Eskom	MATLA POWER STATION SCOPE OF WORK	Document Identifier	14593	Rev	7
		Effective Date	October 2024		
		Review Date	October 2027		

PLANT AREA: Matla Power Station

TITLE: *Scope of Work Matla Power Station Simulator HMI Upgrade*

REF: MEC-05969	Reference Rev No: 0	MULTIDISCIPLINARY: Yes	Plant Level: All

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NB: Do not tamper with the template.

GENERAL

- Data books, reviews, reports, and diagrams/drawings shall be submitted to Engineering after the completion of the work. Engineering to forward the data books to Quality Department (Document Control)
- All QCP's to be submitted to Engineering and Quality for approval prior to outage/project or maintenance work commencement.

	SCOPE OF WORK DESCRIPTION / ACTIVITY	PROCEDURE, SPECIFICATION, ENG. REQUIREMENTS / DOCUMENTATION	HOLD POINTS, WITNESS, REPORTS	RESPONSIBLE PARTY
1.1	Occupational Health and Safety	• Health and safety file should be approved by Safety risk management department prior to any work commences on site • All work is to be done in accordance with OHS Act 85 of 1993, Matla plant procedures and Plant Safety Regulations. (240-150642762). • Matla power station SHEQ induction must be done before access to site can be granted • The contractor should ensure that all employees have acquired the required competency for the task they are performing. • The contractor to ensure compliance to updated legal requirements and other requirements. • **BUY QUIET:** All stakeholders are encouraged to purchase or rent quieter machinery, equipment, and tools to reduce worker noise exposure, contribute towards compliance to OHSA noise exposure limits and ultimately reduce the risk of noise induced hearing loss.	Eskom to witness.	Contractor

1.2	Environmental Management. .	• All activities listed in the National Environmental Act 107 of 1998, EIA Regulations as amended, must have environmental **AUTHORISATION** before commencement of work. • The contractor shall comply with all applicable legal and other requirements. • The polluter pays principle will be applied. • The contractor manager shall ensure compliance with Eskom Matla Environmental procedures to ensure the prevention of pollution (refer: OMOP 4090 and 4402). • The last payment will be processed based on the status of the last housekeeping check sheet (Annexure C: OMOP 4402) of designated area. • EMS file based on ISO14001 will be required.	Eskom to witness.	Contractor
1.3	Quality Management	• The contractor/executioner of work will be responsible for drawing up all QCP documentation and this must be approved by engineering and authorised by the Quality Department before commencing with the work. • Contractors/executioner to adhere to QM 58 and OMOP4497 requirements • Number of NCR issued can affect your next tendering process. • The QCP shall be signed progressively by the Engineer/Supervisor, Eskom QC Inspector, Contractor QC Inspector and/or AIA. • No procuring of outage items without the approval of scopes by quality • All outage scopes creep and scopes addition should be approved by quality • No contractor should be in the possession of scopes for execution without the scopes approved by quality	Hold point	Contractor

		• The contractor is subjected to quality auditing at any point in time during execution of scope		
1.4	Inputs from other departments			
1.5	Commissioning reference			

	SCOPE OF WORK DESCRIPTION / ACTIVITY	PROCEDURE, SPECIFICATION, ENG. REQUIREMENTS / DOCUMENTATION	HOLD POINTS, WITNESS, REPORTS	RESPONSIBLE PARTY
1.	Refer to Appendix 1 for detailed scope of work information	Requirement	Witness	Contractor

SOURCE & Ref No.	Yes	No	N/A	Comments
Previous outage service reports			x	
Return to service data packages			x	
Maintenance Strategy with Rev number			x	
SAP defects (attach list as appendix)			x	
GHRMS (STEP) reports (Generation Heat Rate Management System)			x	
Online Condition Monitoring			x	
Pre-outage performance test results			x	
Post outage performance test results			x	
GPSS/ Plant Performance data on UCLF incurred			x	
OMS / IIRMS recommendations (Audits Reports)			x	
Risk controls (IRM system)			x	
Previous audits and reviews (e.g. ERAP)			x	
Engineering Change Requests (Projects)			x	
LOPP strategy reports			x	
URS			x	
Philosophy (Outage)			x	

Condition Monitoring Report			X	
VA/PHD Viewer trends			X	
Corrective Actions			X	
CARAB reports			X	
Statutory Requirements			X	
Grid code requirements			X	
Waivers and Exemptions			X	
Calibration requirements			X	
Previous Outage SOW variations			X	
Post Mortems Actions from previous outages			X	
Pre–Outage plant walks			X	
Risk based inspection (RBI) report			X	
Simulation, TOIs, OON, SI			X	

COMMENTS

APPENDIX A

Eskom	Specification	Technology

Title:	**Simulator Upgrade Project Technical Specification**	Unique Identifier:	**373-MAT--AABZ18-PN0012-6**
		Alternative Reference Number:	**N/A**
		Area of Applicability:	**Engineering**
		Documentation Type:	**Specification**
		Revision:	**1**
		Total Pages:	**39**
		Next Review Date:	**N/A**
		Disclosure Classification:	**CONTROLLED DISCLOSURE**

Compiled by	Functional Responsibility	Authorised by
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Date: 21/02/2022	Date: 21/02/22	Date: 23.02.2022

CONTENTS

TABLES

1. INTRODUCTION

This document contains Matla Power Station C&I Technical Specification for the Unit Simulator Upgrade Project. The project aims at improving the fidelity of the current Simulator, providing advanced scenario training and to address the obsolescence of the Simulator hardware and software components and the UPS installed due to the OEM no longer supporting the current software and hardware installed.

2. IDENTIFICATION

The system to be upgraded is the Matla Unit Simulator. The identification of the system is indicated in the following design drawings:

- 0.47/0000000 Simulator Switch Cabinet Layout
- 0.47/56001 Simulator Network Layout
- 0.47/56113 Server Cabinet Layout
- SIM-U0386/20/19 Simulator Room Trunking Layout
- SIM-U0386/71/04 Simulator Room HVAC Layout

3. SUPPORTING CLAUSES

3.1 SYSTEM OVERVIEW

Matla is a coal fired power station consisting of 6x 600MW units. Each of the six units at Matla has its own unit control desk where the operator monitors it.

The Simulator is standalone system used primarily for the training of the *Employer's* operating staff, qualify and certify them to operate the unit's control desk.

The Simulator, in the long term, in addition to the operator training is used to train the technical staff in detailed process response and control and to perform engineering analysis test prior to implementation of modifications on both the process and the control logic of the implemented control and instrumentation system.

3.2 SCOPE

The scope of this document is limited to the upgrade of the Simulator components such as control system emulator, HMI and logic application software, instructor station, the plant model and UPS in order to address the issue of obsolescence.

This scope of the *Contractor* includes improving the fidelity of the Simulator in order to provide advanced scenario training to operating, maintenance and engineering.

3.2.1 Purpose

This document provides the Engineering input to be included in a Contract document based on the NEC conditions of contract. The purpose is not to include this document as an appendix to the contract document but as an input to the Works Information.

3.2.2 Applicability

This document is applicable to Matla Power Station.

3.3 NORMATIVE AND INFORMATIVE REFERENCES

3.3.1 Normative

Table 3-1 – Applicable Regulatory and Statutory Documents

Document title		Document number
[1]	Fossil Firing Regulations Standard	240-105453648
[2]	Fossil Fuel Power Plant Simulators, Functional Requirements	ANSI/ISA 77.20

Table 3-2 – Applicable Standards and Codes

Document title		Document number
[3]	Technical Requirements for Power Plant Simulators Standard.	240-154243686
[4]	Maintaining Training Facilities and Equipment	240-46315093
[5]	Virtualization of Control Systems Technology Standard	240-159991017
[6]	Generation Operation Training Requirements Specification for Power Plant Simulator	240-158191826
[7]	Project/ Plant Specific Technical Documentation and Records Management Work Instruction	240-96992014
[8]	KKS Coding Standard	240-93576498
[9]	Eskom KKS Key Part Standard	240-109607736
[10]	Plant Labelling and Equipment Description Standard	240-71432150
[11]	Requirements for Control and Power Cables for Power Stations Standard	240-56227443
[12]	Earthing and Lightning Protection Standard	240-56356396
[13]	Alarm Management System Guideline	240-56355466
[14]	Human Machine Interface Design Requirements Standard	240-56355728
[15]	Environmental Conditions for Process Control Equipment Used at Power Stations Standard	240-56355731
[16]	Cyber Security Standard for Operational Technology	240-55410927
[17]	Information Security – IT/OT and Third Party Remote Access Standard	32-373
[18]	Demilitarised Zone (DMZ) Designs for Operational Technology	240- 79669677
[19]	User Requirement Specification for Fossil Fire Power Plant Simulators	36-1422

3.3.2 Informative

The following documents as listed in Table 3-3 below, although not invoked in this specification, provide additional information or examples.

Table 3-3 – References

Document title	Document number
[20] Design Review Procedure	240 - 53113685
[21] Quality Management Systems	ISO 9001
[22] Systems and software engineering, Life cycle processes, Requirements engineering.	ISO 29148
[23] Engineering Change Management Procedure	240-53114002

3.4 DEFINITIONS

Definition	Description
Approved by	The accountability of the Approver of the document is equivalent to the specified role of Functional Responsible/Owner as identified in 240-53114186 and 32-6 for Documents and Records Management.
Fidelity	The degree of both physical and functional realism.
Reference Plant	The specific power plant area (typically a power island) from which the Simulator control room configuration, the system control arrangements, and the Simulator database are derived.
Power Island	It consists of the core generation components of a power plant e.g. the boiler, turbine, and generator systems. The specific set of plant systems that form a power island is dependent on the applicable power plant's configuration and design.
Balance of Plant	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.
Black-box	It is a standalone device or group of devices that is independent of the plant's main control system or DCS. The black-box may perform process interface, control and/or supervision tasks; all of which are performed independently of the plant's main control system or DCS.
Control System	It is an electronic based system to control and operate process plant. It is a system that responds to inputs from the process and/or from an operator and generates outputs that cause the process to operate in the desired manner. The two main types of control systems used in the process industry are distributed control systems (DCS) and programmable logic controllers (PLC).

Replicate	To imitate the reference plant in such a way as to copy hardware, processes, and data, but not to the point of making substitution possible.
Simulation	The mathematical representation/modelling of physical process and control systems.
Emulation	Software solution that exactly mimics the hardware and software of the reference's plants actual control system. It's a complete replication of the actual plant's control system. Fully emulated systems use an emulation of both the control logic and the operator interface. Emulation is achieved by translating the plant control logic and graphics into the Simulator environment, effectively reproducing the functional operation of the actual controls and the graphic interface of the HMI. With an emulated solution, the simulation vendor uses the actual proprietary plant software code and data file from the DCS vendor to create the solution in the Simulator. This produces the highest fidelity Simulator solution possible. With a simulated solution, a software engineer will produce a lower fidelity, simplified functional model based on a functional description of the plant system.
Engineer	Qualified and competent engineer that performs the engineering and maintenance function of the Simulator system
Instructor	The Instructor is the appointed Simulator training facilitator that is responsible to provide Simulator training to the Trainee.
Trainee	The Trainee is the person receiving training on the Simulator.
Vendor	Simulator supplier.

3.4.1 Disclosure Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

Table 3-4 – Definition of Terms

Term	Definition
Availability	Relates to the ability of the system-of-interest to be accessed and operated when needed.
Constrained	A statement that expresses measurable bounds for an element or function of the system. That is, a constraint is a factor that is imposed on the solution by compulsion and may limit or modify the design changes.
Maintainability	Relates to the ability of the intended system to be easily serviced or repaired, including the ability to be easily diagnosed. In this context, maintainability is synonymous with 'Repairability' or 'Serviceability'.
May	Expresses a non-mandatory suggestion with optional compliance by the implementer.
Must	Preferably not used in requirement statements.

Term	Definition
	If both "shall" and "must" are used there is an implication of difference in the degree of responsibility upon the implementer, which is undesirable.
Shall	Expresses a mandatory demand or a binding requirement.
Should	Expresses a non-mandatory preference, desire, target or recommendation. Other implementations of the requirement can be accepted, but the implementer (if challenged) should be able to demonstrate that these other implementations are equivalent or better.
Reliability	Relates to the ability of the intended system to perform within the specification limits with correct and consistent results over time. This includes the numerical reliability characteristics (with confidence levels, if appropriate).
Will	Expresses the future tense or a declaration of intent. For example, "The operator will initialise the system by..." conveys an item of information for the designer but it does not constitute a requirement on the designer.

3.5 ABBREVIATIONS

Abbreviation	Description
ABAT	As Built Acceptance Test
KKS	Plant Coding System
ANSI	American National Standards Institute
CAT	Capability Acceptance Test
C&I	Control and Instrumentation
CPU	Central Processing Unit
DCS	Distributed Control System
DF	Design Freeze
ECM	Engineering Change Management
FAT	Factory Acceptance Test
HMI	Human machine Interface
HVAC	Heating, ventilation, and air conditioning
KVM	Keyboard Video Mouse
NAS	Network Storage Centre
OEM	Original Equipment Manufacture
OS	Operating System
OT	Operational Technology
PB	Push Button
PC	Process Computer
PCM	Process Control Manual
PS	Power Station
RAID	Redundant Array of Independent Disks
RFT	Ready For Training
RAM	Reliability, Availability and Maintainability

Abbreviation	Description
ROC	Required Operational Capability
SAT	Site Acceptance Test
SCCC	Site Change Control Committee
SIT	Site Integration Test
SRD	Stakeholders Requirements Definition
VAT	Verification Acceptance Test
VDU	Visual Display Unit
UPS	Uninterruptable Power Supply

4. ROLES AND RESPONSIBILITIES

Matla Project Management and Engineering are responsible to produce the Works Information that will ensure that the technical requirements packaged in the Technical Specification is clearly explained and implemented to meet the Simulator Upgrade Project. Matla Project Management is further accountable to manage the scope packaged in the Works Information Related / Supporting Documents.

4.1 PROCESS FOR MONITORING

The Engineering Change Management Procedure and relevant PCM's will be used for monitoring of the project. Changes to the project will be captured through this procedure. All the design work to be executed and reviewed according to Design Review Procedure. Additional Verification and Validation process will be determined during the project as and when required.

5. WORKS TO BE PERFORMED BY THE *CONTRACTOR* FOR THE WORKS

5.1 EXECUTIVE SUMMARY

Matla Power Station is a coal fired power station that was built and commissioned in the early eighties and is located near Kriel in Mpumalanga, South Africa. It is a base-load plant with a total station capacity of 3600 MW. Matla Power Station consist of Unit area and Outside Plant area. There are six units, each unit consist of one Babcock Boiler with six mills and six turbines.

Matla Power Station Simulator reference unit uses the ABB Melody DCS with 800 xA. The control system is made up of several components such as Automation Networks and Processors, Communication Networks and Servers, Operator Interfaces, Engineering Stations, Information Systems. Features such as control and monitoring, diagnostics, archiving and trending, alarming and online engineering are available with the system.

The Matla unit's Simulator was implemented at the beginning of 2008 as part of the C&I Refurbishment Project. The Simulator at the time was developed with limited process data and before the control system was upgraded on the units. At the time the primary purpose was to develop the Simulator to the point that the operators could be trained to perform a complete cold start-up to full load and shutdown with the new system before it was installed in the plant.

The Station is experiencing obsolescence and support issues with the Simulator control system components. The upgrade is aimed at improving the Simulator fidelity and increase the effectiveness of the Simulator for training purposes.

The hardware and software upgrade project aims to address the obsolescence faced by the Station. This involves upgrading of all obsolete electronic equipment associated with the emulator servers, switches, HMI and network components to the latest available technologies offered by the OEMs.

Furthermore, the Station has identified the opportunity to upgrade the obsolete UPS powering Simulator equipment.

Engineering, design, procurement, manufacturing, factory acceptance testing, delivery, off-loading at site, storage, installation, testing, commissioning, capability testing, decommissioning of existing hardware and as-built documentation for the complete Simulator upgrade scope.

Upgrade of obsolete systems and provision of new additional systems in order to comply with the *Employer's* standard 240-154243686 Technical Requirements for Power Plant Simulators Standard.

All plant arears controlled, displayed and alarmed from the reference unit's control system are included in the Simulator modelling scope.

The Simulator modelling scope includes all plant arears which are not controlled by the reference unit's main control system but which are controlled from 3rd party control systems (eg Turbine Control and Protection System, Precipitator Management System) while still operated from the reference unit's operating desk.

All plant models are designed based on first principles to simulate plant operation from cold start-up to maximum, taking to consideration the effects of changing parameters such as pressure, flow and level and also the effects of these parameters due to starting and stopping of all plant auxiliary equipment. All models provide response of the same magnitude and direction as the plant would give under and equivalent set of circumstances.

The control system models are a complete duplication of the systems simulated including all controllers, mode selection, interlock and alarm functions. Control system models for motors, actuators, solenoids valves and similar devices simulated include all permissive, alarms outputs, interlocking and tripping functions. The scope of supply by the *Contractor* includes the following:

- Trainee workstations
- Instructor workstation
- Engineering workstation
- Plant model workstation
- Video workstation
- Required equipment stands
- Emulation Server
- Simulation Server
- Application Server
- I/O Server
- Sound generator
- Essential Measurement Instrumentation screen
- Printers
- Network design and cabling
- Switches
- Time Synchronisation

- Cameras and microphones
- Network attached storage (NAS) for the recording of audio and video system
- Latest software versions
- New UPS
- Backups and disaster recovery procedures
- Training
- Simulator Documentation

The *Contractor's* scope further includes:

- Removal and/or relocation of existing Simulator equipment
- Cabling and racking
- Power supply distribution and interfacing
- Testing and commissioning, including FAT, SIT and capability.
- Simulator codification and labelling of all equipment supplied as part of the *works*
- Earthing of all Simulator supplied equipment as part of the works.
- All activities, services or equipment specified (special tools, consumables, etc).
- All software, license and copyright agreements for the works.

5.2 SIMULATOR USE

The Simulator is used primarily for the training of the *Employer's* operating staff.

The Simulator, in the long term, in addition to the operator training is used to train the technical staff in detailed process response and control and to perform engineering analysis test prior to implementation of modifications on both the process and the control logic of the implemented control and instrumentation system.

The *Contractor* provides the Simulator that is capable of simulating the following as a minimum:

- Complete plant start-up
- Plant shut downs
- Load changes
- Normal operating conditions
- Abnormal operating conditions
- Emergency conditions
- Engineering analysis test and control logic testing

5.3 INFRASTRUCTURE PROVIDED BY THE *EMPLOYER*

5.3.1 Simulator Building

The *Employer* provides the rooms in which the Simulator equipment and UPS is located. The rooms are located at the Simulator building at Matla. The following rooms are provided by the *Employer*:

- Instructor room
- UPS room
- Server room
- Trainee operator room

5.3.2 The Simulator room design

The *Employer's* existing Simulator room design consist of the following:

- Floor tiling
- Ceilings that suits the environment
- Electrical plugs points
- Electrical lighting
- Wall finishes
- Top access for cabling
- Air conditioning
- The furniture

5.3.3 Trainee Control Room Desk Configuration

The *Employer's* desk configuration consist of the following:

- Trainee Control Desk
- Trainee operator chairs
- Existing Flip system

5.3.4 Instructor room configuration

The Instructor desk configuration consist of the following:

- Instructor Desk
- Chair/s
- Printer table
- Locker for the Instructor

5.3.5 Server Room

The server room configuration consist of the following:

- Air-conditioning
- Old server and switch cabinet(which is part of the works)

5.3.6 UPS Room (Electrical)

The UPS room configuration consist of the following:

- Air-conditioning
- UPS, Batteries and Distribution board

5.4 INFRASTRUCTURE PROVIDED BY *CONTRACTOR*

The *Contractor* provides the following:

- Power requirements
- Channelling of new cabling
- Position of equipment and hardware
- Equipment mounting
- Any special isolation from electromagnetic interference
- Any additional electrical plug point for new equipment
- Provision of LAN connections and routing to each desk area where additional connections are required
- Any required equipment stands or table extension
- New layout drawings
- Hardware required for the Simulator upgrade
- Assessment of the existing infrastructure(cabling, desk push buttons ect)

The final requirements and layouts of the desk and hardware is discussed and clarified during the unit Simulator system engineering phase (technical clarification meetings). The new layouts design by the *Contractor* for the Simulator room equipment is provided to the *Employer* for acceptance.

The *Contractor* is responsible for verifying and identifying all scope requirements for the Simulator as part of the *Contractor*s engineering and design effort in order to meet the functional and performance requirements of the works.

5.5 SIMULATOR METHODOLOGY

The project Execution Methodology describes the methodology to be adopted by the *Contractor* for executing the whole works.

The methodology required for the execution of the Simulator is described in the *Employer's* standard: 240-154243686 Technical Requirements for Power Plant Simulators Standard.

The *Contractor* undertakes all activities of engineering and design from basic engineering through technical clarifications, detailed engineering, system development, install and commissioning, acceptance testing, up to handover.

The *Contractor* is responsible for the supply of engineering deliverables in the form of documentation relevant to different activities as stated in the VDSS in Appendix A.

It is the responsibility of the *Contractor* throughout the execution of different contract activities to address the following and obtain the acceptance from a Project Manager:

- Recommend any cost effective proposals
- General assessment of the suitability of the information provided by the *Employer* to achieve the required performance standard
- Translation and incorporation of all mechanical, process and electrical documentation into the *Contractor*'s documentation format ensuring integrated documentation.

A fully integrated, high fidelity working Simulator is provided which meets the safety, reliability and operability criteria as detailed in the works.

6. SYSTEM ENGINEERING

During system engineering phase the *Contractor* performs the standard activities of system engineering as outlined in the sections of this works.

The *Contractor* may use the reference unit's data and the existing Simulator to collect data.

Collection and validation of data for the design of the Simulator is the responsibility of the *Contractor.*

In the event that the *Contractor* determines that a void or conflict in the design data exist, the *Contractor* identified such void or conflict and proposes alternate data, methods of filling the void or resolution of the conflict and submits the proposed solution to the *Employer* for acceptance.

The *Contractor* is responsible for validating and updating of all design data in the Simulator data register.

Design freeze for the Simulator is where the *Employer* accepts the final performance, functional, scope and equipment specifying documents for the unit Simulator and the *Contractor* is authorized to proceed with detailed engineering and design.

The *Contractor* submits documentation at design freeze for acceptance by the *Employer.* Documentation is submitted as per the VDSS Appendix A

6.1 TECHNICAL CLARIFICATION

Technical clarification is where the *Contractor* undertakes the engineering and design activities to clarify with the Project Manager all technical issues to permit the *Contractor* to undertake the basic engineering phase.

All equipment having long delivery times is planned and technically clarified early in the technical clarification stage.

The technical clarification and design freeze activities are phased to suit the Accepted Program.

In the technical clarification, Project Manager reviews the updated performance, functional, and equipment specifying documentation and the *Contractor* prepares formal documentation for design freeze.

As the design and documentation is agreed between the *Contractor* and the Project Manager, it is formally signed off as accepted by the Project Manager.

Design freeze is where the Project Manager accepts the final performance, functional, and equipment specifying documentation as defined in Appendix A - VDSS and the *Contractor* is authorised to proceed with detailed engineering.

6.2 REFERENCE UNIT

The *Employer* defines the reference unit at Basic design.

6.3 SIMULATOR DEVELOPMENT

The Simulator development is done in South Africa.

The Simulator developed by the *Contractor* is a replica of the reference unit.

The *Contractor* is responsible for the development of the high fidelity Simulator, the alarm management as per the reference units design philosophy.

6.4 BASIC ENGINEERING

Basic Engineering is defined as being all activities to clearly identify the *Contractor*'s scope of work for the Simulator concerned

As a minimum, Basic Engineering consists of the following activities:

- High level engineering concepts- during which the rules, concepts followed in the various engineering and design activities are clearly defined, clarified and accepted.
- Scope definition –during which detailed scope definition and clarifications are performed.

The Basic engineering activities are phased to suit the accepted Program.

All equipment having long delivery times are planned and technically clarified timeously during Basic Engineering to allow Detailed Engineering to commence in parallel.

The *Contractor is* responsible to:

- Identify any discrepancies that would lead to shortcomings in the design and making the *Employer* aware of such discrepancies.
- Provide recommendations, where applicable, and take action to resolve such discrepancies.
- Correct any discrepancies found in the design after Basic Design Freeze.

6.5 HIGH LEVEL ENGINEERING CONCEPTS

As a minimum, the *Contractor* develops and clarifies the documents defined as being required for Basic Engineering in Appendix A- VDSS.

6.6 SCOPE DEFINITION

As a minimum, the *Contractor* develops and clarifies the documents as being required for Basic Engineering Design Freeze in Appendix A- VDSS for approval by the Project Manager.

As a minimum, the *Contractor* verifies and clarifies the following documents provided by the *Employer*:

- Model parameters
- Rooms and existing equipment
- Existing drawings

7. DETAILED ENGINEERING

7.1 GENERAL REQUIREMENTS

Detailed design is defined as being all activities required to translate the *Contractor*s scope of work, as defined at Basic Engineering design freeze, into fully functional system(s).

As a minimum, detailed engineering consist of the development, technical clarification and acceptance of the documents required for the Detailed Engineering design freeze as defined in Appendix A-VDSS.

Detailed Engineering activities are conducted on the System Function Groups which will be defined by the *Contractor*.

Detailed Engineering activities of the interfaces within the works and the interfaces to other systems, forms part of the works

The *Contractor* performs the Reliability, Availability and Maintainability (RAM) studies in order to meet the required system performance requirements as Section 18.

The *Contractor* schedules a minimum of 2 design review meetings during this phase.

During the design review meeting the *Contractor* and *Employer* review progress to date and conduct detailed review and validation of the developed Simulator models.

The *Contractor* prepares a design report in preparation for each review meeting. The design reports are submitted to the *Employer* 5 working days prior to the relevant design review meeting.

The *Contractor* submits documentation as listed in the VDSS at production engineering for acceptance by the *Employer*.

7.2 PROCEDURE FOR SUBMITTING AND ACCEPTANCE OF *CONTRACTOR*'S DESIGN

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

- The *Contractor* submits the documents/drawings to the Project Manager.
- The Project Manager register the documents.
- The Project Manager will supply the documents/drawings to all relevant parties within the Project Manager's project team.
- The Project Manager's 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.
- If the Project Manager finds major deficiencies in the submitted documents/drawings the *Contractor* revises the documents/drawings and resubmits to the Project Manager.
- The Project Manager reviews the document/drawings and if no major deficiencies are found, the *Contractor* organizes a Design Review session.
- The Project Manager and the *Contractor* conduct a Design Review.
- If any fundamental errors were found in the design or further actions are required, the *Contractor* records all concerns raised and revises the designs.
- The *Contractor* organizes a Design Review session once all the designs were revised according to the concerns raised by the Project Manager.
- If no fundamental errors were found in the design during the Design Review sessions, the *Contractor* compiles the Design Review minutes or report and submits to the Project Manager.
- The Project Manager registers the report.
- The Project Manager will accept the *Contractor*'s design once the report are accepted by the Project Manager's team.

7.3 DESIGN REVIEW PROCEDURE

The *Contractor*'s is the Design Authority as defined in the Design Review Procedure (240-53113685).

The *Contractor* is responsible for following this design procedure and conducting all the design reviews as specified in this procedure.

The *Contractor* is responsible for conducting the following design reviews:

- Basic Design Reviews
- Detailed design reviews
- Integrated design reviews
- Construction review
- Acceptance review

7.4 PROJECT ENGINEERING CHANGE PROCEDURE

The *Contractor* takes note of the *Employer*'s Project Engineering Change Procedure (240-531144026). An engineering change includes any proposed change originating from *Contractor's* engineering, project management or construction management.

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

7.5 CONFIGURATION MANAGEMENT

A comprehensive configuration management program ISO is provided as part of the works to ensure that Simulator components, computer software conform to approved design requirements

"As built" physical and functional characteristics is accurately reflected in documents and database, including those for design, procurement, construction, operation, testing and training

The configuration management program is applicable for use throughout all phases of the project life cycle, including that of management of spare parts, replacement parts and products upgrades, and is part of deliverables at Handover to the *Employer* for use during the operation and maintenance phases of the plant. All simulator components shall be KKS coded.

7.6 SYSTEM INTERGRATION

The *Contractor's* works include test and verification of individual software and hardware components of the design specification as agreed upon at Design Freeze as well as integration of all hardware and software of the works.

The *Contractor* integrates all the works including the 3rd party systems.

The *Contractor* is responsible for the integration of the plant model, emulation system and the process automation system application software

8. SYSTEM REQUIREMENTS

8.1 GENERAL REQUIREMENTS

The *Contractor's* plant investigation, installation and commissioning are done at site, Matla Power Station, and the basic engineering is done in South Africa.

The *Contractor* provides all material, equipment and services necessary for the obsolete Simulator hardware and software upgrade scope.

The *Contractor* includes all equipment, devices and services which are not specifically mentioned within this Works Information document, but are necessary for the completeness of the design, equipment and systems, meeting the functional intent and requirements of the works.

The solution is consistent with modern power plant best practices, and is in compliance with all applicable standards, guidelines and statutory regulations and functional safety requirements.

For the duration of the works, the *Contractor* provides specialist expertise, in accordance with the activities during the various project phases for:

- The upgrade that will be undertaken as part of the works
- Identifying the commissioning strategy, planning and execution on the Simulator. The specialist and resources does not change during that specific phases for the sake of continuity unless required by the Project Manager.

The plant responses as simulated by the Simulator are identical in time and response to the actual reference plant time and responses under similar conditions. Operator training is thus performed in an environment that is identical to that of the reference plant.

The *Contractor* provides a high fidelity training Simulator as part of the works.

All critical functions, major plant components and auxiliaries that directly affect the primary operation of the plant, are modelled with high fidelity to provide a high degree of realism to the operator.

The entire Simulator is provided in accordance with 240-154243686 Technical Requirements for Power Plant Simulators Standard and 240-55410927 Cyber Security Standard for Operational Technology.
The Simulator is provided with functionality as described in the standard ANSI/ISA-77.20-2012 Fossil Fuel Power Plant Simulators Functional Requirements.

The *Contractor* submits the model simulation fidelity requirements for total simulation to the *Employer* for acceptance prior to design freeze.

The *Contractor* upgrades the existing UPS for the Simulator equipment.

The Simulator design allows for expansion and future modifications.

8.2 PLANT MODEL

The plant model is defined as the physical model of the plant (contains models of the plant equipment (level, temperature, flow etc.) and equipment behavior.
The *Contractor* provides an integrated industry standard development software package. The front end of the development software package for plant models and C&I employ object orientated functionality making it user friendly to Operating and Maintenance engineers in the long term, without the need for manual intervention and or/specialist Simulator engineering skills.
The plant models simulates the actual mechanical plant, based on first principles, accurately simulating operational parameters for all components of the plant/process.
Plant model shall comply with Section 3.2.3 and Section 3.2.1.5 of 240-154243686 Technical Requirements for Power Plant Simulators Standard.

8.3 EMULATOR (DCS)

The emulator consists of the control system emulator. The *Contractor* implements the emulator using proven industrial technology.

Emulator complies with Section 3.2.2.9 to 12 of 240-154243686 Technical Requirements for Power Plant Simulators Standard.

The *Contractor* provides as part of the works a complete engineering facility for the Simulator. The engineering facility for the Simulator allows the *Employer* to perform engineering, maintenance and/or development on all the Simulator subsystems and programs.

The Simulator engineering facility is integrated as part of the Simulator and comply with the requirements in Section 3.2.1.3 of 240-154243686 Technical Requirements for Power Plant Simulators Standard.

8.4 INSTRUCTOR STATION

Instructor station defined as the interface point between the instructor and the simulation software. Through this workstation, the instructor controls the simulation process, initiates functions, malfunctions, and manipulates plant model variables.
The Instructor workstation shall comply with 240-154243686 Technical Requirements for Power Plant Simulators Standard.

9. SIMULATOR FUNCTIONAL REQUIREMENTS

The *Contractor* engineers a high fidelity Simulator.

The Operator training Simulator is provided with functionality described in the standard: ANSI/ISA-77.20-01-2012 Fossil Fuel Power Plant Simulators Functional Requirements.

The Simulator shall be a replica of the reference unit which will be defined by the *Employer* at Basic design.

The Simulator complies with the functional requirements described in Section 3.1 of 240-154243686 Technical Requirements for Power Plant Simulators Standard.

9.1 SIMULATOR NON-FUNCTIONAL REQUIREMENTS

The Simulator non-functional requirements shall comply with the requirements in section 3.2 of 240-154243686 Technical Requirements for Power Plant Simulators Standard and 240-158191826 Generation Operation Training Requirements Specification for power plant Simulator.

9.2 SIMULATOR PERFORMANCE REQUIREMENTS

The Simulator provided by the *Contractor* is capable of simulating the following systems:

- All systems controlled, displayed and alarmed from the control room's reference unit
- Capability to simulate modified plant designs, different process scenarios and plant conditions.

The Simulator performance criteria complies with ANS/ISA-77.20-2012 Fossil Fuel Power Plant Simulators Functional Requirements.

9.3 SIMULATOR HARDWARE

9.3.1 General Requirements

The *Contractor* provides all hardware necessary to fulfil the works.

The Simulator hardware complies with the requirements in Section 3.2.1 of 240-154243686 Technical Requirements for Power Plant Simulators Standard and Section 3.1 of 240-158191826 of Generation Operation Training Requirements Specification for Power Plant Simulator.

As a minimum, the *Contractor* provides the following hardware equipment but not limited to:

- Trainee workstation
- Engineering workstation
- Instructor workstation
- Plant model workstation
- Simulator servers
- Sound generator
- Essential Instrument screen
- Printers
- Network and network switches
- Time synchronisations hardware
- Cameras and microphones
- Network attached storage

The *Contractor* shall perform an assessment on the existing server cabinet, switch cabinet, trainee desk push buttons and verifies if they can be reused, and if equipment is deemed functional and in good working order, the *Contractor* will incorporate this equipment in his works.

Operator interface (servers, PCs, workstations, VDU based systems, network and communication systems) shall be supported for 6 years.

9.3.2 Servers

The minimum specification for control server hosting operating, engineering, supervisory applications and plant information as well as the operating and engineering database are as follows:

- Redundant CPU
- Hot swappable redundant power supplies
- 19" Rack mounted
- Redundant case fans

Power supply distribution to servers is the responsibility of the *Contractor.*

Unauthorised access is denied on all servers

9.3.3 Switches

The network switch shall be compatible with the operating system

Switches are located in a network cabinet, shall be of industrial Ethernet type and suitable for an uncontrolled & harsh environment conditions.

Unused ports are blocked via network management system and can be activated when required.

Any software required when replacing the switch is supplied as part of the works together with the procedure to configure a switch.

9.3.4 Workstations

The operator workstation is the primary interface of the operating plant personnel.

Trainee and the engineering workstation functionality, quantity, type, specification, configuration, peripherals and layout shall be a replica to that of the reference unit.

9.3.5 HMI

The HMI application software and its functionality (graphics, alarms, faceplates, trends, process tags, etc) is identical to the reference unit.

9.3.6 Printers

Printers are provided at Trainee control room and Instructor room for logs, reports, hard copies and other documents on request by operators, engineers and maintenance personnel.

As a minimum, all printers provided by the *Contractor* are laser printers with A3 and A4 printing capabilities.

The *Contractor* decommissions all old printers and hand them over to the Employer.

9.3.7 Printer Stands

The *Contractor* provide a suitable table or stands for the Trainee control room printer, the printer stand subjects to acceptance by the *Project Manager*.

The Instructor room printer shall use the existing table. All systems should be connected to all printers provided.

10. Simulator Software Requirements

The *Contractor* provides the Simulator software in accordance with the requirements in Section 3.2.2 of 240-154243686 Technical Requirements for Power Plant Simulators Standard and Section 3.2 of 240-158191826 Generation Operation Training Requirements Specification for Power Plant Simulator.

All software patches, bug fixes, and software upgrades for the systems are provided throughout the duration of the works

Upgrades are undertaken to correct any deficiencies, defects and bugs found with the installed software

The Simulator software shall include, as a minimum, the following software programs:

- Software plant models, which simulate continuously in real time the behaviour of the simulated reference plant(s) systems over the entire range of normal, abnormal, and emergency conditions.
- Functional fidelity of the Simulator should be based on the reference unit.

- Instructor station software, which provides the instructor with the necessary Simulator control and trainee monitoring functions.
- Development and maintenance software necessary to update the plant models
- Computer operating systems and utility software
- All software, license and copyright agreements for the works.

10.1 User Management

User management is provided for each user of the C&I system of the Simulator to manage all users, user rights and user authentication.

The functionality provided by the user management system includes-but not limited to the following:

- Issuing and monitoring authorisations i.e. user administrator
- Logging all permissible connections and manually reporting thereof
- Access security
- Management of user's rights across all software packages such that it is possible for each user to have a user-defined username and password to access the different software packages
- Configuration of each user's access rights or access level across the different software packages

Passwords can be changed at regular intervals

10.2 Data and Configuration Backup Recovery

The backup and restore software shall have the following features in accordance with the requirements in Section 3.2.2 of 240-154243686 Technical Requirements for Power Plant Simulators Standard:

- Recover a server or a workstation from scratch.
- Restore images to machine with different hardware.
- Restore small portions of the image, a single file, or directories.
- Recover from an online or offline backup

11. External Environmental Requirements

11.1 NETWORK CABINETS

The following types of equipment are located in a network cabinets unless specified otherwise or elsewhere in this document:

- Servers
- Switches
- Workstations

- Automation network equipment
- Power Distribution Units (PDU's)

11.2 NETWORK CABINET PHYSICAL CHARACTERISTICS

Each network cabinet has the following characteristics:

- Front and rear access
- Network cables and power cables shall be separated(not use the same rack at entry)
- The cabinets doors shall be lockable
- The design of the cabinet ensures that the air flow is managed correctly
- Internal cable management systems are used for both horizontal and vertical cable management
- Intelligent rack mounted power distribution units(PDUs) are used
- A single rack mounted LCD & Keyboard per network cabinet for access to all servers and workstations contained in the cabinet concerned

11.3 NETWORK CABLING

Network cabling is defined as being all cabling forming part of the automation network.

Network cabling and associated infrastructure are provided as part of this project

The scope includes design, supply, installation, termination, labelling, testing and commissioning.

Where new routes for network cabling and any power supply cabling are required, these are of a consistent and integrated design that takes into account cabling and racking routes for common modes of failure and the redundancy that is required in order to prevent a single point of failure.

12. CABLE SCHEDULES

Accurate records are kept in Cable Schedules for all cabling

The cable schedules are provided inclusive of origin, location, details, revision, target, type, size and termination details

Termination schedules are to be provided for all cables

All network cabling that is required to be routed separately from each other is defined

A cable stock schedule is kept to record all cables delivered to and removed from site.

The *Contractor* provides a cable management system for duration of the works for acceptance by the Project Manager.

13. POWER SUPPLY AND DISTRIBUTION

Contractor is fully responsible for Simulator power distribution design, cabling and commissioning to all C&I equipment.The power supply distribution design complies with 240-56227443 Requirements for Control and Power Cables for Power Station.

14. INTERFACE REQUIREMENTS

The following has been identified as interfaces:

14.1 OPERATOR/TRAINEE INTERFACES

The *Contractor* design ensures that the Simulator HMI presents the same interfaces as the reference unit at Matla. Such interfaces includes but not limited to:

- Turbine Control and protection system
- Electrical systems (AVR, Metering, Gen protection, etc.)
- Dust handling plant
- Bottom ash
- Emissions monitoring and control
- Outside plant indications
- Precipitators Interface

14.2 SYSTEMS INTERFACES

The *Contractor* performs an assessment on already installed Permit to work system: A "dummy" key safe for the issuing of simulated permits, to determine if it can be reused.

Eskom workstation (Ops- suite system) - This system hardware and software does not form part of the scope. It is available and will not be decommissioned. Ops-suite system enables the process of issuing simulated permits and Out of Normals (OONs). The *Contractor* ensures that the system and its associated network cabling is not decommissioned and remains available on the desk after handover.

UPS- the Simulator will interface to the UPS for the supply of all hardware equipment.

14.3 SECURITY INTERFACES:

Where external interfaces are identified during detail design, the *Contractor* shall comply with 240-55410927 Cyber Security Standard for Operational Technology. All external interfaces are required to pass through a DMZ using firewalls to prevent unauthorised access to Simulator system.

14.4 ELECTRICAL INTERFACES

Where Electrical interfaces are required during detail design, the *Contractor* shall comply with Eskom standard 240-56227443 Requirements for Control and Power Cables for Power Stations Standard.

15. GENERAL DESIGN AND MANUFACTURING PROCESS

The *Contractor's* responsibilities includes the following:

The *Contractor* complies with the quality requirements as per QM-58: Supplier Contract Quality Requirements Specification

Standardise equipment used by utilising existing methods of operation with existing type of components ensuring spares availability at Matla Power Station.

Detailed drawings for construction. Drawings are also submitted in CAD formats.

The *Contractor* provide calculations, new and updated drawings, test reports, manuals, data sheets and documentation for each sub-system.

Adhere to Matla labelling system for plant identification (issuing of KKS numbers).

All equipment provided by the *Contractor* is comprehensively factory tested prior to shipment.

15.1 TESTING REQUIREMENTS

As a minimum, the *Contractor* performs the Acceptance Tests as detailed in Appendix B of 240-154243686 Technical Requirement for Power Plant Simulators Standard.

The tests are conducted at the end of each respective phase of the Simulator development

The Acceptance Tests are incorporated in the project Program.

15.1.1 Simulator SAT

The *Contractor* performs SAT in accordance with Appendix B of 240-154243686 Technical Requirement for Power Plant Simulators Standard.

15.1.2 Simulator FAT

The *Contractor* performs the Simulator, FAT in accordance with Appendix B of 240-154243686 Technical Requirement for Power Plant Simulators Standard.

The FAT is carried out on System Group basis, at the *Contractor*'s manufacturing facility

All Simulator equipment supplied as part of the works are tested at FAT

The Project Manager has a right to reject the Simulator at FAT if the model is not satisfactory.

16. EQUIPMENT AND MATERIAL

The *Contractor* provides an inventory listing all equipment to be shipped to site. The Project Manager verifies and accepts this inventory list prior to packaging and shipping.

16.1 PACKAGING, HANDLING AND TRANSPORTING REQUIREMENTS

All equipment that will be used must be packaged such that it can be easily transported without being damaged. This is inclusive of computer screens, workstations and servers.

The equipment that needs to be removed will be clearly marked before decommissioning starts by the Contractor. Equipment not marked for re-use must be removed and handed over to the Project Manager if still functional or transported to the dedicated disposal areas.

17. CONSTRUCTION ON SITE

The works forming part of commissioning and testing is not embarked on until the Project Manager's acceptance has been obtained for construction and erection work performed in this stage.

The minimum documentation required for the installation and commissioning stages is defined in the VDSS.

The stage consists of procurement, installation and onsite inspection and testing of all supplied items forming part of the scope. Three copies of detailed production engineering and construction package documentation are prepared and issued by the *Contractor* to the *Employer* for acceptance.

These documents are issued for design review 10 days prior construction commencement and by the dates shown in the program.

Testing of supplied and existing equipment is required by the *Employer*, these tests are carried out by the *Contractor* after erection to prove compliance to the *Employer*'s standards and works.

The erection and installation is considered complete once the quality inspections and test for the installation concerned have been accepted by the *Employer*.

The *Employer* reserves the right to appoint representatives to inspect all parts during erection or after and to be present at any of the test specified. The *Employer* is free to specify hold points and witness points during installation and testing stages of the project.

The *Contractor* gives 5 working days advance notice to the *Employer* of hold and witness points.

The *Contractor* provides all test equipment and tools required for testing.

Assessment of existing cable racks and provision of all new racking requirements where necessary is the responsibility of the *Contractor*. The cabling layout and design shall be subject to the *Employer*'s approval.

17.1 SIMULATOR SITE INTEGRATION TEST

The Simulator SIT consist of tests and inspections that determine the Simulator's conformance with the reference plant data and Simulator specifications listed in this works.

The following test and inspections are conducted during the Simulator SIT as a minimum:

- Verification that all HMI and display graphics have been provided and conforms to the Works requirements.
- Verification of all Operator Station functions (operation, trending, alarms, etc.)
- Verification of the Simulation modelling scope for all unit's plant areas with the Works Information requirements.
- Verification of initial conditions, remote functions and external parameters
- Verification of the functionality and correct response of every malfunction(both discrete and variable malfunctions)
- Verification of proper operation of the Simulator when the simulated plant equipment is operated improperly
- Verification of proper control system actions when transmitters and equipment fail

- Verification of the transient and steady state response of the Simulator with the performance criteria specified in section 9.1 above
- Verification of the Simulator documentation for content and completeness
- Verification of actual C&I control logic and database
- Verification of the actual plant's HMI philosophy
- Verification of the actual C&I system's Alarm philosophy such that the alarm performance criteria as specified in the 240-56355466 Alarm Management System Guideline.

On achieving successful Ready-for Training status, the Simulator is subjected to a two months availability test period to prove the Simulator system's conformance to the specified availability requirements.

17.2 SIMULATOR UPDATE "AS BUILT STATUS"'

Once the Simulator models and design data have been updated with the reference unit "As Built" data, the *Contractor* conducts the unit Simulator "As Built" Acceptance Test.

The minimum inspection and test requirements for the "As Built" Acceptance Test are specified in Appendix B of 240-154243686 Technical Requirement for Power Plant Simulators Standard

The Simulator Test is shown in the Accepted Program.

The proposed test procedure together with the test dates is prepared by the *Contractor* and submitted to the *Employer* for acceptance during the system engineering stage.

The final test procedure is prepared by the *Contractor* and submitted to the *Employer* for acceptance at least ten working days to the schedule test date.

The Simulator is accepted as Complete by the *Employer's* operating personnel upon successful completion of the Simulator "As built" Acceptance Test and confirmation of the database updates to reflect the latest logic changes, alarms, performance, functionality, capability and behavior. The Simulator is only accepted once operating personnel confirms that the Simulator fully replicates the reference unit.

The *Contractor* provides the Simulator Completion as shown in the Accepted Program.

17.3 SIMULATOR "AS BUILT ACCEPTANCE TEST"

The Simulator "As Built" Acceptance Test consists of verification of the "As Built" units Plant Simulator with the "As Built" Plant reference data.

The Simulator test and inspections are conducted as per Section B5 of 240-154243686 Technical Requirement for Power Plant Simulators Standard

17.4 SIMULATOR VERIFICATION ACCEPTANCE TEST

The Simulator Verification Acceptance Test shall be conducted as per Section B6 of 240-154243686 Technical Requirement for Power Plant Simulators Standard.

17.5 CAPABILITY TESTING

Capability testing shall be done in accordance with the requirements in section 3.12.2 of 240-154243686 Technical Requirement for Power Plant Simulators Standard.

17.6 ACCEPTANCE CRITEREA

The *Contractor* demonstrates that the training Simulator meets the requirements in 240-154243686 Technical Requirement for Power Plant Simulators Standard and 240-158191826 Generation Operation Training Requirements Specification for Power Plant Simulator

The *Contractor* demonstrates that the Simulator meets the requirements of the Works Information and it replicates the reference unit.

17.7 SAFETY

The *Contractor's* design shall comply with all safety codes and standards specified in this technical document. Protection system shall be tested after replacements are completed to verify and ensure performance and functionality has not been impacted by the upgrade.

18. RELIABILITY, AVAILABILITY AND MAINTAINABILITY

The *Contractor* performs the RAM assessment detail design. The *Contractor's* assessment results indicate the following:

18.1 RELIABILITY

No single system failure mode shall repeat itself more than once every twelve months.

Any updates and patches at construction should be tested and proven reliable by the OEM before updating Matla equipment.

No redundancy shall be required for the components or sub-systems of the Simulator, unless if the lack of such redundancy will violate the reliability and availability. The reliability and on-site spares holding of all components within the Simulator system shall support this availability figure.

18.2 AVAILABILITY

The system shall be designed for 96.71% availability, measured annually. From the date the hardware is energized.

Time to repair any Simulator component shall be less than 12 hours on weekdays and less than 24 hours on weekends.

18.3 MAINTAINABILITY

The *Contractor* is responsible for the maintenance of replaced equipment until officially handed over to Eskom.

The *Contractor* shall provide maintenance training for Eskom employees before execution of the upgrade. Training for the server setups, diagnostics and maintenance regimes shall be given to ensure compliance with warranty conditions.

Engineering and maintenance training should focus on system administration, backups, new logic configuration and testing, logic changes downloads, navigation and fault finding.

Engineering and maintenance staff require training on server maintenance, fault finding, backup and archiving, server upgrade and switch configuration.

A maintenance strategy complete with recovery procedure is to be provided for backing up and recovery of a system in case of system failures. This includes verification and testing of backups.

All maintenance manuals, datasheets, training documents must be supplied by the *Contractor* before acceptance of replaced equipment.

Server failure emergency response procedures are required. This should include a hard drive replacement and extension procedures. Ensure synchronisation and RAID configuration is maintained between servers. The procedure supply maintenance instructions for all self-diagnostic warnings and alarms

The *Contractor* provide a list of critical spares required for day to day maintenance. Standardisation between units and Simulator equipment must be maintained as far as possible to minimise spare holdings

The system support shall be provided by the OEM throughout the life of the Simulator system (2034).

19. SYSTEM LIFE-EXPECTANCY

The *Contractor* shall provide the latest power plant proven technology for the Simulator system.

No unproven technology shall be provided.

Simulators Operator interface (HMI, Server, workstations, network communication systems, software upgrades and PC based equipment) lifespan is the same as the reference unit. The UPS lifespan is 15 years.

The Simulator information system and components are supported and maintainable until the end of life of the plant (until year 2034).

The *Employer* participate in the necessary hardware and software upgrades as proposed by the OEM during the system life cycle.

20. SECURITY

The Simulator security design shall comply with section 3.2.5 of 240-55410927 Cyber Security Standard for Operational Technology. The upgrade must allow software updates to ensure security is maintained to latest version, such as malware definitions and patch management of all software and operating systems.

21. LICENCES

All licenses covering the equipment, standard software and application software provided are included as part of the works.

Licenses are permanent and are site licenses used at Matla

Licenses remain valid in the event of failure and replacement of faulty equipment

Licenses for equipment provided includes *Contractor*'s Sub-*Contractor* and they are valid for the entire life of the Simulator.

Installation disks and license keys are provided for all licensed software

21.1 UPGRADES

Upgrades of software and the associated licences are provided throughout the duration of the works

All software patches, bug fixes and software upgrades for the system are provided throughout the duration of the works.

21.2 WARRANTEES

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

All warranties are in the name of Matla Power Station.

22. CIVIL AND STRUCTURAL

Civil structures includes the re-routing of the cables, support and drilling to the walls. Upon drilling the *Contractor* shall submit their method statement as to how they will mount the cable supports.

Incase the UPS and new C&I equipment are heavier than the current one, the *Contractor* is responsible for additional support under the suspended floor to ensure no damage and failure on the floors.

In the event where some cables will be rerouted to run on the ceiling/roof, roof structural analysis shall be done to ensure safety of the roof.

23. ELECTRICAL

23.1 UPS

The UPS system is sized such that there is a 20% spare capacity allowed. Sizing of the battery for the UPS is taking into consideration, power factor and inverter efficiency.

The UPS rating output of the current UPS is 20 kVA, with input mains 400V AC 50HZ, Bypass line input must be separate.

23.1.1 UPS Batteries

Battery type:

Main Offer Self Contained NiCad

Number of cells 168 per UPS – 220 volts nominal

Battery stand Steel Cabinet

The batteries must be 140AH batteries type KM140P

The following standards must be adhered to:

- Battery Room Standard 240-56177186
- ACCEPTANCE AND COMMISSIONING OF DC SUPPLY EQUIPMENT 240-108614750

24. REMOVAL OF EXISTING EQUIPMENT

24.1 GENERAL

The *Contractor* decommissions the hardware currently installed at the Simulator Trainee workstation, server room and instructor room and hand them over to the *Employer*.

Other equipment declared scrap will be removed including UPS, old batteries and transported to the dedicated disposal areas at Matla. The equipment to be removed is indicated in Table 24-1, Table 24-2, Table 24-3, below:

Table 24-1 Trainee workstation

Equipment Location	Hardware Installed	Software	Application
Simulator Control room	Dell 3400	Windows XP 2003	Workstation 1
Simulator Control room	Dell 1908FP	Windows XP 2003	Monitor
Simulator Control room	Dell 1908FP	Windows XP 2003	Monitor
Simulator Control room	Dell 1908FP	Windows XP 2003	Monitor
Simulator Control room	Dell 1908FP	Windows XP 2003	Monitor
Simulator Control room	Dell T3400	Windows XP 2003	Workstation 2
Simulator Control room	Dell 1908FP	Windows XP 2003	Monitor
Simulator Control room	Dell 1908FP	Windows XP 2003	Monitor
Simulator Control room	Dell 1908FP	Windows XP 2003	Monitor
Simulator Control room	Dell 1908FP	Windows XP 2003	Monitor
Simulator Control room	Dell T3400	Windows XP 2003	Workstation 3
Simulator Control room	Planar	Windows XP 2003	Display Monitor
Simulator Control room	Planar	Windows XP 2003	Display Monitor
Simulator Control room	Planar	Windows XP 2003	Display Monitor
Simulator Control room	Keyboard 1 and mouse		
Simulator Control room	Keyboard 2 and mouse		
Simulator Control room	Keyboard 3 and mouse		

Simulator Control room	HP LaserJet		Printer

Table 24-2 Current Instructor Station

Equipment Location	Hardware Installed	Software	Application
Instructor room	Dell 3400	Windows XP 2003	Workstation
Instructor room	Dell 1908FP	Windows XP 2003	Monitor
Instructor room	Dell 1908FP	Windows XP 2003	Monitor
Instructor room	Mecer	Windows XP 2003	Monitor
Instructor room	Mecer	Windows XP 2003	Monitor
Instructor room	HP Laserjet		Printer

Table 24-3 Simulation Server

Equipment Location	Hardware Installed	Software	Application
Simulator Server Room	Dell power Edge 2950	Windows Server 2003 R2 SP2 32Bit	Aspect server
Simulator Server Room	Dell power Edge 2900	Windows Server 2003 R2 SP2 32Bit	Connectivity servers(x2)
Simulator Server Room	Dell power Edge 2900	Windows Server 2003 R2 SP2 32Bit	Melody/Engineering server
Simulator Server Room	OptiPlex 755	Windows Server 2003 R2 SP2 32Bit	Emulator
Simulator Server Room	Dell Power Edge Rack Console 17FP		Keyboard and Screen
Simulator Server Room	Gigabyte Chassis	Windows Server 2003 R2 SP2 32Bit	Process Model
Simulator Server Room	Edge-Core ES4524D		24 Port Gigabit Ethernet switch
Simulator Server Room	Advantech-Corporation		BI Interface Module

Where the *Contractor* removes equipment, the *Contractor* provides as part of the *works,* the restoration of floors, tiling and any other applicable items.

All removed equipment is transported by the *Contractor* to the areas specified by the *Employer.* All such areas are located within the boundaries of Matla Power Station.

All equipment and material that is removed is deemed re-usable and remains the property of the *Employer.* Where equipment and/or cabling has been removed, the area needs to be restored in accordance with the requirements of the *Project Manager.*

25. DOCUMENTATION

25.1 REQUIREMENTS

The *Contractor* provides documentation as specified in the VDSS and the standards.

25.2 DOCUMENTATION MANAGEMENT

The Technical documentation covers all stages of the works.

The language of all documents shall be English.

The *Contractor* shall include the *Employer*'s drawing number in the drawing title block. This requirement only applies to design drawings developed by the *Contractor* and Subcontractors

The *Contractor* will work with the *Employer*'s configuration department in developing the drawing numbers for the drawing and equipment codes for the works

25.3 DOCUMENT SUBMISSION

All project documents must be submitted to Project Manager with transmittal note according to Project/Plant Specific Technical Documents and Records Management Work Instruction (240-76992014)

All documents used within the project follow the same standards of layout, style and formatting as described in the Work instruction above

The *Contractor* is required to submit documents as electronic and hard copies and must be delivered to the Project Manager with a transmittal note. The transmittal note must have the following minimum, fields:

- Name of the Package
- Name of the *Contractor*
- Transmittal number
- *Contractor* Details
- Date of submission
- Response date
- Description of the document
- Document Number
- Document media type
- Number of copies
- Purpose of the submission

The *Contractor* shall maintain a master document list capturing all documents issued to the *Employer*

Soft copies and hard copies of each document specified in section 3.9 of 240-158191826 Generation Operation Training Requirements Specification for Power Plant Simulators and the VDSS are provided by the *Contractor*. Documents are provided at the stages defined in the VDSS

3 hard copies and 2 soft copies (1 pdf and original CAD format) of "As built" documentation shall be provided by the *Contractor* as part of the works.

Acceptance of the "As Built" documentation by the *Employer* is a pre-requisite for the Sectional Completion of the plant Area concerned. Computer Aided Design (CAD) drawings are provided during the various stages of the project can be edited and viewed using Bentley Micro station; version is agreed with the *Employer*.

25.4 CABLING DOCUMENTATION

The *Contractor* provide the cable documentation for control and power cable for the works.

The *Contractor* transfer all cable schedule information in electronic format.

25.5 FAILURE TO SUPPLY DOCUMENTS AND MANUALS

Testing and commissioning will not start until testing procedures as defined in Appendix A is accepted by the Project Manager.

26. PLANT IDENTIFICATION

26.1 PLANT CODING ALLOCATION

Coding of the design will be based on the KKS coding system and the *Employer* will undertake the coding in line with 240-93576498 KKS and 240-109607736 Eskom KKS Key Part Eskom Standards.

The KKS coding shall be applied during the design reviews stage(s) and across referenced to all arrangement drawings, schematics and wiring diagrams. The *Contractor* will be required to include allocated coding to electronic design drawings.

26.2 EQUIPMENT LABELLING

The *Contractor* will also manufacture and install KKS labels to identified plant items as per list supplied by the *Employer* Labels will be manufactured and installed according to the *Employer*'s KKS Plant Labelling and equipment Descriptions Standard 240-71432150 Plant Labelling Standard and 240-109607450 Plant identification Work Instruction.

27. SIMULATOR TRAINING

The *Contractor* provides training as per section 3.2.13 of 240-154243686 Technical Requirements for Power Plant Simulators Standard and 240-158191826 Generation Operation Training Requirements Specification for Power Plant Simulator.

27.1 TRAINEE PARTICIPANTS

The following participants are to be trained:

Basic maintenance	: 10
Advanced maintenance	: 10
Engineering	: 10
Instructor Training	: 2

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

The *Contractor* provide additional (repeat) training courses as and when instructed by the Project Manager.

28. STANDARDS

The standard specifications applicable to the works are listed in the table of standard specification.

The *Contractor* shall obtain own copies of International and National standard specification document.

The *Employer* standard specification documents are obtained from the Project Manager.

29. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Christoph Kohlmeyer	C&I Chief Engineer CoE
Xolani Dashe	C&I Maintenance Manager
Lindokuhle Ngobese	Engineering Manager (Acting)
Thabo Gininda	Operating Manager
Nozipho Mavimbela	Training Officer
Morne Du Plessis	Training Officer
Michael Nkosi	Training Manager
Clinton Smith	Plant EDWL
Fatty Mahlangu	Civil LDE
Londani Masutha	Electrical LDE
Katlego Mangope	C&I Engineering Manager
Sibusiso Ngcobo	C&I Senior Advisor

30. REVISIONS

Date	Rev.	Compiler	Remarks
Jan 2022	1	N. Mchunu	Tech. Spec development

31. DEVELOPMENT TEAM

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

- Nokuthula Mchunu
- Londani Masutha
- Fatty Mahlangu
- Clinton Smith

32. ACKNOWLEDGEMENTS

- Christoph Kohlmeyer

APPENDIX A: VDSS

APPENDIX B: DRAWINGS