Eskom	Specification	Technology

Title:	**Duvha Power Station Cooling Water (CW) Pumps Control System PLC Upgrade Technical Specification**	Unique Identifier:	**382-171295**
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CONTENTS

FIGURES

TABLES

1. INTRODUCTION

Duvha Power Station has 5 units, each capable of providing 575 MW sent out to the Eskom national grid.

The turbine condensers use the traditional wet type cooling tower systems, and the outside plant is generally classical Eskom design, consisting of two (North and South) Main Cooling Water (CW) Plant systems each consisting of 6 pumps and 3 wet cooling towers.

Each of the twelve (12) CW pumps has its standalone Siemens Simatic S5 95U PLC with an operating panel OP27.

The PLC has external analogue input modules and is connected to a control/data network called L2 FDL bus. L2 connects all the Outside Plant PLCs into a network. The end of L2 is connected to the S7 Marshalling PLC that condenses data on the L2 network and profinet. The marshalling PLC is then linked to the SCADA gateway, situated in the Outside Plant Control Room (OPCR).

- S5 PLC and OP27 is obsolete and need to be migrated to Simatic S7-1500 PLC and to a new local Simatic Human Machine Interface (HMI) operating panel respectively.

The outside plant system is presented in figure 1 below.

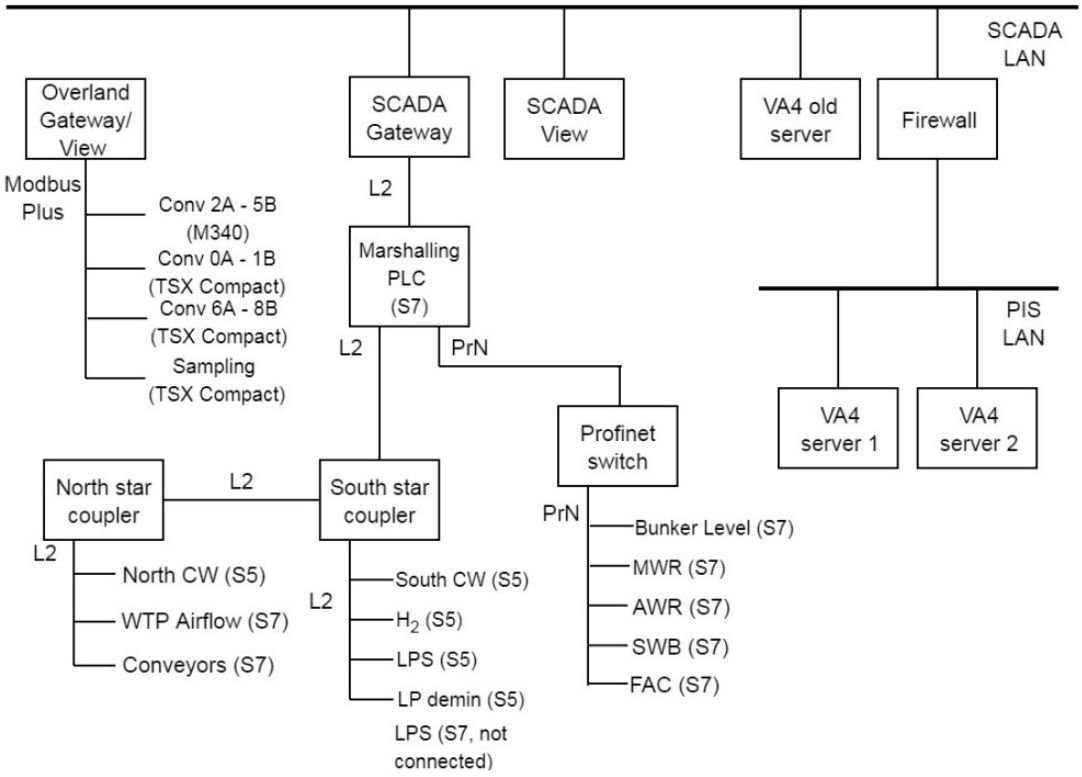

Figure 1: Outside plant as-is

2. SUPPORTING CLAUSES

2.1 SCOPE

High level scope of the Works:

(1) Engineering, design, procurement, manufacturing, factory acceptance testing, delivery, off-loading at site, storage, installation, testing, commissioning, and as-built documentation for the Duvha Cooling Water (CW) Pumps control system S7-1500 PLC.

(2) The specific sub-systems provided as part of Duvha Cooling Water (CW) Pumps control system include:

i. Battery Chargers and their status monitoring system to interface to the marshalling S7-400 PLC.

ii. Existing interface to L2 connected plant via Profinet enabled gateway.

iii. Connecting the supplied S7-1500 PLC to the marshalling S7- 400 PLC.

(3) Installation and commissioning of twelve (12) CW Pumps Sump Level Transmitters & Probes

(4) Supply, installation and commissioning of twelve (12) CW Pumps bearings CW flow meters.

(5) Removal and/or relocation of existing equipment where required by new design.

(6) Plant and labelling of all equipment supplied as part of the works.

(7) Earthing of all equipment supplied as part of the works.

(8) Training of Operating, Engineering & Maintenance staff

(9) All activities, services or equipment specified (special tools, consumables, etc.)

(10) All software, license and copyright agreements for the works.

2.1.1 Purpose

(1) Migrating the obsolete CW Pumps S5 PLC to S7-1500 PLC

I. Eliminating obsolescence risk of the CW Pumps PLC

II. Replacement of the PLC obsolete battery chargers.

2.1.2 Applicability

This document is applicable to Duvha Power Station.

2.2 NORMATIVE AND INFORMATIVE REFERENCES

2.2.1 Normative

Table 1 – Applicable Regulatory and Statutory Documents

Document title	Document number	Revision
[1] Engineering Change Management Procedure	240-53114002	
[2] Design Review Procedure	240-53113685	

Table 2 – Applicable Standards and Codes

Document title	Document number	Revision
[3] The wiring of premises, part 1: low-voltage installations	SANS 10142-1	
[4] Electric cables - Flexible cords and flexible cables	SANS 1574	
[5] Optical fibre cables Part 1: Generic specification	SANS 60794-1-1,	
[6] Materials of insulated electric cables and flexible cords	SANS 1411 (parts 1-7)	
[7] Mechanical properties of fasteners made of carbon steel and alloy steel	ISO 898-1	

Table 3 – Applicable Eskom Documents

Document title	Document number	Revision
[8] Requirements for Control and Power Cables for Power Stations Standard	240-56227443	
[9] Plant Labelling and Equipment Description Standard	240-71432150	
[10] Human Machine Interface Design Requirements Standard	240-56355728	
[11] Essential Power Supplies for Power Station Standards	240-56176852	1
[12] Specification for Thyristor and switch mode chargers, AC/DC to DC/AC converters and inverter / uninterruptible power supplies.	240-53114248	3
[13] Structural Design and Engineering Standard	240-56364545	
[14] Field Instrument installation standard	240-56355754	
[15] Flow Measurement Systems Installation Standard	240-56355789	1
[16] Coal Fired Power Station's Common Plant Siemens S5 PLC Migration Guideline	240-129144507	1

[17] Plant Labelling and Equipment Description Standard	240-71432150	
[18] Control & Instrumentation Field Enclosure and Cable Termination Standard	240-56355815	2
[19] Engineering Drawing Standard	240-86973501	

Table 4 – Other Applicable Documents

Document title	Document number	Revision
[20] [Title here]	[Doc no here]	[year or rev]
[21]		
[22]		

2.2.2 Informative

Table 5 – References

Document title	Document number	Revision
[23] Stakeholder Requirements Definition for Duvha Power Station Cooling Water (CW) Pumps Control System PLC upgrade	382-171149	0

2.3 DEFINITIONS

2.3.1 Disclosure Classification

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

Table 6 – Definition of Terms

Term	Definition
Acceptance	The *Employer* accept the condition or design but does not take responsibility from the Contractor
Approval	Written agreement or authorization by *Employer*. All requests for approval must be submitted in writing and any proposed deviation from specified requirements must be fully justified and agreed by *Employer*.
Contractor	Refers to the corporation appointed to perform the engineering, procurement, and construction works required for the project.
Design freeze	Is a binding decision that defines the whole product, its parts or parameters and allows the continuation of the design based on that decision (no further changes can be made to the design, it is cut-off for the engineers)
Employer	Refers to Eskom Holdings State Owned Company
Eskom Plant Engineering	Refers to the Eskom Engineering team who will perform the reviews and provide technical assistance for the work performed by the appointed Contractor.

Term	Definition
Integrated engineering system	An engineering system capable interface with the PLCs over the Profinet communications network to perform remote maintenance and configuration. An engineering system must either be integrated with the HMI, or be able to provide forward engineering capabilities to the HMI, eg automatic tag generation from PLC source code
Interface	Interface in this document means either to hard wired or software interaction between the *Contractor* and/or other Works
Maintenance	Maintenance can be defined as the function of keeping components or equipment in or restoring them to a serviceable condition so that they comply with design and statutory requirements and *Employer* standards. Maintenance includes the cleaning, removal of contaminants and waste, correct adjustment and setting, tightening, testing, fixing, refill, lubrication, rust prevention, touch up, refrigeration charge, servicing, inspection, replacement, re-installation, troubleshooting, calibration, condition determination, repair, modification, overhaul and rebuilding of equipment. Maintenance can be either preventative or corrective of nature.
Maintenance Management	Maintenance Management can be described as the management (planning, organising, leading and control) actions needed to ensure effective maintenance execution to provide the most efficient and optimum availability (capable of being used) and reliability (consistent quality) of the equipment installed.
Owners Engineer	Owners Engineer - When Eskom acts as the Owners Engineer on a project/package/plant/system/asset, the reviewer(s) are to review the design documentation issued by the Design Authority to ensure that: the design satisfies the stakeholder requirements (i.e. validation of design deliverables against stakeholder requirements). General technical oversight is provided over the design.
Specification	The document/s forming part of the contract in which the methods of executing the various items of work to be done is described, as well as the nature and quality of the materials to be supplied and it includes technical schedules and drawings attached thereto as well as all samples and patterns
The Client	The end user will be Eskom who will be represented by client throughout the duration of the Project.

2.4 ABBREVIATIONS

Abbreviation	Description
AC	Alternating Current
AKZ	Analagen kennzeichnung system
C&I	Control and Instrumentation
CoC	Certificate of Compliance
CW	Cooling Water
DC	Direct Current
ECSA	Engineering Council of South Africa
FAT	Factory Acceptance Test
HMI	Human Machine Interface

CQP	Contract Quality Plan
I/O	Input/ Output
IP	Ingress Protection
ISO	International Standards Organisation
ITP	Inspection and Test Plan
LOSS	Limit of Supply and Services
MCB	Miniature Circuit Breaker
OHS	Occupational, Health and Safety.
OEM	Originally Equipment Manufacturer
OPCR	Outside Plant Control Room
P&ID	Piping and Instrumentation Diagram
PLC	Programmable Logic Controller
Pr. Eng.	Professional Engineer
QCP	Quality Control Plan
SANS	South African National Standard
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition
SIT	Site Integration testing

2.5 SYSTEM FUNCTION AND PERFORMANCE REQUIREMENTS

S7-1500 PLC shall perform the following functions:

- Protection of the North and South CW pumps on
  - Low bearing oil level,
  - high bearing temperature,
  - Auto closing valve failure to open,
  - Back up valve hydraulic leakage excessive
  - and reverse rotation.

- Detection of a main cooling water pump, pumping against a closed valve. The closed limit of the valve is used in conjunction with the electrical current of the pump to determine if the pump is pumping against a closed valve.
- Monitor sump pump fill duration to prevent flooding of the main cooling water pumps warning operating if fill duration is less than 1 hour and alarm if fill duration is less than an hour.
- Detection if a pump is pumping against a closed ACV valve.

- Control Auto closing valves, back-up valves and sump pumps as per the current control and operating philosophy.

(1) All equipment and control components are supported and maintainable until for at least 15 years.

(2) All network equipment is available in South Africa as commercially- off- the-shelf (COTS) products, however any specialised software required for the equipment must be installed by the OEM before the equipment can be connected to the Duvha Outside Plant C&I system.

(3) The following equipment has a failure rate of less than 0.2% of the installed base over a calendar year:

i. IO modules

ii. Field equipment

(4) The availability of the complete CW Pump C&I system over its life in percentage of time is 99,999% or greater measured annually. This is based on a MTTR of 4 hours.

(5) The redundant battery charger system shall be adequately designed and sized (battery capacity) with a standby time of 16 hours.

2.6 PHYSICAL CHARACTERISTICS REQUIREMENTS

All equipment and materials will be designed to take into consideration the space constraints as per the plant layout and existing PLC cabinets.

2.7 RELIABILITY, AVAILABILITY AND MAINTAINABILITY

All the subsystems, products and components of the CW Pump control system and battery charger system must be supportable for the duration of its specified life cycle.

2.8 SYSTEM LIFE-EXPECTANCY

All equipment and control components are supported and maintainable at least until the end of the year 2036.

2.9 SECURITY

(1) The network, system and components to be designed in order to achieve the required goals must conform to the required standards.

(2) Cyber Security for OT systems is governed by the standard 240-55410927: Cyber Security Standard for Operational Technology Revision 2.

(3) The *Contractor* is responsible to ensure the design takes all the various aspects into consideration.

(4) The *Contractor* is responsible for highlighting any deviation from the standard to the *Employer* during detailed design stage.
(5) Any deviation must be approved and signed off by the *Employer.*
(6) Should a deviation not have been highlighted by the *Contractor*, correcting such a deviation will be for the *Contractor*'s cost.
(7) Should a deviation not be approved, the design should be duly corrected by the *Contractor* to accommodate the required aspect.
(8) The aspect of backup/restore and disaster recovery must be proven on the system.

2.10 SAFETY REQUIREMENTS

The *Contractor* shall comply with the latest revision of the Eskom Generation Plant Safety Regulation as well as site specific procedures and stipulations of the Occupational Health and Safety Act.

For any contracted work by the Main *Contractor* the following is applicable:

a) The *Contractor* must demonstrate to the *Employer* that the process followed of baseline risk assessment, and SHE Plan in line with the scope of work.

b) The *Contractor* must provide notification to the *Employer*, prior to the appointment of any contractor/s or suppliers for the commencement of work.

c) The *Contractor* shall ensure that adequate resources possess Occupational Health and Safety (OHS) related competencies. Eskom has the right to verify authenticity of certain competencies where it deems it necessary.

d) The *Contractor* is accountable for the management of its personnel in order to ensure that the applicable OHS legal and *Employer* requirements (that are applicable to the *Contractor* during contract execution) are complied with by the *Contractor*.

e) The *Contractor* shall monitor its personnel through audits and assessments with regard to SHE compliance during the execution of the works.

f) All non-conformances/non-compliance by the personnel (all tiers) to the *Contractor* shall be dealt with directly with the *Contractor* in terms of performance and penalty processes.

2.11 QUALITY REQUIREMENTS

(1) No Work will be done without a QCP that is approved by the *Employer.*

(2) QCP's and related documentation shall be subject to comment and approval by the *Employer's* Quality Control personnel as well as Engineering. QCP's will make provision for signatures for interventions by the *Contractor's Supervisor and* QC Representative, the *Employers* QC Representative and the *Employer's* Engineering Department.

(3) The *Contractor* shall comply with the *Employer*'s Quality Requirements as specified in the Supplier Quality Management Specification 240 – 105658000 (QM-58). Form A (Tender and contract quality requirements for QM 58 and Quality Requirements for ISO 9001 standard) of this Specification indicates the specific application thereof.

(4) All Quality Control documentation must be submitted to *the Project Manager within 30 days or as per stated timeline after the contract date, prior to the commencement of work, for acceptance by Eskom.* Quality Control Plans must include hold and witness points, must clearly state 3rd party interventions and quality/test specifications where applicable.

(5) The contractor provides a well-developed Contract Quality Plan in accordance with the ISO 10005 Quality Management System Guidelines for Quality Plans. The Eskom template 240-109252698 for Contract Quality Plan provided shall be used as guideline, where the supplier does not have a CQP template.

2.12 DESIGN AND CONSTRUCTION REQUIREMENTS

The *Contractor* ensures that the complete design is performed by, or under the direction, control and supervision of an Engineering Council of South Africa (ECSA) registered professional person for each discipline as required by the scope of the design. The *Contractor* ensures that the complete design is signed off by an Engineering Council of South Africa (ECSA) registered professional person for each discipline as required by the scope of the design. In instances where the design is performed under the direction, control and supervision of a professional person, the professional person shall be responsible for signing off the design as applicable to his field of registration.

- **Removal of existing equipment**

(1) The *Contractor* is responsible for the decommissioning and removal of old equipment.

(2) All removed equipment is transported to the areas specified by the *Employer*. All such areas are located within the boundaries of Duvha Power Station.

(3) All equipment and material that is removed is deemed re-usable and remains the property of the *Employer*.

(4) Where field equipment and/or cabling have been removed, the area needs to be made good in accordance with the requirements of the *Project Manager*.

(5) The term “making good” refers to the following;

I. The removal of all the equipment and components of the old C&I and Electrical system. These include signal and power cabling, conduit, trunking, racking, UPS, batteries.

II. All areas where equipment was removed on the plant are made neat by means of closing of holes, grinding of old anchor points and welding, repainting and resurfacing.

The interface points between the new system and existing equipment or plant is made neat and functional to prevent weak points in the final delivered product e.g. the fixing of brackets and supports of interface boxes, covers, cabinets locks and seals to maintain the required Ingress Protection (IP) rating, locking nuts etc

The *Contractor* shall dispose removed equipment in accordance with Eskom environmental standard ENVP0005.

2.12.1 General Design and Manufacturing Process Constraints

- **General Requirements**

(6) The *Contractor* is responsible for carrying out all activities and supplying everything to provide the works.

(7) This includes clarification and co-ordination with process plant engineers, other equipment manufacturers/suppliers and the Project Manager.

(8) All documentation submitted by the *Contractor* is in an adequate state of completeness.

- **Plant Investigation Work**

(1) The scope of the plant investigation work includes, but is not limited to:

I. Verification of the scope of work as defined by the LOSS diagrams, schedules, operating procedures, P&IDs and the Works Information

II. Investigation of the accuracy of all As-Is drawings.

(2) During the plant investigation work, the *Contractor* takes responsibility for collecting all the relevant data and information to enable the *Contractor’s* design to be completed.

- **Engineering Design**

(1) Engineering design is defined as being all activities required to translate the *Contractor*’s scope of works, into a fully functional automation system.

(2) All Engineering design activities are executed by the *Contractor* in active co-operation with the Project Manager

(3) The engineering design activities are phased to suit the Accepted Programme

(4) A plant walk is performed including, but not limited to:

i. Verification of location and suitability of hardware installation points.
ii. Verification of location and suitability of cable routing paths.
iii. *Contractor* shall submit the Investigation findings to Eskom for review/comments.

(5) As a minimum, Engineering design consists of the development, technical clarification and acceptance of the following:

i. Engineering programme
ii. Index and master register of documents
iii. Documentation synopsis
iv. OEM best practices
v. Cabinet Layout Diagrams
vi. Cable Routing Diagrams
vii. Cable & Termination schedules
viii. Engineering and maintenance procedures
ix. Network Topology Diagrams
x. Network installation philosophy
xi. Switch configuration diagrams
xii. Cabling concept
xiii. Power distribution philosophy
xiv. Integration test procedures
xv. Bill of Materials (make, model, rating, quantity, maintenance manuals, catalogues etc…)

(6) The *Contractor* identify any discrepancies that would lead to shortcomings in the design and makes the *Employer* aware of such discrepancies and provides recommendations, where applicable. The *Contractor* takes action on such discrepancies.

(7) The first CW Pump C&I System – excluding field equipment – will undergo Factory Acceptance Testing (FAT).

(8) The *Contractor* conducts a pre-factory acceptance test at the *Contractor's* factory in preparation for the FAT.

(9) The Pre-FAT is shown in the Accepted Programme.

(10) During FAT, the *Contractor* demonstrates that the CW Pump C&I System meets the requirements of this Works Information.

(11) The FAT is done at the *Contractor*s manufacturing factory.

(12) The *Contractor* shall provide the equipment list with descriptions.

(13) The *Employer* uses AKZX codification system and will provide these codes to the *Contractor*.

(14) The *Contractor* shall manufacture and install plant labels according to the Plant Labelling and Equipment Description Standard 240-71432150.

(15) The *Employer* will provide cable numbers and issue to the *Contractor* to manufacture and install cable numbers as per Plant Labelling and Equipment Description Standard 240-71432150.

(16) The *Employer* will provide cable schedule template.

2.12.2 Engineering Disciplinary Requirements

2.12.2.1 Civil and Structural

- All designs to comply with the latest SANS standards and Eskom Standards (240-56364545 Structural Design and Engineering Standard Revision 2), and all design documents to be submitted to the Eskom Civil & Structural department for review prior to construction.

2.12.2.2 Electrical

- **Decommissioning of the current installed chargers and batteries supplying individual PLCs.**
  - I. The *Contractor* shall decommission the existing chargers and batteries. The *Contractor* shall dispose the decommissioned batteries in accordance with Eskom environmental standards. The preservation of existing chargers, and cabinets shall be the responsibility of the *Employer*.
  - II. The *Contractor* shall decommission the existing power cables supplying each charger in the CW system. Preservation of the decommissioned power cables shall be the responsibility of the *Employer.*

- **Design, construct, manufacture, test, supply, deliver and install two (2) distribution boards; one dedicated distribution Per CW system.**
  - I. All boards shall be in accordance with the types as specified, be constructed according to the detail or type drawings and must be approved by the *Employer* before installation.
  - II. Any construction or standard type of a distribution board proposed, as an alternative to that specified must have the prior approval of the *Employer*.
  - III. All incomer breakers on single phase distribution boards shall be rated a minimum of 63A with a minimum fault current level of 10kA.
  - IV. The distribution boards shall be constructed in such a way that it will be capable of withstanding all the mechanical, electrical and thermal stresses as well as the effects of dust ingress and humidity which will be encountered during normal operation.

V. The minimum thickness for the plate steel shall be 1.6mm. Cubicle doors shall be positively drawn closed onto seals by means of padlock-lockable lever operated catches. Perforated foam type seals shall not be provided.

VI. Finishing colour shall be to SANS 1091 “Light Orange” and “Signal Red” for a normal and essential 230/400V distribution boards for.

VII. The distribution boards utilised outdoors shall be IP65 rated and for indoor IP55 rated.

VIII. All bus-bars, wiring, terminals, etc., are to be adequately insulated and supported for fault current forces. All wiring is to enter the distribution board from the bottom or top of the board.

IX. Clearly engraved labels shall be mounted on or below every switch. The wording of the labels in English, is as directed by the *Employer*’s representative and must be confirmed on site. Flush mounted boards shall be installed with the top of the board 2,0m above the finished floor level.

X. All power supply cabling from the 400V switchgear boards to the main distribution boards shall be provided, installed and terminated by the *Contractor*. All cabling required in the installation shall be the responsibility of the *Contractor*.

XI. On completion of the installation, an Electrical Certificate of Compliance (CoC) must be issued to the *Employer* by the *Contractor*.

- **Design, construct, manufacture, test, supply, deliver and install two (2) dual redundant DC system; one dedicated for South CW system and the other dedicated for the North CW system.**

I. The provision of the 24V DC redundant battery chargers, with adequately sized battery banks and battery cabinets shall be procured following the normal tendering process.

II. The dual redundant 24V DC systems (Chargers and batteries) shall be designed to cater for future expansion. The redundant DC system shall be designed to supply the complete load-systems with 30% or less than their full capacity. And 70% or shall be catered for maintenance and future expansion.

III. Each single DC system (Charger and battery) shall be designed independently to be able to supply the complete load-systems with 60% or less than their full capacity.

IV. *Contractor* shall design, construct, manufacture, factory acceptance test (FAT), transport, offload, install, and perform site acceptance tests and commission the 24V DC redundant system (Chargers, batteries, and cabinets). The redundant system shall be adequately designed and sized (battery capacity) with a standby time of 16 hours.

V. The redundant battery charger is required to continuously supply six (6) PLCs per CW system.

VI. The maximum estimated load for each PLC is 10A.

VII. Two (2) additional miniature circuit breakers (MCB) (3 in total for each redundant charger) shall be supplied, installed, and commissioned as part of the Works.

VIII. The 24V DC supplies shall be combined at the load by means of load combining diodes.

IX. The dual redundant DC systems shall be installed 1m above the ground in each of the CW Plant Pump House.

X. After completion of the works, a full test shall be carried out on the installation during the commissioning to determine the satisfactory working thereof. During the commissioning, the installations will be inspected, and the *Contractor* shall demonstrate the installation to the satisfaction of the *Employer* and resolve any defects which may arise.

XI. The design of the 24V DC redundant battery chargers and battery banks, including battery cabinets shall be done in accordance with the following standards:

- 240-56176852: Essential Power Supplies Standard.
- 240-53114248: Specification for Thyristor and switch mode chargers, AC/DC to DC/AC converters and inverters / uninterruptable power supplies.
- 240-56360086: Specification for vented Nickel-Cadmium cells and batteries.
- 240-56227589: List of approved electronic devices to be used on Eskom Power Stations.
- 240-56177186: Acceptance and Commissioning of DC Supply equipment.
- 240-56356510: Definition of terms applicable to DC Emergency Supplies Standard.
- 240-137465740: Standby Battery Storage and Commissioning in Eskom.

XII. After completion of the works, a full test shall be carried out on the installation during the commissioning to determine the satisfactory working thereof. During the commissioning, the installations will be inspected, and the *Contractor* shall demonstrate the installation to the satisfaction of the *Employer* and resolve any defects which may arise.

2.12.2.3 Instrumentation and Control (C&I)

(1) Replacement of each of twelve (12) existing Simatic S5 95U PLC and I/O units to the latest Simatic S7-1500 PLC and I/O units.
(2) Each CW control system shall have its own new local Simatic HMI operator panel.
(3) Network and communication to the existing marshalling S7-400 PLC shall be provided via Profinet.
(4) Existing PLC cabinets shall be utilized and made good.
(5) All twelve (12) 220V AC sump level transmitters and probes shall be replaced with 24V DC version and shall be connected to the new 24V DC supply provided as part of the works as per the LOSS and Function IO Block Diagram in the appendix 1 and 2.
(6) Battery Chargers supplied in the Works shall be monitored at the Outside Plant Control Room (OPCR) HM through the existing marshalling S7-400 PLC via Profinet. The *Contractor* ensure that the monitoring is functional at the OPCR.
(7) All new requirements for HMI displays and alarming to be done by the *Contractor*. That is additional to the current design base of the CW control philosophy.
(8) Battery Chargers Function IO Block Diagram is in appendix 2.

The *Contractor* is responsible for carrying out all activities and supplying all that is necessary to provide the *works* in accordance with the requirements of the *works information*.

The *Contractor* is required to perform a mandatory plant walk down and evaluate items described in the *works* for inclusion in their tender submission.

The *Contractor* provides all equipment and services and executes all *work*s to fulfil all requirements specified in this Works Information.

The *Contractor* is required to develop a detailed design for acceptance by the *Employer*.

The *Contractor* is required to adhere to the Eskom Standards and the relevant SANS standards that apply.

The *Contractor e*nsures that all testing conducted is as per the OEM best practices.

The equipment requirements are defined in the following documents:

I. Appendix 1 – Limits of Supply and Services (LOSS)
II. Appendix 2 – Function IO Block Diagram
III. Appendix 3 – Project Drawings
IV. Appendix 4 – Project Standards & Specifications

2.12.2.4 Computer Hardware and Software

The requirements below will be for the programming tools (PG units) required to program and configure the relevant PLCs mentioned in this document:

(1) All licenses covering the equipment, standard software and application software provided are included as part of the works.
(2) All licenses remain valid in the event of the failure and replacement of faulty equipment.
(3) All licenses provided are valid for the entire life of the Duvha CW Pumps C&I system.
(4) All licenses are site licenses for use at Duvha Power Station Site.
(5) Installation disks are provided for all licensed software provided.
(6) Two (2) Programming (PG) Units shall be supplied by the *Contractor*.

2.12.3 Documentation

- **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 3 hardcopy master sets and three soft copies.
(4) All training documentation provided by the *Contractor* is customised for Duvha Power Station.
(5) The training documentation contains the specific Main CW Pumps C&I systems' architecture, configuration, layout, software, equipment, HMI 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.

- **As Built" Documentation**

(1) 'As Built' documentation is supplied by the *Contractor* to the Project Manager upon completions of works.
(2) 2 hard copies and 2 soft copies of As Built documentation is provided by the *Contractor* as part of the works.
(3) Acceptance of the 'As Built' documentation is a pre-requisite for the completion of the works
(4) The documents are reviewed by the Project Manager for correctness and conformance to the accepted design.
(5) Soft copies must be in Microsoft Office 2010 or higher format.
(6) Drawings must be in Bentley Microstation or similar CAD format and shall comply with Engineering Drawing Standard 240-86973501.

(7) *Employer* will provide the *Contractor*'s drawing block and drawing numbers.

(8) Approved QCP/ITPs

2.12.4 Packaging, Handling and Transporting Requirements

(1) All the identified equipment that will be re-used must be packaged such that it can be easily transported without being damaged.

(2) The equipment that needs to be packaged is clearly marked by the *Contractor* before decommissioning starts.

(3) The packaging material and specifications is supplied by the *Employer*.

(4) Equipment not marked for re-use is removed and transported to the dedicated disposal areas.

(5) All electronic modules and computer equipment is removed and packaged by the *Employer*

2.13 OTHER REQUIREMENTS – TRAINING WORKSHOPS AND TECHNINOLGY TRANSFER

2.13.1 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 Duvha Power Station and is directly applicable to the actual equipment and software supplied for the works.

(3) Training is focused on the specific HMI and systems' architecture, configuration, layout, equipment, software, HMI 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 facilities for the Engineering and Maintenance are provided by the *Contractor*.

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

(7) The training facilities provided are:

i. air-conditioned and suitably sized.

ii. accommodates all trainees comfortably.

iii. includes all engineering tools and workstations.

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

(9) The *Contractor* shall develop a checklist for FAT and SAT.

(10) The training is completed before the start of FAT.

2.13.2 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 Engineering & Maintenance Staff
ii. Training of Operators
iii. The training must be done upfront before implementation. The elements of the training are described in the subsections below.

2.13.3 Upfront Training of Engineering & Maintenance Staff

(1) Engineering & maintenance training includes, as a minimum:

i. Usage of all sub-systems in the CW Pumps control system PLC and DC Systems.
ii. Familiarisation with the documentation forming part of the works, including drawing configuration logic.
iii. Hardware familiarisation
iv. Hardware configuration which includes the computers, network modules and all other peripheral equipment supplied as part of the works.
v. Hardware installation
vi. HMI and C&I system software reloading
vii. Graphic display design, development and configuration
viii. Network maintenance
ix. Operator interface familiarisation including keyboard and display functions, controls, alarms and messages.
x. System 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
xi. CW Pumps PLC system hardware maintenance training including network and all other peripheral equipment supplied as part of the works.
xii. HMI local display panel maintenance and configuration training.
xiii. Usage of Engineering tools.
xiv. Installation, configuration and maintenance of all software packages forming part of the works.
xv. Operation and maintenance of the DC systems (Batteries and Chargers)
xvi. Online monitoring of the DC systems (Batteries and Chargers)

2.13.4 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, Operator interface familiarisation including display functions, plant control, plant monitoring, navigation, alarms, messages.
iii. Training of Operating Staff must take place at Duvha Power Station.

2.13.5 Trainee Participants

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

i. Engineering & Maintenance : 30(20 C&I System, 10 DC System)
ii. Operator : 12(9 C&I System, 3 DC system)

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

2.13.6 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 3 hardcopy master sets and three soft copies.

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

(5) The training documentation contains the specific Main CW Pumps C&I systems' architecture, configuration, layout, software, equipment, HMI 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.

2.14 VERIFICATION

The *Contractor* shall develop a checklist for the Factory Acceptance Test (FAT), Site Integration Test (SIT) and Site Acceptance Test (SAT).

All testing conducted is as per the OEM best practices.

2.14.1.1 Factory Acceptance Test (FAT)

(1) During FAT, the *Contractor* demonstrates that the Duvha CW Pumps C&I system meets the requirements of this Works Information and the detailed engineering design freeze documentation.

(2) The FAT is done at the *Contractor*s manufacturing factory.

(3) The *Contractor* and the *Project Manager* witness the FAT.

(4) The scope of the equipment tested at FAT is as follows:

i. All of the first CW Pumps C&I and Electrical system.

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

(6) The *Contractor* ensures that all C&I and Electrical system hardware and software is available and operational in time for the individual tests.

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

i. Testing of the functional logic and HMI templates/typicals.
ii. Full testing of the automation systems' functional logic
iii. Full testing of the electrical system.
iv. Mechanical and visual inspection and tests of all equipment
v. Wiring and visual inspection of systems internal wiring.
vi. C&I and Electrical system integrity and application tests
vii. Testing of bus interfaces to 3rd party system/marshalling S7- 400 PLC.

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

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

(10) 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

2.14.1.2 Site Integration Test (SIT)

(1) The SIT only begins once the PLCs and/or Battery Chargers have been installed in the final location and connected to permanent power supplies.

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

i. Compliance with the Works Information and the engineering design freeze documentation

(3) The *Contractor* prepares a detailed SIT procedure.

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

ii. Major test activities
iii. Comprehensive list and description of the individual tests to be performed.
iv. How the tests are to be prepared and conducted
v. Test dates and durations
vi. Checklists - how the test results will be documented.
vii. Acceptance Criteria
viii. How the identified discrepancies will be processed.
ix. Retesting requirements

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

(6) 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.

(7) Major faults such as incorrect configuration, lack of communication or major faults as determined by the Project Manager may lead to the termination of the SIT.

(8) 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.

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

x. Test procedures used during SIT.
xi. Detailed Test results
xii. Discrepancies identified during the tests.
xiii. Resolution of the discrepancies
xiv. Retests conducted and results thereof
xv. SIT certificate.

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

(11) 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.

(12) The submission and update of all documentation shall comply with VGB R 171, 2nd edition, 2010.

3. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Lemuel Zwart	C&I System Engineer
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4. REVISIONS

Date	Rev.	Compiler	Remarks
September 2024	0	S. Makhoba	First revision
November 2024	1	S. Makhoba	Section 3.7.2.4 updated to include installation of 24V DC of sump level Tx, Probes and Pumps bearings CW flow meters, Battery chargers monitoring at the Outside Plant Control Room (OPCR).
November 2024	2	S. Makhoba	Section 2.5. Monitoring sump pump fill duration and alarm at the Outside Plant Control Room (OPCR) to prevent flooding. Alarming if a pump is pumping against a closed ACV valve.
Dec 2024	2.1	S Makhoba	Quality & Safety Requirements update section 2.10 & 2.11

5. DEVELOPMENT TEAM

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

Sibu Makhoba – C&I System Engineer
Elliot Mamba – Electrical System Engineer

6. ACKNOWLEDGEMENTS

Fred Mashiane – Outside Plant C&I Maintenance Senior Technician

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