all the events

(22) The operating system utilized on all equipment to realize the HMI functions, including the Operator and Engineering System is “Windows 10” or later.

(23) Graphics for the different types of components that will be presented on the HMI due to upgrades or modifications for the purpose of interfacing the HMI to the Process Automation System are designed and clarified during Detailed Design with the Employer’s Operating and Engineering team.

7.3.5 SERVERS PHYSICAL SPECIFICATIONS

The *Contractor* shall provide all the required control system servers with the following physical specifications

The minimum specifications for each control system server will be as follows:

1) Redundant connections to each applicable network.
2) Use dedicated server hardware.
3) Hot swappable redundant power supplies.
4) Hot swappable redundant hard drives via a suitable RAID configuration.
5) Server cubicles

7.3.6 INTERFACE TO EXISTING/NEW SYSTEMS

(1) The Control System provided by the *Contractor* interfaces to the existing Field Equipment and Switchgear as per LOSS diagrams in Appendix D

(2) The *Contractor* to interface to the currently installed radio link for starting and stopping of the pumps at the SWR switchgear.

(3) The *Contractor* to interface to the ash pumps at the units used for ashing by configuring the interlocks for the releases. The philosophy and the interlocks of the ash pumps will be provided to the *Contractor* by the Employer.

(4) The *Contractor* to interface to the K-pumps by studying the control and operating philosophy of the K-pumps and reinstating them to the normal working operation. The interlocks and control and operating philosophy will be handed over to the operator after contract awarding.

(5) The *Contractor* retains the existing network interfaces to main water treatment plant (WTP), North WTP and any other interfaces, which will be affected by the *works*.

7.3.7 PLANT INFORMATION SYSTEM (Historian)

The *Contractor* provides, as part of the works, a Plant Information System (PIS) that is a central database repository for the long term storage of all plant information produced at Matla Power Station Slurry Plant. This includes plant information generated by the *Contractor's* control systems, as well as other sources identified by the Project Manager.
The system is used for the remote access and retrieval of near real-time and historical plant information by the PIS Clients. The slurry plant PIS provides easily accessible information for power plant technical services such as operating, maintenance and engineering.

7.3.8 PLANT INFORMATION STORAGE

The PIS stores the plant information for the Outside plant centrally on a fully redundant server. The redundant PIS data server is physically separated from the Control system servers, EDC (Engineering/Diagnostics/Commissioning) workstations and operator workstations, and is provided by the *Contractor* as part of the works.

The PIS is able to store all analogue tags with a resolution of 1ms or better, and all events at a resolution of 1 ms. The PIS is also able to store each analogue tag according to the amount of change in the tag value, where the amount of change is specified by the user. The PIS data servers store a minimum of 5 years of all historical plant information on-line at maximum resolution of off-line data, as part of the works.

The PIS is able to back up the historical plant information stored on the PIS data servers to external hot-swappable HDDS (Hard Disk Drives), while on-line and without any loss of availability and functionality of the PIS.

7.3.9 PIS INTERFACE

The *Contractor* supplies as part of the works web server software that allows the PIS clients, with the appropriate user rights and a standard Internet browser, to view all the near real-time and historical plant information from the PIS in the form of

- Trends
- Chronological lists
- Reports
- Process graphics

The design and engineering of web pages that supply the near real-time and historical plant information from the PIS to the PIS clients is provided as part of the works. A maximum of 50 PIS clients are able to access all near real-time and historical plant information from the PIS, and a maximum of 50 PIS clients are able to access near real-time and historic plant information from the PIS simultaneously.

7.3.10 STATION LAN INTERFACE

The plant information system connects to the station LAN through a redundant firewall. The firewalls are provided as part of the works.

The *Contractor* installs and supplies all cabling required to connect to the station LAN and all necessary associated equipment such as connection boxes, and switches. Bus cable jointing, and termination forms part of the works.

The *Contractor* assesses the cable routes at site and provides full details for the Project Manager's acceptance.

7.3.11 REDUNDANCY

The PIS data server is fully redundant. In the event of a failure of one of the PIS data servers, the other PIS data server automatically takes over its functions, without any loss in availability or functionality of the PIS.

All interfaces to the PIS are fully redundant. There is no single point of failure. The failure of any single component (for an example, a switch, a NIC, a cable, or a firewall) does not result in any loss of functionality or availability of the PIS.

7.3.12 TIME SYNCHRONISATION

The PIS data servers are synchronized with the GPS system supplied as part of works by the *Contractor.*

7.3.13 SECURITY

A user is requested to enter username and password before being able to access the configuration and diagnostic software of any PIS component.

7.3.14 PIS DATABASE STRUCTURE

The databases on the PIS data servers hold all plant data and are open to the queries from the control system data servers and the PIS client. The database structure is modifiable to fit the needs of Matla Power Station. Any changes made to the database are made real-time and on-line, and all changes are effective without restarting any part of the system.

7.3.15 REPORTS

As a minimum, the following reports are generated by the Plant Information system on a regular basis:

- Alarm log
- Hourly log
- Daily log

- Incident review logs
- Running time and status change log
- Summary logs

All reports generated by the Plant Information System are viewable on all PIS Clients. The final list of reports generated by the PIS is clarified during the system engineering phase.

7.3.16 LICENSING

The software licenses (both runtime and engineering) shall be portable allowing the user to transfer licenses from one PC to another without requiring intervention from the OEM/supplier.

7.3.17 AVAILABILITY

The *Contractor* configures the control system to minimise the effects of equipment failure on the overall plant and mimics the mechanical plant configuration.

7.3.18 CONTROL SYSTEM AVAILABILITY

- The availability of the control system and of the individual sub-systems is 99.99% or greater.

7.3.19 RELIABILITY

- No single point failure in the system causes unavailability or trip of any of the control system or associated plants
- If a failure occurs on the level of the operator/engineering systems, server or network, the automation units continue to operate uninterrupted.

7.3.20 SAFETY

- No individual C&I fault or no two concurrent faults may endanger the safety of the plant or people or jeopardise the integrity of major plant.

7.3.21 OPERATOR INTERFACE

- No individual fault causes the loss of an operator workstation. No individual loss causes loss of the control or operator information.

7.3.22 REDUNDANCY

The redundancy of functions within the Automation Units and hardware modules is such that the reliability, availability and maintainability levels as defined in section 6.4.
The transfer from master Automation unit processor to the slave Automation unit processor is seamless.

7.3.23 LIFE EXPECTANCY

The *Contractor* provides product supply life cycle in which the stages are depicted, stated and predictable.

All components are supported and maintainable as indicated below:

iv. PLC Life span is ≥18 years
v. SCADA Life span is ≥6 years
vi. Operator station Life Span is ≥6 years
vii. Information System/Historians Life span is ≥6 years
viii. Network Infrastructure Life span is ≥12 years
ix. Chargers life span is ≥20 years,
x. UPS life span is ≥15 years

At the start of commercial operation, **no** C&I or Electrical equipment and its associated equipment shall be at the end of life or obsolescence phase of its product life cycle.

7.4 CONTROL ROOM REQUIREMENTS

The *Contracto*r to supply equipment necessary support such as documentation, references, procedures and computerised support system necessary for the execution of the operators, engineers and maintenance staff duties. A printer is provided for Slurry plant control room to be used for logs, reports and drawings and other documents on request by operators, engineers and maintenance personnel

The *Contractor* to provide the following as a minimum:

- Lighting and Luminaries requirements (normal and emergency)
- Small power requirements
- Electrical plug points
- Channelling for cabling
- Position of equipment and hardware
- Provision of telephone for each operating desk area
- Air conditioning, heating and coaling loads
- Any special isolation from electromagnetic interference
- Provision of LAN connections at each operating desk area

All desks are custom designed, suitable for mounting the operating display devices required by the respective operator workstation. The desks surfaces provide space for writing as well as space for a telephone. Each desk contains a facility for the storage of the keyboard such it does not interfere the operator's working area when it is not in use. A set of matching desk drawers are provided for each operator. Desks are durable, robust suitably matched to the furniture and control room décor.

All furniture is of the modular type, and is of robust design clad in industrial type fabric suitable for the environment in which it used (i.e. continuous use 24 hours per day) and is in accordance *Employer's* corporate identity standards and per the specification, Matla_002.

The final design and layout of the desks, furniture and panels are discussed and clarified during the system engineering phase (technical clarification meetings) and provided to the Project Manager for acceptance.

7.5 SLURRY PLANT OPERATOR WORKSTATION AND DESK CONFIGURATION

The Slurry Plant Operator workstation requires a six operating display units configured to allow two independent operations to be undertaken concurrently by the Slurry Plant operator and assisting operators with associated pointing devices.
The *Contractor* provides two operator display units for the Slurry Plant Engineering Station and as a minimum the *Contractor* also provide three workstations.

The Engineering Station to be housed at the PLC room were the currently S5 PLC cubicles are, after the cubicles have been removed.
The *Contractor* to provide a desk and two chairs for the Engineering station, a LAN connections, all the cabling and the cabling racks for Engineering Station.

7.6 LIST OF REFERENCE PROCEDURES, STANDARDS AND SPECIFICATIONS

The *Contractor* complies with all standards, specifications and regulations as listed within this works Information, on the table below:

Table 5: Eskom Governance and Project Controls Specifications

No.	Document No.	Description / Title
1.	36-681	Generation Plant Safety Regulations
2.	32-520	Occupational Health and Safety Risk Assessment Procedure
3.	32-727	SHEQ Policy/Procedure
4.	ISO 9001	Quality Management Systems
5.	240-53113685	Design Review Procedure (DRP)
6.	240-52844017	System Reliability, Availability and Maintainability Analysis Guideline
7.	240-56355728	Human Machine Interface Design Requirements Standard
8.	240-56355815	Control & Instrumentation Field Enclosures and Cable Termination Standard
9.	240-109607736	Eskom KKS Key Part Standard
10.	240-109607332	Eskom Plant Labelling Abbreviation Standard
11.	240-55410927	Cyber Security Standard
12.	40-72926760	Operational Technology (OT) Operating Model
13.	240-56355731	Environmental Conditions for Process Control Equipment Used at Power Station
14.	EED Matla FS rev 1	Matla Power Station Refurbishment Project MV Switchgear Replacement Project Load Flow And Fault Study Report
15.	240-56357424	MV and LV Switchgear Protection Standard
16.	240-143485806	Generation auxiliary plant medium voltage protection standard.
17.	Type testing report 4419/38e, LD 3231	Standard low voltage switchgear 8PU with high level busbars and 3WN1 circuit breaker
18.	240-56227516	LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltage up to and including 1000V AC and 1500V DC Standard CONTROLLED
19.	SANS/IEC 61439-1	Low voltage switchgear and controlgear ASSEMBLIES. Part 1: Type-tested and partially type-tested ASSEMBLIES
20.	SANS/IEC 61641	Enclosed low-voltage switchgear and controlgear assemblies — Guide for testing under conditions of arcing due to internal fault
21.	240-56227589	List of Approved Electronic Devices to be Used on Eskom Power Stations Standard
22.	240-56361454	Undervoltage Protection Standard
23.	240-56176852	Essential Power Supplies for Power Stations Standard
24.	32-245	Eskom Waste Management Standard
25.	4444	Matla Power Station Risk Management Procedure
26.	474-305	Plant Equipment Risk Management Procedure
27.	13340-04	Matla Power Station Environmental Policy

7.7 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 *Site* Information.

Drawing number	Revision	Title
0.47/41120	1	New Ash Handling Plant Basic Flow of AWR and Slurry Pipelines
0.47/52549	0	Ash Handling Plant (Under PFA Silo1)
0.47/52550	0	Ash Handling Plant (Under PFA Silo2)
0.47/52551	0	Ash Handling Plant (Under PFA Silo3)
0.47/52552	0	Ash Handling Plant (Air Slide 1)
0.47/5255	0	Ash Handling Plant (Air Slide 2)
0.47/5255	0	Ash Handling Plant (Air Slide 3)
0.47/5257	0	Ash Handling Plant (Hydrobins)
0.47/5258	0	Ash Handling Plant (BBA Conveyors)
0.47/5259	1	Ash Handling Plant BBA Box (Mixers)
0.47/52560	0	Ash Handling Plant BBA Box (AWR and AWRSE Tanks)
0.47/52562	1	Slurry Pumping System

C3.2 *CONTRACTOR*'S WORKS INFORMATION