

PART 3: SCOPE OF WORK

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C3.1: EMPLOYER'S WORKS INFORMATION

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1 Description of the *works*

1.1 Executive overview

The Stator Coolant Water (SCW) system plays an important role since it is used to provide a source of demineralised water to the generator stator winding for direct cooling of the stator winding and associated components.

Units 4 – 8 were initially installed with a single 220 Vac UPS. Whenever the UPS failed the Stator Coolant Water Conductivity transmitters would fail and trip the unit on Stator Coolant Water Conductivity 2v3 Trip protection. Due to the high number of trips that were incurred as a result of these failures of the UPS, a project was initiated and carried out to change the supply of the transmitters from 220 Vac to 24 Vdc instrument supplies.

Units 1 – 3 Stator Coolant Water Conductivity transmitters (*MKF 30 CQ001/02/03) are powered by redundant 220 Vac UPS's which were installed by CED during the RTS period. Units 1 – 3 were left on the 220 Vac since they were equipped with redundant UPS's and were therefore perceived to be reliable and not a risk at that time. However, the risk has changed and the UPS's have become unreliable due to aging. This has caused trips in the recent past. Whenever the UPS failed the Stator Coolant Water Conductivity transmitters would fail as well and trip the unit on Stator Coolant Water Conductivity 2v3 Trip protection

In order to standardise across all the units, as this change was done on Units 4 - 8, it is required to change the power supply for the Stator Coolant Conductivity transmitters from 220 Vac to 24 Vdc.

1.2 Employer's objectives and purpose of the *works*

The objectives of the *works* are as follows:

- (1) To pull cables, terminate and commission a stable 24 Vdc PS for the three Analysers on U1-3 Stator Coolant Water Conductivity that are powered by 220 Vac.
- (2) Successfully moving or implementation of the changes will improve the reliability of the protections and prevent reoccurrence of future unit trips due to 220 Vac UPS failures.

1.3 Interpretation and terminology

1.3.1 Abbreviations

The following abbreviations are used in this Works Information:

Abbreviation	Description
ac	Alternating Current
DB	Distribution Board
C&I	Control and Instrumentation
CED	Construction Engineering Department
COE	Centre Of Excellence
dc	Direct Current
DCS	Distributed Control System
LOSS	Limit Of Supply and Service
HI	High
HIHI	High-High
KKS	Kraftwerks-Kennzeichen-System
LDE	Lead Discipline Engineer
PS	Power Station
RTS	Return To Service
SLD	Single Line Diagram
SCW	Stator Coolant Water
UPS	Uninterruptable Power Supply
V	Voltage

2 Engineering and the *Contractor's* design

2.1 *Employer's* design

2.1.1 Operating Philosophy

The operating philosophy of the U4 -8 stator conductivity **240-35845390** is similar to U1-8. It is important that the control philosophies which govern the automation adhere to the correct and desired responses to ensure safe and optimal functioning of the plant.

The stator coolant plant is a part of the generator auxiliaries and supplies demineralised water to the stator bars for cooling. The control philosophy and protection of this system on all eight units.

2.1.1.1 Normal operation – Stator conductivity

During normal operation, the stator conductivity will be between 0.8-2 μS , the indications are locally displayed on the 3 transmitters in the plant as shown on U1-3. Examples are shown in **Figure 1**, **Figure 2**, and **Figure 3**. The *contractor* will not interfere with the reliability and integrity of these indications. The *contractor* is required to provide 24 Vdc power supply to the transmitters. No changes are required to the cabling, transmitter's setup and position, settings, software and drawings related to the transmitters.



Figure 1: U1 Transmitters



Figure 2: U2 Transmitters



Figure 3: U3 Transmitters

The trends for the stator conductivity are displayed on unit operator's screen to operate the plant as trained. The *contractor* will not make any changes on the C&I MSR drawings Appendix 05, KKS, description, units and ranges of the signal identification as shown of **Figure 4**, **Figure 5** and **Figure 6**. This will all remain unchanged.

SIGNAL TAG	DESIGNATION	RANGE ...	RANGE HI	CURSO...	CURSO...	Y DIFF	UNIT	LAST
1 0MKF30 CQ001 XQ01	STATOR CLNT WTR CO...	0.0000	10.0000				μS	1.4810 ▲
1 0MKF30 CQ002 XQ01	STATOR CLNT WTR CO...	0.0000	10.0000				μS	1.4570
1 0MKF30 CQ003 XQ01	STATOR CLNT WTR CO...	0.0000	10.0000				μS	1.4960

Figure 4: U1 Signal Identification

SIGNAL TAG	DESIGNATION	RANGE ...	RANGE HI	CURSO...	CURSO...	Y DIFF	UNIT	LAST
2 0MKF30 CQ001 XQ01	STATOR CLNT WTR CO...	0.0000	10.0000				μS	0.7030 ▲
2 0MKF30 CQ002 XQ01	STATOR CLNT WTR CO...	0.0000	10.0000				μS	0.7140
2 0MKF30 CQ003 XQ01	STATOR CLNT WTR CO...	0.0000	10.0000				μS	0.6730 ▼

Figure 5: U2 Signal Identification

SIGNAL TAG	DESIGNATION	RANGE ...	RANGE HI	CURSO...	CURSO...	Y DIFF	UNIT	LAST
3 0MKF30 CQ001 XQ01	STATOR CLNT WTR CO...	0.0000	10.0000				μS	1.5860 ▲
3 0MKF30 CQ002 XQ01	STATOR CLNT WTR CO...	0.0000	10.0000				μS	1.5660
3 0MKF30 CQ003 XQ01	STATOR CLNT WTR CO...	0.0000	10.0000				μS	1.5360

Figure 6: U3 Signal Identification

2.1.2 Abnormal operation

During the abnormal condition, the operator will received an alarm with the following description

Alarm Received ~ “Stator Water Conductivity HI”

HIGH < 2.6 μS Warning Alarm

HIHI < 9 μS At this level the turbine will trip

During the above condition, the turbine protections and automatic controls will operate as required and operator safeguards the unit. This condition will ensure both the safety of the workers and plant will be the priority concern.

2.2 Summary of Unit Alarms and Trip Conditions on the Stator Coolant System

Table 1, below shows different alarms and trip condition on the stator coolant water conductivity as per in the philosophy document.

Description of condition	Normal Operation	Warning initiation	Alarm Initiation	Trip Initiation
Stator Conductivity (μSC ⁻¹). 2 out of 3.	0.8-2 μS C ⁻¹	(X 0MKF30 CQ001 002,003) None	(X 0MKF30 CQ001 002,003) Alarm (High)>2.6 μS C⁻¹	(X 0MKF30 CQ001 002,003) Trip (HiHi) >9μSC⁻¹

Table 1: Alarm and trip conditions

2.2.1 Alarms

The existing alarm and trip values from the philosophy will remain the same in the plant display and on the operators screen, the *Contractor* will not change coolant alarm and trip and its ranges.

2.2.1.1 Coolant Flow Failure Alarm & Trip

The alarm operates when the flow measuring orifice with 3 differential pressure transmitters (X 0MKF60 CF001, CF002 and CF003) gives a low signal on two out of three transmitters and trips when a low-low limit is reached.

2.2.1.2 System Identification

This alarm operates when the conductivity probes with three conductivity transmitters on the **Table 2** below gives a High signal on two out of three transmitters and trips when a HHH limit is reached.

Identification/codification number of the system:

Unit	KKS	Description
1	1 0MKF30 CQ001	Stator Coolant Water Conductivity 1
	1 0MKF30 CQ002	Stator Coolant Water Conductivity 2
	1 0MKF30 CQ003	Stator Coolant Water Conductivity 3
2	2 0MKF30 CQ001	Stator Coolant Water Conductivity 1
	2 0MKF30 CQ002	Stator Coolant Water Conductivity 2
	2 0MKF30 CQ003	Stator Coolant Water Conductivity 3
3	3 0MKF30 CQ001	Stator Coolant Water Conductivity 1
	3 0MKF30 CQ002	Stator Coolant Water Conductivity 2
	3 0MKF30 CQ003	Stator Coolant Water Conductivity 3

Table 2: System identification

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

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

2.3.1 General Requirements for the *Works*

- (1) The *Contractor's* engineering work is done at site, Camden Power Station.
- (2) The *Contractor* provides all equipment and services and executes all *works* to fulfil all requirements specified in this Works Information.
- (3) The *works* complies with professional engineering practice and standards, and is designed for the environmental conditions prevailing at Camden Power Station Site.
- (4) The *Contractor* provides a complete detailed design package for review by the *Employer* as per Appendix 01.
- (5) The equipment requirements are defined in this Works Information and also in the following documents:
 - i. Appendix 02 – Standards and Regulations
 - ii. Appendix 03 – U1-3 Stator Conductivity Water Coolant
 - iii. Appendix 04 – Electrical Drawings
 - iv. Appendix 05 - C&I MSR Drawings

2.3.2 Power Supply Requirements

2.3.2.1 General

- (1) The *contractor* submits only one consolidated programme to the employee for approval; clearly indicating the contractor's *works* and proposed periods for all the activities. For each activity, the start date, completion date, activity duration, predecessors and links to activities are clearly indicated.
- (2) The *Contractor* is responsible for powering all transmitters that form part of the *works*.
- (3) New power supply, required as part of the *works*, and 24 Vdc used on the plant at Camden PS.

2.3.2.2 Limits of Supply and Services (LOSS)

- (1) The LOSS diagrams demarcate the responsibilities for the various stages of the project from basic engineering up to and including commissioning.
- (2) Components not shown in the LOSS diagram but that are required for the *works* are provided as part of the *works*.
- (3) The LOSS diagrams provided by the *Employer* are corrected and updated by the *Contractor* and submitted as part of the detailed design package as per Appendix 03. If there are no changes to the LOSS diagrams the *Contractor* will inform the *Employer* and submit the unchanged LOSS diagrams as per Appendix 03.

2.3.2.3 Electrical Design Solution

The *contractor* to remove U1-3 Stator Coolant Conductivity cables from the 220Vac Power Distribution panel (Panels Identification 1/2/3 0CVC20) and rerouted the cables to existing panel in the equipment room MAIN 24VDC PANEL (1/2/3 0CUB15).

New Scope Requirments:

- Confirmation of the loading on the panel
- 27 x hager MC 2 Amps circuit breakers
- 54 of 1.5 block connectors
- 9x number 0 glands with shrouds
- 500m 24Vdc, 3 core x 1.5mm armoured cable.
- Decommission the existing cables of the analyzers.
- Attach cable numbers to number cables
- Provide as in plant drawings
- Use of the existing 24 Vdc cable racks is highly recommended.

Transmitters Identification:

Make: Endress+Hauser stator conductivity meter

Type: CLM253-CD0005

To achieve the above requirements the *Contractor* makes use of the drawing number 0.36/13672 on the Appendix 04 to design the upstream electrical feed "Camden PS Station Reticulation Single Line Diagram" (SLD). The

drawing number 0.36/13672 shows the Station Transformer 1 feeds 6.6 kV Station Board 1 which in turn supplies power 380 V Distribution Board 1. The drawing 0.36/14070 on Appendix 04 shows the 380 V DB 1 feeds power to the 220 Vac UPS A and B recticulation.

The electrical supplies upstream of the 220 Vac UPS and Battery Chargers will not be changed. As such, there will be no impact on electrical maintenance philosophies for these boards. The existing 220 Vac UPS and battery chargers are maintained by appointed Eskom Electrical department OEM contractor.

2.3.3 Field Requirements

2.3.3.1 Conductivity Analyser Transmitters

2.3.3.1.1 Power Supply

- (1) The *Contractor* is responsible for pulling cables and powering of the 24 Vdc power supply to transmitters upon approval of the *Employer*.
- (2) The power supply must be compatible to transmitters required input power rating and as per the drawing 0.36/14070.
- (3) The Distribution Box (DB) is designed specifically for Camden PS and must meet all the requirements.

2.3.3.2 Power Cabling & Associated Infrastructure

- (1) The *Contractor* makes use of the existing power cables
- (2) If the existing power cables are damaged or insufficient the *Contractor* provides a proposal for the replacement of the cables. All new cables adhere to **240-56227443** Requirements for Control and Power Cables for Power Station Standard.
- (3) The *Contractor* makes use of existing cable racking as far as possible. Where not possible the *Contractor* will advise the *Employer* on the best racking routes.

2.3.3.3 Earthing and lightning protection

- (1) The *Contractor* implements the correct earthing concept for reliable operation as per **240-56356396**.
- (2) The *Contractor* tests the integrity of the earthing system, to ensure compliance to internationally recognised earthing standards and best practices.

2.3.4 Commissioning and Testing

A complete commissioning and testing programme will be drawn up between the contractor and Eskom Engineering to test the function of the Stator Coolant Water Conductivity transmitters after connection to the 24 Vdc power supplies. All QCP's and ITP's will be identified and agreed to by the OEM and the Client (Eskom C&I and Electrical Engineering).

2.3.5 De-commissioning requirements

220 Vac Power Supply cables decommissioning will be done together with Eskom Electrical department, under the existing contract. It is the same contractor maintaining the existing UPS on U1-3.

2.3.6 Training

- (1) The *Contractor* will provide on the job training for operating staff.
- (2) The *Contractor* will provide on the job training for maintenance staff.
- (3) The *Contractor* will provide on the job training for engineering staff.

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

2.4.1.1 Design Freeze Milestone

- (1) The *Contractor* cannot commence any of the installation work until the detailed design is complete and accepted by the Employer. This shall be indicated as a milestone in the Project Execution Programme.
- (2) All design documentation must be completed before design freeze as per Appendix 01 – VDSS.
- (3) A detailed implementation plan must be completed and accepted by the *Employer* before the design freeze.
- (4) The field work cannot commence without official access from the *Employer*.

2.4.1.2 Commissioning Completion Milestone

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

2.4.1.3 Project Completion Milestone

- (1) The *Contractor* updates the design freeze documentation package with any changes made during commissioning.
- (2) The *Contractor* submits as-built documentation to fulfil the project complete milestone as per Appendix 01 – VDSS.

2.5 Other requirements of the *Contractor's* design

- (1) The *Contractor* follows the existing Camden PS plant codification philosophy as per the latest revision of **240-64550692** - Camden PS Labelling Specification and Plant Coding Procedure.
- (2) The *Contractor* follows the existing Camden PS plant labelling philosophy as per the latest revision of **240-64550692** - Camden PS Labelling Specification and Plant Coding Procedure.
- (3) The *Contractor* follows the existing Camden PS modifications philosophy.
- (4) The *Contractor* follows the existing Camden PS documentation control philosophy.

2.6 As-built drawings, operating manuals and maintenance schedules

All documentation shall be provided as per Appendix 01.

3 List of Drawings

3.1 Drawings issued by the *Employer*

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

Note: Some drawings may contain both Works Information and Site Information.

Drawing number	Revision	Title
13672	Rev 14	Sheet 1 Station Reticulation Single Line Diagram
0.36/13672		Station Transformer 1 feeds 6.6 kV Station Board 1
0.36/14070		380 V DB 1 feeds power to the 220 Vac UPS A and B reticulation