Eskom	Specification	Technology

Title: **Hendrina Refurbishment of Blower and South Fuel Oil Plants Programmable Logic Controllers Technical Specification**

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1. INTRODUCTION

This Technical specification document covers the minimum requirements for the engineering change focused on the upgrade of the North and South Blower plants and the South Fuel Oil Plant Control system at Hendrina Power Station.

The appointed *Contractor* will be required execute the system upgrade and his work will include; complete design, provision of all required materials, installation and commissioning including decommissioning of the existing system, as well as address defects identified. This document sets to detail the Technical requirements identified by the *Employer* for the *Contractor* to implement.

1.1 SYSTEM IDENTIFICATION

1.1.1 Blower Plant

- Identification number of the system: 00HPC – FABRIC FILTER PLANT PULSE AIR SUPPLY SYSTEM
- Official name of the system; Hendrina Power Station Blower Plant

1.1.2 South Fuel Oil

- Identification number of the system: 02QFB11 - SOUTH FUEL OIL PLANT
- Official name of the system; Hendrina Power Station South Fuel Oil Plant

2. SUPPORTING CLAUSES

2.1 SCOPE

2.1.1 Purpose

The purpose of this specification is to provide the Technical Specification for the replacement of the Hendrina Blower plant and South Fuel Oil plant PLC system and the methods to be used to ensure that each requirement has been met. It is meant to provide clear instructions on the intent, performance and construction of the project. It also references the Technical quality and standards which should be applied.

The specification will form part of the contractual documents to the prospective *Contractors*, along with the drawings, and therefore helps minimise project risk and provide support should there be any legal disputes.

2.1.2 Applicability

This document applies to:

i. Hendrina Power Station North and South Blower plant (00HPC – FABRIC FILTER PLANT PULSE AIR SUPPLY SYSTEM)
ii. Hendrina Power Station South Fuel Oil plant (02QFB11 - South Fuel Oil Plant)

2.2 NORMATIVE AND INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] 380-EN-AABZ28-SP0004-13 Operating Training FFP Section 7 Cleaning Air Supply Units 1 to 5 Rev 2

[2] 380-HEN-AABZ28-SP0004-14 Operating Training FFP Section 6 Cleaning Air Supply Units 6 to 10 Rev 2

[3] Operating Technical Specifications: Hendrina Power Station Outside Plant Module 2 Fuel Oil Systems Section 2 South Fuel Oil Plant

2.2.2 Informative

[1] 240-105929225: Compressed Air System Standard

[2] 240-109607332: Eskom Plant Labelling Abbreviation Standard

[3] 240-129144507: Technology Roadmap for Coal Fired Power Station's Common Plant Siemens S5 PLCs

[4] 240-132042275: Power Plant Controls & Instrumentation; Control Systems; Distributed Control Systems (DCS); Part 2: Operator & Supervisor System Standard

[5] 240-53113685: Design Review Procedure

[6] 240-53114002: Engineering Change Management Procedure

[7] 240-54179170: Technical Documentation Classification and Designation Standard

[8] 240-54937439: Fire Protection/Detection Assessment Standard

[9] 240-54937450: Fire Protection & Life Safety Design Standard

[10] 240-56227443 Requirements for Control and Power Cables for Power Stations Standard

[11] 240-56227516: LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltage up to and Including 1000V AC and 1500V Standard

[12] 240-56241288: Standard for Fuel Fired Boiler Protection Functions

[13] 240-56355466: Alarm Management System Guideline

[14] 240-56355541: Control System Computer Equipment Habitat Requirements Guideline

[15] 240-56355728: Human Machine Interface Design Requirements Standard

[16] 240-56355731: Environmental Conditions for Process Control Electronic Equipment used at Power Stations

[17] 240-56355754: Field Instrument Installation Standard

[18] 240-56355815: Field Instrument Installation for Junction Boxes and Cable Termination Standard

[19] 240-56357424: MV and LV Switchgear Protection Standard

[20] 240-56737448: Fire Detection and Life Safety Design Standard

[21] 240-56737654: Inspection, Testing & Maintenance of Fire Detection Systems Standard

[22] 240-64550692: Label Specification and Plant Codification

[23] 240-65459834: Project Documentation Deliverable Requirement Specification

[24] 240-66920003: Documentation Management Review and Handover Procedure for Gx Coal Projects

[25] 240-70164623: Design Guideline for HVAC in the Eskom Coal Fired Power Stations

[26] 240-71432150: Plant Labelling Standard

[27] 240-76992014: Project / Plant Specific Technical Documents and Records Management Work Instruction

[28] 240-86973501: Engineering Drawing Standard

[29] 240-93576498: KKS Coding Standard

[30] R/ESK1618 Hendrina Power Station Hazardous Location Classification

2.3 DEFINITIONS

2.3.1 Disclosure Classification

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

Table 2.3 – Definition of Terms

A	
Alarming	A notification of an undesirable event that requires operating, engineering or maintenance personnel's attention.
Availability	Relates to the ability of the system-of-interest to be accessed and operated when needed.
Automation Network	The network via which communication between the Control System servers and automation units occur.
Automation Processor	Fully programmable, micro-processor-based system designed for use in power plant applications
Automation Unit	A fully self-contained integrated control unit with input/output capabilities, communication modules, power supplies, cross marshalling and intelligent redundant automation processors.
C	
Control System	The Control System consists of the Operator System, Engineering System, Process Automation System, Protection Automation System, Operating & Engineering Network, Automation Network, Network Management System, User Management System and interface to unitised 3rd Party Systems
D	
Data backup	A full backup of the database concerned such that the database can be restored to a fully functioning state as of the date of the backup

	capture.
Drives	Drives are all mechanical or electrical prime movers, e.g. actuators, pumps, etc.…
E	
F	
Field cabling	All cabling between field devices and the first junction and/or splitter box.
Field equipment	Transmitters, gauges, impulse piping, fittings, manifolds, switches, positioners, valves, solenoid, junction boxes, splitter boxes, field cables, transmitter racks, conduits, secondary racking.
Functional logic	The control logic – inclusive of all sequence control logic, analog control logic, interlocks, etc.… - that is contained within the automation system(s).
Functional logic diagrams	Diagrams depicting the functional logic using functional logic symbols and circuit diagrams.
H	
Hard copy	A laser colour printed document appropriately labelled, numbered, and bound/filed.
High availability	An availability of 99,999% or better. This translates into downtime – including both scheduled and unscheduled maintenance – of less than 5 minutes per year.
HMI	The human interface used for the operation and monitoring of the Blower plant System.
HMI faceplate	The interface or window of particular component in an HMI graphic page through which said component is operated and monitored in detail.
HMI mimic	The graphical page containing the mimic of a specific area of plant, trends, alarms, etc.
Hot-swappable	The capability of being able to disconnect and connect devices while the computer or other device is on and have those devices automatically detected without having to re-boot the computer or device.
I	
Indication	Display of the state of a device or the degree or quantity represented on a measuring instrument or device.
M	
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. If both “shall” and “must” are used there is an implication of difference in the degree of responsibility upon the implementer, which is undesirable.
N	
Network cabling	All the cabling that forms part of the Automation Network, Operating & Engineering Network and Common Network.
O	
OEM	The Internationally registered legal entity who owns the rights for the manufacture, design and repair of the Process and Protection Automation Systems.
Obsolete	No longer supported, having been replaced by something newer and better or more cost effective or profitable. Product reached the end of its useful life or end of active support from the OEM
Operating Technical Specification	The Operational Technical Specification (OTS) for an asset contains a set of operational envelopes on unit, system and component level which includes the range of normal operation, the operational limits and the analysed functional design limits as provided for in the engineering calculations provided in the Design Base. It further provides for the management of the operational margins and out of normal asset operating conditions
Operating screen	LCD display monitor used in the operator workstations.
Operator workstation	The primary interface of the operating plant personnel. It is the computer via which the HMI is accessed with the specified number of operating display units and pointing devices.
Operator action	Operator input to the Process Automation System, e.g. an on/off command, or a set point change.
P	
Power cabling	All the cabling to power the Control System and Common Control System
R	
Redundant	A system or equipment is redundant when it is duplicated to enable a continued service when there is a complete failure of the one system or piece of equipment
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).

S	
Shall	Expresses a mandatory demand or a binding requirement.
Should	Expresses a non-mandatory preference, desire, target or recommendation.
Specification	The document(s) forming part of the contract describing the methods of executing the various items of work to be done, and the nature and quality of the materials to be supplied and includes technical schedules and drawings attached thereto as well as all samples and patterns.
Station or Power Station	Hendrina Power Station.
T	
Trending	A functionality whereby a trend requested by operating, engineering or maintenance personnel can be displayed.
Trunking	A rigid structure supporting a number of cables.
Trunk Cabling	All the cabling between the junction boxes or 3rd Party System and the Automation System(s).
PLC OEM	The OEM of the plant PLCs at Hendrina PS.
U	
Upgrade	The replacement of hardware and software (Change limited to system hardware and/or software components such as clients and servers) based on the newest OEM technology, typically every five to six years for HMI equipment. The intent is to do minimal engineering but to carry over the intellectual property into the newer platform.
Unit de-loading	De-loading is when boiler unit load is forced to be reduced due to the FFP's inability to adequately maintain pressure drop within the requirements and this often caused by unavailability of pulse air from the Blower plant. De-loading may lead to contravention of the FFR due to not being able to sustain minimum load conditions, or cause additional NO'_x emissions
W	
Will	Expresses the future tense or a declaration of intent.

2.4 ABBREVIATIONS

Abbreviation	Description
CCCC	Central Change Control Committee
C&I	Control & Instrumentation
CoE	Centre of Excellence
CPU	Central Processing Unit

Abbreviation	Description
DRTL	Design Review Team Lead
ECM	Engineering Change Modification
EDWL	Engineering Design Work Lead
EMS	Environmental Management Systems
FFP	Fabric Filter Plant
LCS	Local Control Station
LDE	Lead Discipline Engineer
OEM	Original Equipment Manufacturer
OTS	Operating Technical Specifications
P&ID	Piping & Instrumentation Drawing
PEI	Production Engineering Integration
PLC	Programmable Logic Controller
PLCM	Project Life Cycle Model
PRV	Pressure Regulating Valve
ROC	Required Operational Capability
SCADA	Supervisory Control and Data Acquisition
SRD	Stakeholders Requirements Definition
SOR	Switch Operating Room

2.5 ROLES AND RESPONSIBILITIES

[1] The CoEs multidisciplinary team's role and responsibility is to compile a technical specification.

[2] *Employer* is responsible for the overall management of the project with respect to time, cost, and quality throughout the project.

[3] The LDEs ensure that the wok required for the designs is carried out and that the correct procedures and governance are complied with.

[4] The PEI representative and Plant system engineer's roles and responsibilities are to provide technical support.

2.6 PROCESS FOR MONITORING

This document is governed by the Design Review Procedure (240-53113685). Any changes shall be managed through the Project Engineering Change Management Procedures (240-53114026).

2.7 RELATED/SUPPORTING DOCUMENTS

[1] 380-EN-AABZ28-SP0004-13 Operating Training FFP Section 7 Cleaning Air Supply Units 1 to 5 Rev 2

[2] 380-HEN-AABZ28-SP0004-14 Operating Training FFP Section 6 Cleaning Air Supply Units 6 to 10 Rev 2

[3] 25.15/35278 Rev. 2: Hendrina Power Station Common Plant Pulse Jet FFP Air Blower System P&ID Concept Design Information

[4] 0.15/30737 Sheets 1&2:Hendrina Power Station Common Processor Plant MCB Distribution circuit diagram

[5] 25.15/38151 Hendrina Power Station Units 1-5 380V Blower House Boards 1 and 2 Single Line Diagram

[6] Operating Technical Specifications: Hendrina Power Station Outside Plant Module 2 Fuel Oil Systems Section 2 South Fuel Oil Plant

[7] MESK101Unit 6-10 South Fuel Oil Plant-Plant Pumps (PLC Modified)

[8] 25.15/39445 rev 0, 25.15/39432 rev0, 25.15/339426, 25.15/39425, 25.15/39414, 25.15/39413 for unit 6 to 10 South Service Fuel Oil Pump Plant.

3. ENGINEERING AND THE *CONTRACTOR*'S DESIGN

(1) The *Contractor* shall provide the whole of the Works as defined in section 3 of this document except where explicitly stated as otherwise.

(2) The *Contractor's* design complies with the *Employer's* operating and control philosophy in Appendix 5 and 6 with the related documents described in section 2.7.

(3) Furthermore, the specification of the *Employer's* design is defined in sections 3.1.

3.1 *EMPLOYER*'S DESIGN

i. The purpose of the project is to eliminate the risk of load loss due to the control system failure at the plants.

ii. The objective of this project is to address the Obsolescence of the PLC based control system and its SCADA system by replacing it with the new PLC technology to ensure the plants' integrity of the following plants:
   a. Blower Plant
   b. South Fuel Oil Plant

iii. Each plant Control system is implemented using individual standalone controllers (Figure 3-1), known as single-loop controllers (PLCs). Sensors, controller, and controlled equipment are within close proximity to the local PLC and the scope of each controller is limited to a specific system or subsystem. Local controllers are capable of initiating or terminating locally-controlled automatic sequences, or to adjust control set points, as the control action itself is determined in the local controller.

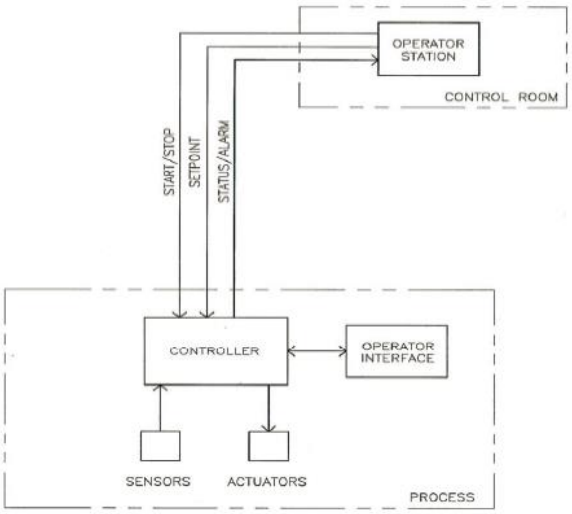

Figure 3-1: General View of the Standalone Control System

iv. The main elements of a PLC are the microprocessor-based controllers and their input/output (I/O) cards. It is a standalone automation system dedicated to the control and protection of the plant systems.

v. The system has a local operator interface and a communication network interfaced to the remote SCADA system.

3.1.1 Hendrina Blower plant System Description

The FFP makes use of air pulses to clean the filter bags. The Blowers supply air to the pulse tanks located on top of the FFP casings.

i. The Blowers for Units 1 to 10 are Rotary Piston type, positive displacement pumps.

ii. The resulting compressed air from the Blowers is delivered both pulsating and oil free.

iii. The Blower gear case is equipped with an oil level sight glass and a drain plug assembly.

iv. The Blower units are installed on a common base frame with a 380V 110kW electric motor.

v. Each Blower has a dust filter element on the inlet pipework, to prevent abrasive dust from entering the Blower (causing wear).

vi. The Blower air outlet is equipped with an outlet silencer, pressure relief valve, discharge non-return valve, and a manual isolation valve.

vii. A Thermocouple is also installed on the discharge of the Blower which monitors air discharge temperature.

viii. The pulse air main manifold is equipped with electro-pneumatic and mechanical control valves to control the system pressure effectively. Both these final control elements are equipped with manual isolating valves.

ix. At Unit 3 and Unit 7 Blower house, two small bore stainless steel pipes fitted with hand isolating valves, taps off the pulse air main and are routed to pressure transmitters situated next to the Local Control Panel (LCP) inside the Blower houses.

x. Three low point manually operated drain valves are installed to drain any condensation that might have collected within the pipe-work. The hand operated isolation valves must remain open to allow operation of these automatic drains.

xi. Where the main manifold reaches the top of Units 3 FFP housing, two hand isolating valves are installed in the range which, when closed, isolates the air supply to Boilers 1 to 3 and Boilers 4 to 5.

xii. Where the main manifold reaches the top of Units 7 FFP housing, a hand isolating valves is installed which, when closed, isolates the air supply to Boilers 6 and 7. An identical arrangement is found on Boiler 8 FFP housing which isolates the air supply to Boilers 8 to 10.

3.1.1.1 Unit 1-5 System

i. This plant is situated in the North of the power station.

ii. There are six Blowers housed in the Blower house behind Unit 3 at the North Blower plant.

iii. These Blowers supply pulse air to Units 1 – 5 for cleaning of the filter bags.

iv. The filter unit supplies clean air to the Blower house, providing intake air for the Blowers and pressuring air for the Blower building.

v. The building has two rooms; one room has seven Blowers and their LCS whereas the other Switchgear room that houses 380 V FFP Blower house boards and the PLC cubicle side-by-side.

vi. The North side has a total of 7 PLCs installed (1 master and 6 slaves).

3.1.1.2 Units 6-10 System

i. This plant is situated on the South side of the power station.

ii. There are six Blowers supplying pulse air to Units 6 – 10 at the South Blower plant. There are two Blower houses for this plant; one is at Unit 8 and the other at Unit 7.

iii. Three of six Blowers are in the Blower house behind unit 7 (7 0UHP00) and the other three are housed in the Blower house behind unit 8 (8 0UHP00).

iv. The common pulse air main pipe links the two Blower house buildings

3.1.1.3 Operation and Control

i. The pulse air Blower system is controlled by a PLC system that has automatic and manual operating capabilities.

ii. The cleaning Air Blowers are operated on “demand” to maintain an adequate pressure (75 kPa) in the pulse air main. Individual Blowers are switched ON or OFF by an independent PLC (Master PLC) that monitors overall system requirements. Each individual Blower has its own PLC (Slave PLC) that monitors the Blower and its switch gear conditions and these PLCs are connected to the Master PLC at each site area (North and South).

iii. All the field signals are wired to the Marshalling rack inside the PLC cubicle, where these are distributed to the PLCs and LCS.

iv. The whole plant is monitored at the SOR via a SCADA system.

3.1.1.4 Automatic Mode of Operation

System pressure is controlled by a Pressure Regulating Valve that vents access air to atmosphere via a silencer:

i. The cleaning air Blowers are operated on 'demand' to maintain an adequate pressure 75kPa) in the pulse air main.

ii. Individual Blowers are switched ON or OFF by an independent PLC via the Master PLC

iii. The PLCs are programmed to 'share' the operating duty – (time) among all available Blowers through the Master PLC.

iv. The Blower motor is interlocked with the Blower hood ventilation fan motor such that the fan must be in operation before the Blower can start.

v. The detailed Automatic mode of operation the controls are found in the supporting document (380-EN-AABZ28-SP0004-13 Operating Training FFP Section 7 Cleaning Air Supply Units 1 to 5 Rev 2 and 380-HEN-AABZ28-SP0004-14 Operating Training FFP Section 6 Cleaning Air Supply Units 6 to 10 Rev 2)

3.1.1.5 Manual Mode of Operation and Control

i. If the mains pressure goes low or high for any reason and the standby Blower/s fails to start or stop, prompt manual action is required. Also, if the pressure control fails or needs to be controlled manually, the full time of a dedicated operator is required to perform this task via the Local Control Panel.

ii. On manual mode the associated dedicated Blower PLC is disconnected from their Master PLC.

iii. On manual mode the affected dedicated PLC (slave PLC) takes over the control of its own Blower.

The detailed Manual mode of operation the controls are found in the supporting document (380-EN-AABZ28-SP0004-13 Operating Training FFP Section 7 Cleaning Air Supply Units 1 to 5 Rev 2 and 380-HEN-AABZ28-SP0004-14 Operating Training FFP Section 6 Cleaning Air Supply Units 6 to 10 Rev 2)

3.1.1.6 Battery Limits

The *Contractor's* battery limit will include:

i. Design and develop the control logic in the PLCs

ii. Provide the SCADA interface to the PIS

iii. Providing field installation and configuration of the upgraded system that will include cabling, instrumentation installation to interface with the PLCs.

iv. Redundant power supply to the PLCs

v. Source all materials, factory acceptances testing, transports components to site

vi. Update design documentation and submit documentation to the *Employer* as per Appendix 1 (C&I Documentation Requirements from Vendors)

vii. Commission and handover the plant.

3.1.1.7 Control and Instrumentation Engineering Battery Limits

The *Contractor* shall provide the PLC based Blower plant control system. The works will include:

(1) Engineering and installation of North and South Blower plant PLCs, for the control, protection interlocking and monitoring of the FFP Blower Plant. This includes all hardware, enclosed in suitable stainless enclosures equipped with the necessary filtering and fans, installed in the current location of the PLC panels.

(2) Implementation of Blower outlet temperature controls, monitoring and generation of trip signals (currently implemented via the Temperature Indicator mounted on the LCS) is included in the scope of works. The PLC system will generate alarms and trips to the electrical circuit.

(3) The revision of existing Blower plant S5 control logic, conversion or rewrite to new format. The new control logic must have the addition of dynamic control capabilities based on the upgrades on the Blower plant system.

(4) Catering for the additional I/O capacity and capability on the PLC system to accommodate future field equipment required to improve the plant efficiency and availability. The following specified additional I/O signals will be used to enable sizing and specifying the PLC to allow for future plant upgrades only. The installation of the additional field instrumentation is not part of the works unless specified in this Technical specification:

- 12 Blower intake Temperatures
- 12 Blower discharge pressure
- 12 Blower intake pressure
- 3 Blower house ambient temperature
- 12 Blower acoustic-hood intake temperature
- 14 Pressure Differential Transmitters for Blocked Filter detectors.
- 2 Pressure release valve position detection and monitoring

(5) Implement Local/Remote Control mode of operation functionality.

(6) Decommission of the existing S5 PLC and its associated subsystems.

(7) Engineering and installation of new Local Operator Stations.

(8) Engineering and installation of a new SCADA in the SOR.

(9) Development of PLC Functional Design Specification, including the functional logic flow charts

(10) Interfaces to the PIS for data storage and long term information.

(11) Provision of all software, licensing and copyright agreements to enable the operation of the system(s) as specified by the works.

(12) Reinstating any interfaces that currently exist with other plant systems.

(13) Implementing additional monitoring and control parameters:

i. SCADA to display all interlocks and information for trip or failure of Blower plant.

ii. Expansion on the capacity and capability on the existing PLC to accomplish improved efficiency and reliability of the plant for the future upgrades.

3.1.1.8 Electrical Power Supply Battery Limits

The *Contractor's* battery limit shall be as depicted in Figure 3-2 and 3-3.

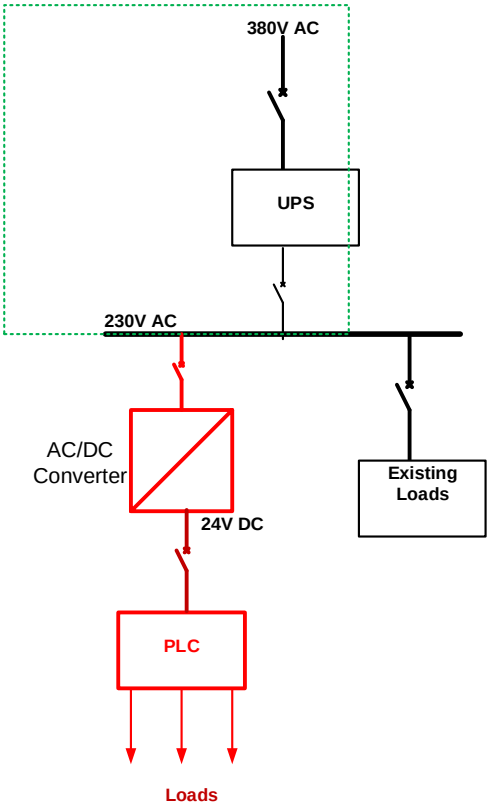

Figure 3-2: *Employer's* design proposal showing the changes to be effected for unit 1-5

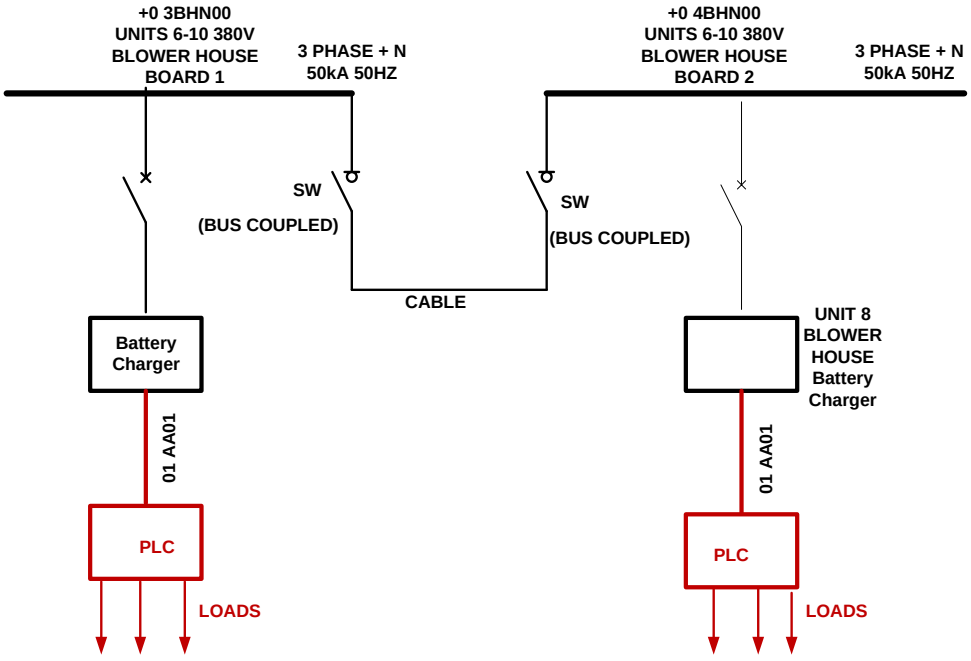

Figure 3-3: *Employer's* design proposal showing the changes to be effected for unit 6-10

Further to Figure 3.2 and 3.3, the *Contractor* shall perform the following:

i. For unit 1-5, assume the responsibility to perform assessment within the battery limits to demonstrate that the selected UPS (A or B) has sufficient capacity to supply the new PLCs loads and that all components within the battery limits are still adequate to allow the system to operate normally without system overloading constraint after the commissioning of the new PLCs.

ii. For unit 6-10, assume the responsibility to perform assessment within the electrical battery limit to demonstrate that the cable supplying power to the PLC is adequate.

3.1.2 Hendrina South Fuel Oil plant System Description

i. Hendrina power station has two distinct fuel oil systems referred to as the North and South Fuel oil systems. The North fuel oil system supplies Boilers 1 to 5 and the South side supplies Boilers 6 to 10. The two systems are interconnected to allow fuel to be transferred from North to south or South to North.
ii. Each one of the two fuel oil plants (North and South) has an off-loading system and a service system.
iii. The fuel oil off-loading system receives oil from delivery tankers and transfers to the bulk storage tanks.
iv. The South Fuel Oil service system receives oil from the bulk storage tanks and transfers it to the boiler burners. The project is based on the control of the South Fuel Oil supply pumps that are expected to operate continuously maintaining specific oil pressure and flow requirements to the South Units burners as these Burners require continuous cooling. The South plant burners do not retract from the Boiler as compared to the North plant Burners, and hence the installed standalone PLC system at the South plant only. This project does not affect the North Fuel Oil system on the North of the station.
v. The South Fuel Oil Plant Process description:
    - The South Fuel Oil pump house is fitted with four screw type positive displacement fuel oil pumps, Pumps No. 4, 5, 6 & 7.
    - Fuel Oil is:
        - Supplied to the four pumps from the two 25 tonne daily service tanks via a common suction manifold.
        - Fed from the pumphouse via a common discharge header through a single supply line to the Boiler House where it is split into two supply mains running the entire length of the south half of the station, i.e.: Boilers 9 to 10.
        - Supplied to each Boiler from a take-off on each main, and via an automated trip valve to the Burners.
        - Circulated to the burners around each boiler, the unconsumed oil returning via two return mains running the entire length of the south half of the station, i.e. Boilers 6 to 10 and then via a single return line to the pumphouse.
    - A Pressure Maintaining Valve (PMV) is fitted on the return line in the pumphouse, the outlet from this valve returning (currently) to the common suction manifold. A thermowell is provided on the return line, upstream of the PMV to enable monitoring of the return fuel oil temperature.
    - Each pump train is fitted with a dual manual change over Suction filter and a dual manual change over discharge filter.
    - The pumps are screw type positive displacement Rapid Allweller pumps mounted on bedplates on plinths and are driven by electric motors.
    - Pump Motor power is supplied from remote MCCs in the 380 Vac Station Boards 2A & 2B.
    - Pressure gauges are fitted on:
        - The common suction manifold
        - The common discharge header

- The return main before the PMV
- At each pump suction and discharge

- Differential pressure switches are fitted across each filter, at the suction and discharge points, to monitor filter blockage. These pressure signals will raise an alarm, and trip the respective pump after a predetermined time if the fault is not corrected.
- A pressure transmitter is fitted to:
  - The common suction manifold
  - The common discharge header
  - The return main before the PMV
- A P.L.C is provided to automatically regulate the number of pumps in service and to maintain the fuel oil system pressure (and hence, flow) at the desired value. The P.L.C is coupled to a SCADA unit used for monitoring only, which is located in the SOR.
- The system is completely self-contained and operates as a Standalone unit.
- A pair of (Start/Stop) push buttons and a manual mode key switch (for maintenance or manual operation) is provided for each pump unit.

vi. The main purpose of the Fuel Oil plant is to supply the correct quantity of fuel oil at the correct pressure to the boilers under all operating conditions:

- To establish combustion in the boiler furnace.
- To warm up boiler components during boiler light up before pulverised fuel is introduced.
- To support combustion when changing over mill groups.
- To support combustion during an emergency and maximum operating conditions.
- To support combustion during boiler shut down phases.

The detailed system description is outlined in the Appendix 3 documents.

3.1.2.1 Operation and Control

3.1.2.1.1 Local Automatic Mode of Control

(1) Pumps will be started and run automatically when the PLC is energised and system selected to "Automatic", provided that the following criteria are satisfied:

i. Common for all pumps;

- The PLC is healthy
- The suction pressure as measured by the suction pressure transmitter (0 2EGD60 CP001) at the common suction manifold is greater than 20 KPa (nom).
- The PMV position is less than <15%
- The fuel oil pressure as measured by the common discharge header pressure transmitter (KKS) is less than 2800 KPa.

ii. Individual for each pump;

- A fault signal from the switchgear is not present. Those fault signals will indicate that the switchgear has tripped, or the control power supply is not healthy.
- The pump suction filter differential as measured by the suction filter differential pressure switch is not high
  - Pump 4 DP switch - 0 2EGD62 CP301
  - Pump 5 DP switch - 0 2EGD63 CP301
  - Pump 6 DP switch - 0 2EGD64 CP301
  - Pump 7 DP switch - 0 2EGD61 CP301

  (10kPa Pressure rising contacts close)
- The pump discharge filter differential as measured by the discharge filter differential pressure switch is not high.
  - Pump 4 DP switch - 0 2EGD62 CP302

- Pump 5 DP switch - 0 2EGD63 CP302
- Pump 6 DP switch - 0 2CGD64 CP302
- Pump 7 DP switch - 0 2EGD61 CP302

(150kPa Pressure rising contacts close)

- The maintenance key switch is in the “automatic" mode position, i.e. not selected to maintenance mode.
- The pump running time is the least of all available (non-running) pumps, i.e. the pump is not running and has been run for the shortest over all time

(2) If all the above criteria are satisfied:

i. Pump 4 (0 2EGC82 AP001), or the pump with the least overall running hours will start first. If this pump is not available, then pump 5, or the pump with the next least running hours will be automatically started.

ii. Pumps will be started at 30 second Intervals.

iii. If one pump is insufficient to maintain the fuel oil pressure at 2800 kPa, or the PMV position remains at less than 45%, then a second pump, pump 5 (0 2EGC63AP001), or the pump with the next least overall running hours, will start

iv. The PLC will not attempt to start a pump which has any fault conditions present.

v. Should a pump fail to start within a period 1or 2 seconds after a command to start has been given by the PLC, an alarm will be raised at the SCADA system, and the fault must be investigated.

vi. If, after three pumps have been started during any start-up of the plant, the fuel oil pressure remains below the 2300 kPa, or the PMV position remains below 45%, either of these criteria will indicate that there is a fault with the system, and an alarm will be raised. If the fault persists for a period of longer than 30 minutes, ell pumps will be shut down and the PLC will "lockout", The piping system and Burners must be checked and the fault cleared prior to a restart.

vii. Pumps will always be shut down in sequence, the longest running pump being shut down first, followed by the next longest running pump and so on.

viii. The auto shut down of the fuel oil pumps will result in a lockout of the system, and it will be necessary to reset the PLC through use of the reset push-button to inside the PLC cabinet before the system can be re-started.

ix. A thorough check of the entire fuel oil plant and pipelines must be carried out and any faults corrected prior to attempting to restart the system.

(3) Note;

i. The method for resetting the PLC is as follows;

- Select a/f key switches lo "Manual"
- Operate the reset push-button inside the PLC
- Select all the key switches in “Automatic”
- Operate the reset push-button inside the PLC - The PMV will move to its predefined position, and the first pump will start, followed by two more pumps starting at 30 sec intervals. The system is now on 'Automatic’ and fully operational.

ii. On reset of the PLC the system will automatically restart in sequence as noted above.

iii. Other than the auto start of the standby pump during the auto change over sequence, a fourth pump will never be started automatically. This sequence does not preclude the manual start of any pump, irrespective of the number of pumps in service at any time.

(4) The pumps will be used on a rotation basis, and after 168 Hrs, (one week) the standby pump (or if more than one pump is off, the pump with the least overall run time) will automatically be started and the pump which has been running the longest time, will be shut down, i.e. the running time of all running pumps is compared and the pump with the longest run time is shut down first.

(5) The running time of each pump is monitored and this time is stored in a buffer memory. The reason for storing this time in a buffer, is to ensure that, in the event of a PLC failure or shutdown, the information Is not lost, and on restart, the pump with the shortest run lime will be started first, the pump with the next shortest run time started second and so on.

(6) If, during start up, it is not necessary to run more than one or two pumps, i.e. the system pressure is satisfactory, and then succeeding pump will not be started.

(7) If during running, the discharge pressure exceeds 2950 kPa, or the PMV opens to a position greater than 80%, that will indicate that too many pumps are in service, and the pump with the longest run time will be shut down.

(8) If, after shutting down one pump, the pressure remains above 2950 kPa, or the PMV position remains above 80%, and there is more than one pump running, then a second pump (the succeeding pump with least total run time) will be shut down. One pump will always remain in service.

(9) If only one, or two, pumps were running at the end of the auto change over period, then a second, or third off pump, with the shortest total run time will be started, end the running pump, or if two pumps were running, the pump with the longest total run time will be shut down.

3.1.2.1.2 Local Manual Mode of Operation and Control

(1) The local Start / Stop push buttons on the PLC panel are normally inactive. Each pump set of push buttons can be made active (i.e., become usable) through use of its own maintenance Key switch being set to maintenance/manual mode.

(2) The push buttons will also automatically become active if a PLC failure occurs, thus enabling pumps to be started and shut down manually,

(3) With push buttons active, pumps can be started / stopped through use of the push buttons

3.1.2.1.3 Maintenance Mode of Control (Switchgear Controlled)

(1) The pumps are switched on and off from the switchgear directly and the PLC is bypassed. A three position selector switch at the switchgear with the following settings:

- Remote: PLC in control
- Off: power cut off
- Local: Pump motor switched on directly from the Switchgear

(2) In this mode the selector switch is selected to Local and the protections and interlocks are disregarded.

3.1.2.1.4 Plant Protections

(1) There are only two basic faults which can arise on the system:

i. Switchgear Trip

- The relevant pump motor will trip and the PLC, which monitors these trip functions, will take action and start a standby pump.
- An alarm will be raised on the SCADA system.

ii. Pump suction - or discharge filter blocked:

- An alarm will be raised on the SCADA system.
- If action to correct the fault is not taken within 30 minutes, the PLC will start a standby pump and will shut down the pump with the blocked filter.

(2) Alarms

iii. The following alarms are raised on the SCADA:

- Fuel oil discharge pressure low.
- Fuel oil discharge pressure high.
- Pump tripped (all pumps).
- Pump suction filter blocked (all pumps).
- Pump discharge filter blocked (all pumps).
- PLC failure.
- Pump selected to maintenance mode (key switch).

iv. The following indications must be present at each pump:

- Pump on auto / manual.
- Pump fault.
- System status.

3.1.2.2 Battery Limits

The *Contractor's* battery limit will include:

i. Design and develop the control logic in the PLC

ii. Provide the SCADA interface to the PIS

iii. Providing field installation and configuration of the upgraded system that will include cabling, instrumentation installation to interface with the PLC.

iv. Redundant power supply to the PLC

viii. Source all materials, factory acceptances testing, transports components to site

ix. Update design documentation and submit documentation to the *Employer* as per Appendix 1 (C&I Documentation Requirements from Vendors)

x. Commission and handover the plant.

3.1.2.2.1 Control and Instrumentation Engineering Battery Limits

The *Contractor* shall provide the PLC based South Fuel Oil plant control system. The works will include:

(1) Engineering and installation of the plant PLC, for the control, protection interlocking and monitoring of the plant. This includes all hardware, enclosed in suitable stainless steel enclosures equipped with the necessary filtering and fans, installed in the current location of the PLC panels.

(2) The revision of existing plant Siemens S5 control logic, conversion or rewrite to new format. The new control logic must have the addition of dynamic control capabilities based on the upgrades on the plant system.

(3) Catering for the additional I/O capacity and capability on the PLC system to accommodate future field equipment required to improve the plant efficiency and availability. The following specified additional I/O signals will be used to enable sizing and specifying the PLC to allow for future plant

upgrades only. The installation of the additional field instrumentation is not part of the works unless specified:

- 4 Pump bearing temperature monitoring.
- 2 Service fuel Oil tank Level transducers for level monitoring and control
- 8 Pump Suction and discharge pressure transmitters
- 8 Pressure Differential transmitters across the Filters to detect blockage

(4) Implement Local/Remote Control mode of operation functionality.

(5) Decommission of the existing S5 PLC and its associated subsystems.

(6) Engineering and installation of new Local Operator Stations.

(7) Engineering and installation of a new SCADA in the SOR.

(8) Development of PLC Functional Design Specification, including the functional logic flow charts

(9) Interfaces to the PIS for data storage and long term information.

(10) Provision of all software, licensing and copyright agreements to enable the operation of the system(s) as specified by the works.

(11) Reinstating any interfaces that currently exist with other plant systems.

(12) Implementing additional monitoring and control parameters:

i. SCADA to display all interlocks and information for trip or failure of the plant.

ii. Expansion on the capacity and capability on the existing PLC to accomplish improved efficiency and reliability of the plant for the future upgrades

3.1.2.2.2 Electrical Power Supply Engineering Battery Limits

The power supply configuration to the PLC addresses power supply redundancy and is considered adequate for the upgrade. The power supply will remain unchanged:

(1) The power supply of the South Service Fuel Oil Plant System is outsourced from the 380V Substation Board 1B and 2B with pumps 4 and 5 being supplied from 380V Substation Board 1B and pump 6 and 7 from 380V Substation Board 2B.

(2) Similarly, the control supply to the PLCs is from the MCB Panel 2B within the 380V Substation Board 1B and 2B through a 300VA battery charger with input voltage of 220V AC and output voltage of 24V DC. Each battery charger is powered through a 20A single pole miniature circuit breaker (MCB). Figure 3-4 shows a generic power reticulation to the PLC.

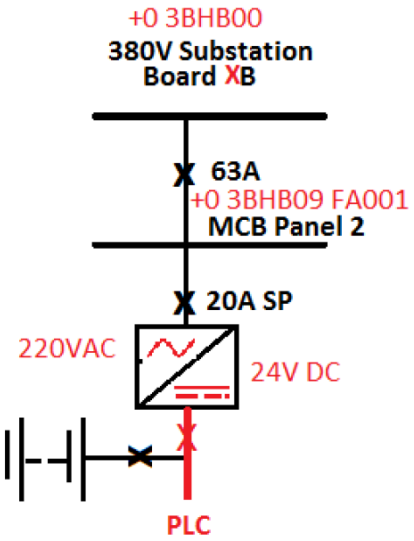

Figure 3-4: Generic Power Reticulation

(3) The rating of both MCBs supplying the PLC on either board (1B or 2B) panels is 20A single pole of type G63-C63.

3.2 *CONTRACTOR'S* DESIGN

3.2.1 General

(1) The *Contractor* shall provide new equipment and cabling to execute all Works to fulfil all requirements unless specified otherwise in this Specification.

(2) The *Contractor* shall provide the control system for the operation, control, protection, interlocking, and monitoring of the North and South Blower plants and South Fuel Oil plant.

(3) This works shall include the engineering, design, procurement, manufacturing, factory acceptance testing, and delivery to site, off-loading at site, storage, installation, testing, commissioning, optimisation, and as-built documentation for the plants' control systems.

(4) The control system shall provide all information, protection, control and local control facilities to enable the operator to execute his tasks safely, reliably and consistently.

(5) The Works shall comply with professional engineering practice and standards for fossil fuel power plants, and shall be designed for the environmental conditions prevailing at Hendrina Power Station Site.

(6) The system shall perform all functions related to:

i. Analogue and binary control.
ii. Process interlocking.
iii. Safety and protection functions.
iv. Supervisory functions.
v. Signal conditioning.
vi. Signal acquisition.
vii. Signal validation.
viii. Data communications.
ix. Engineering functions.

x. Configuration management.
xi. Information processing.
xii. Alarm Management.
xiii. Operating functions.
xiv. Cyber security.
xv. Long term archiving
xvi. Asset Management

(7) The functions listed above shall provide a complete functioning system.

(8) The *Contractor* shall implement the controls design with the intent of safely and optimally operating the:
   i. The Blower plant system.
   ii. The South Fuel Oil plant

(9) The design shall include all operating conditions of the plant, namely:
   i. plant preparation for start-up
   ii. plant start-up
   iii. plant running
   iv. plant shut-down
   v. Power plant operation during incidents

(10) This works shall be implemented in accordance with:
   i. Scope, Interface and Construction Definition Documents: Descriptions (Appendix 8)
   ii. Operating and Control Philosophies described as provided by the *Employer* (Appendix 5 & 6)

(11) The implemented philosophies shall meet the following:
   - 240-56355729 - Plant Control Modes Guideline.

(12) The command and monitoring operator intervention actions, interfaces and alarms shall be considered during the above conditions to enable effective overall plant control.

(13) The *Contractor* shall provide the design of the control logic as per the operating philosophy of the Blower plant.

(14) The C&I system shall be configured such that it responds to failures in a way that it suits the application.

(15) The C&I system shall maintain the control of the process within the operating envelope of the plant and alarm the operator when the process reaches the limits of the operating envelope

3.2.2 *Contractor's* Design in Detail Engineering

(1) It is the *Contractor*'s responsibility to verify the plant system and the documentation provided by the *Employer* before using it.

(2) Detail engineering is defined as being all activities to clearly identify the *Contractor*'s scope of works for the upgrade of the plants Control logic and Protection System concerned.

(3) As a minimum, detail engineering consists of the following activities:

i. High Level Engineering Philosophies & Concepts – during which the rules, philosophies and concepts followed in the various engineering and design activities, are clearly defined, clarified and accepted.

ii. Plant investigation work – during which the *Contractor* conducts his plant investigation work as input to his design.

(4) The plant investigation work and scope definition activities are conducted on a plant KKS basis.

(5) All detail Engineering activities are executed by the *Contractor* in active co-operation with the Project Manager.

(6) The detail engineering activities are phased to suit the Accepted Programme.

(7) All equipment having long delivery times are planned and technically clarified early in the Detail engineering technical clarification stage to allow early detailed engineering to commence in parallel.

(8) The *Contractor* and the PLC OEM 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.

(9) Any discrepancies found in the design after detail design freeze is the responsibility of the *Contractor* to correct.

3.2.2.1 High Level Engineering Philosophies & Concepts

(1) As a minimum, during the concept design activity, the *Contractor* develops and clarifies the documents defined in as being required for the Design in Appendix 1 – C&I Documentation Requirements from Vendors.

(2) Detailed engineering of the interfaces within the works and the interfaces to other systems, forms part of the works.

3.2.2.2 Plant Investigation Work

(1) The *Contractor's* scope of the plant investigation work includes:

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

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

3.3 SCOPE DEFINING DOCUMENTS FOR THE WORKS

(1) As a minimum, during the scope definition activities the documents in Appendix 1 – C&I Documentation Requirements from Vendors that are required for basic engineering design freeze are developed and clarified by the *Contractor* to be approved by the *Project manager*.

(2) As a minimum, during scope definition activities the following items that have been provided by the *Employer* are verified and clarified by the *Contractor*:

i. North Blower Plant design (Appendix 2).

ii. South Blower Plant design (Appendix 3).

iii. South Fuel Oil Plant (Appendix 4)

iv. South Fuel Oil Plant Operating Technical Specification (Appendix 5)

v. Blower Plant Operating Technical Specification (Appendix 6)

vi. Existing SCADA IO List (Appendix 7)

vii. Scope, Interface and Construction Definition Documents: Descriptions (Appendix 8)

3.4 PLANT C&I SYSTEM

(1) The SCADA is currently configured for the monitoring of the Blower and the South Fuel Oil plants. The SCADA is obsolete and requires upgrading. Appendix 7 document contains the list of all the existing signals connected to the SCADA

(2) The FFP Blower and the South Fuel Oil plant control systems are standalone systems.

(3) Figure 3-5 shows the proposed SCADA upgrade interface setup. The Diesel Generators interface to the SCADA will not form part of works in this project.

(4) The *Contractor* will be responsible for the upgrade of the obsolete SCADA system operated at the SOR and will take into consideration the additional control and monitoring parameters associated with the upgrades on the two plants only.

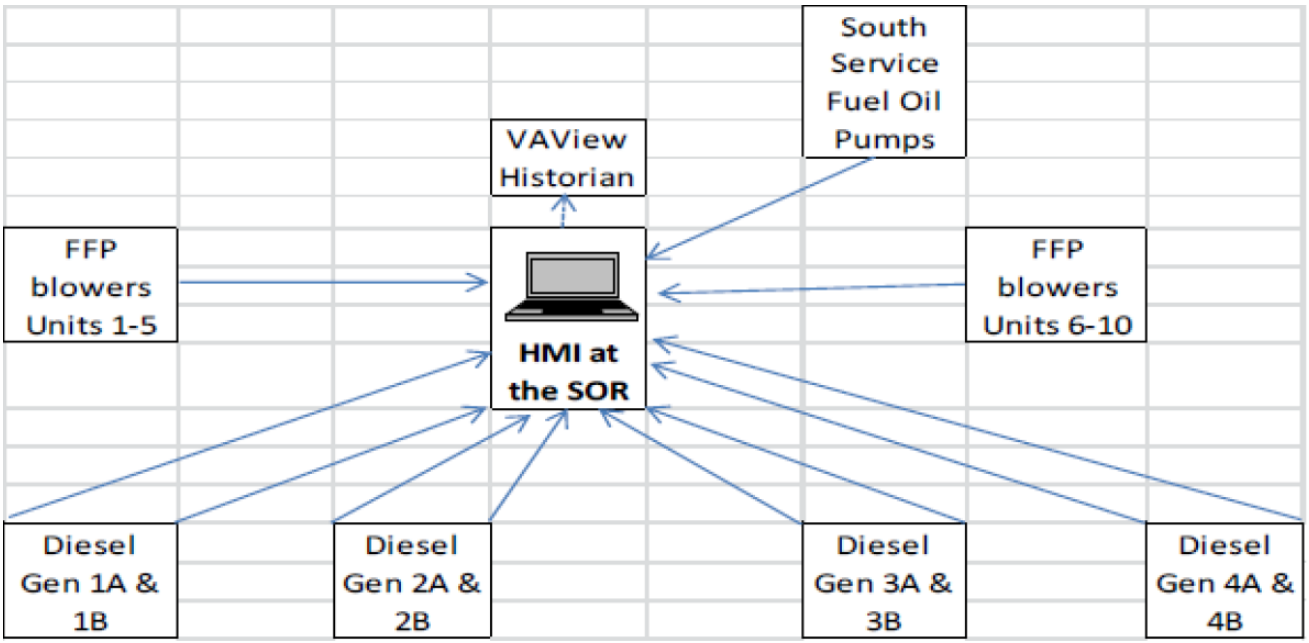

Figure 3-5: High level overview of the proposed remote SCADA HMI interface at the SOR

1) The SCADA system will be interfaced to the PIS for data storage and trending facility via VA view. The upgraded system should cater for the required engineering to devices and systems (including computer and telecommunication / telephony systems) that will monitor, manage and control plant, equipment and networks in real-time, or near real-time to ensure the integrity and performance of operations.
2) This modification should include the following operational technology:
   i. Complete replacement of the SCADA system hardware that includes the HMI at the Operator desk, communication equipment, interface equipment and the cabling from various PLCs to the HMI.
   ii. Complete replacement of the SCADA system software for all the associated equipment
   iii. The SCADA will be responsible for monitoring, alarming and facilitate archiving of the plant information.
   iv. The *Contractor* will update and provide mimics for the SCADA:
      a. Mimics for alarm displays from the plant areas connected to the SCADA.

b. Mimic showing the plant layout and showing the statuses of the monitored plant items. There will be updated mimics for existing plants and restoration of existing interfaces to the SCADA, hence there will be a mimic for:
   - North Blower-house plant
   - South Blower-house plant
   - South Fuel Oil plant

v. Planning for obsolescence and future replacement of hardware;
vi. Self-diagnostics features
vii. Redundancy, independence and separation of hardware;
viii. Standby power requirements;
ix. Human machine interfacing and ergonomics
x. Interface to Information Technology. The SCADA system configuration will include connections to the VA View historian and the GPS clock.
xi. When a new PLC has been installed, it will be connected to the new SCADA. During the commissioning, the plant in question will be monitored locally.

5) The existing SCADA is a CitectSCADA. The current PC (windows xp pro) citect 7.3 is an alarms server, trend server, and report server. In addition, an OPC server for VA is running on the machine. The CitectSCADA Technical Overview document is attached as Appendix 9 of this Technical specification.

3.4.1 SCADA Specification

(1) The *Contractor*'s SCADA upgrade design shall be based on the following *Employer*'s standards:

i. Human Machine Interface Design Requirements Standard (240-56355728)

ii. Power Plant Controls & Instrumentation; Control Systems; Distributed Control Systems (DCS); Part 2: Operator & Supervisor System Standard (240-132042275)

(2) The HMI shall be the human interface for the operating and monitoring of the Blower plant system at SOR.

3.4.1.1 SCADA Documentation

SCADA system documentation provided by the *Contractor* should include the following:

(1) One-line diagrams

(2) Process and instrumentation diagrams (P&IDs)

(3) Sequences of operation

(4) Instrument data sheets

(5) Points list

(6) Loop diagrams or I/O wiring diagrams

(7) Binary logic diagrams

(8) Control schematics

(9) PLC program listing

(10) HMI description (screen prints and database)

(11) Software configuration management documentation

(12) Facility physical and information security policies

3.4.2 Plant Control System Specification

1) All the PLCs will be replaced by a redundant CPU PLC configured in an H bridge configuration to form redundant control system architecture in each equipment room.
2) Existing PLC cubicles will used and will be modified accordingly to accommodate the new PLCs.
3) There will be a total of three redundant PLCs and one Remote IO station:
   - One redundant PLC in the North plant located at Unit 3 Blower house for Units 1 to 5
   - One redundant PLC at Unit 7 house linked to a Remote IO station at Blower house at Unit 8 for the South plant, one located at Unit 7 and the other at Unit 8 Blower houses for Units 6 to 10.
   - One redundant PLC at the South Fuel Oil plant pump house
4) Each PLC will be programmed to protect, monitor and control the plant.
5) The current Local Operating Panels will be upgraded to be local operation HMIs.
6) The upgraded systems will be monitored both locally as well as remotely via an upgraded SCADA system.
7) The SCADA will be re-connected to the PIS to facilitate data acquisition and trending, via a suitable OPC client.
8) The Control and Operating philosophies described in Appendix 5 and 6 will be updated to align with any changes.
9) The *Contractor* is expected to comply with the following *Employer*'s standard and guidelines provided:
   i. 240-56355729: Plant Control Modes Guideline
   ii. 240-56355731: Environmental Conditions for Process Control Equipment Used at Power Stations Standard
   iii. 240-119638133: Control Systems Design for Redundancy and Diversity Standard

3.4.2.1 PLC Minimum Specification

Component	Specification
Control Cubicle	Existing cubicles to be utilised
CPU	Redundant system. Two CPUs enjoy equal rights so that either CPU can be the master or the standby CPU.
Remote IO station	Linked to redundant PLC
Power supply	Redundant 24Vdc For two PLCs and one Remote IO station
Mounting Racks	Compatible to the new PLC
Digital Input Module	Non-redundant with spare capacity 16 x DC24V
Digital Output Module	Non-redundant with spare capacity 16 x DC24V
Analogue Input Module	Non-redundant with spare capacity
Analogue Output Module	Non-redundant with spare capacity
Cubicle Wiring	PROFIBUS shielded cables

Programming software	Failure of a central processing unit or power supply. Fault-Tolerant System Response in the Event of faults Failure of a fibre-optic cable
Communication Module	Redundant configuration
Cabling	Hardwired to the SOR SCADA HMI. Copper cabling
Operator Interface	Local operator interface (local HMI) and remote interface (SCADA HMI) required

3.4.3 Field Equipment Cabling & Installation Design Specification

The field instrumentation and cabling scope breakdown will include the following:

(1) The *Contractor* shall provide the Cabling, wiring and termination of the signals of the upgraded system from the field to the PLCs.

(2) The *Contractor* shall provide the Provide power supply required for the operation of the modified system components.

(3) The *Contractor* is expected to comply to the following *Employer*'s standard provided:

i. 240-56355754: Field Instrument Installation Standard
ii. 240-56355815: Field Instrument Installation for Junction Boxes and Cable Termination Standard
iii. 240-56227443: Requirements for Control and Power Cables for Power Stations Standard

3.4.4 Protections and Alarms Specification

(1) The Blower System local and remote SCADA protections and alarms will be reinstated as detailed in the following supporting documents:

i. 380-EN-AABZ28-SP0004-13 Operating Training FFP Section 7 Cleaning Air Supply Units 1 to 5 Rev 2
ii. 380-HEN-AABZ28-SP0004-14 Operating Training FFP Section 6 Cleaning Air Supply Units 6 to 10 Rev 2

(2) The South Fuel Oil System local and remote SCADA protections and alarms will be reinstated as detailed in the following supporting documents:

i. Operating Technical Specifications: Hendrina Power Station Outside Plant Module 2 Fuel Oil Systems Section 2 South Fuel Oil Plant
ii. MESK101Unit 6-10 South Fuel Oil Plant-Plant Pumps (PLC Modified)

(3) Additional protections and alarms and their response actions are to be specified and documented according to the *Employer's* Alarm Management System Guideline 240-56355466.

3.4.4.1 Alarms

(1) A comprehensive and integrated alarm handling system shall be employed.

(2) The alarm handling system shall clearly distinguish between different alarm types and provide alarm filtering functionality.

(3) Alarm information shall not be lost or inaccessible whilst navigating through displays. Alarm presentation shall be dynamically provided to the operator with information matched to the current situation and its criticality.

(4) The alarming shall comply with the requirements of 240-56355466 - Alarm Management System Guideline.

(5) Nuisance alarms shall not be repeated on the alarm pages.

(6) Users shall be able to navigate directly from any alarm to the alarm response sheet for that specific alarm.

(7) Alarm response sheets shall be provided for all configured alarms including alarms specific to the C&I system.

(8) Alarm response sheets shall be provided in PDF format to the operator.

(9) All alarm response sheets shall comply with the requirements of 240-56355466 - Alarm Management System Guideline.

(10) The *Contractor* shall implement an alarm philosophy in the C&I system such that:

i. [from VGB R 170 B3e] “Prioritisation and categorisation possibilities of the alarms in at least four stages.”

ii. [from VGB R 170 B3e] “Possibility of navigation to allocated process displays per alarm.”

iii. [from VGB R 170 B3e] “Alarm lists on visualisation systems with indication of power plant marking system [KKS], alarm text, alarm state (colour distinctions), time stamp (sorted).”

iv. [from VGB R 170 B3e] “All signals must be sortable and filterable according to identifier [KKS], priority, time stamp and status and in fact in ascending and descending order.”

3.5 ELECTRICAL POWER SUPPLY

3.5.1 Blower Plant Electrical Power Supply Design

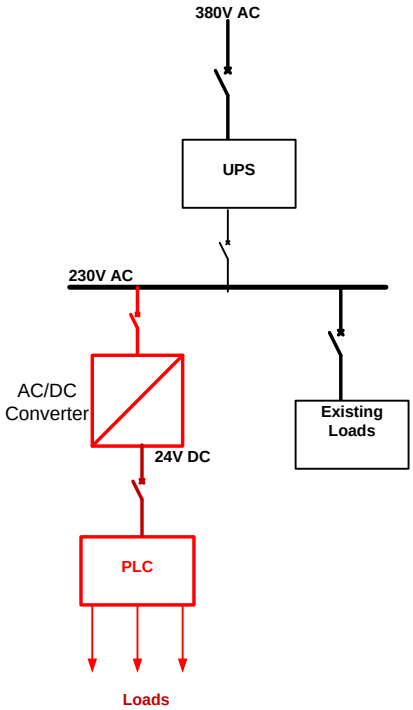

Figure 3-6: Unit 1-5 power supply reticulation configuration to new PLCs.

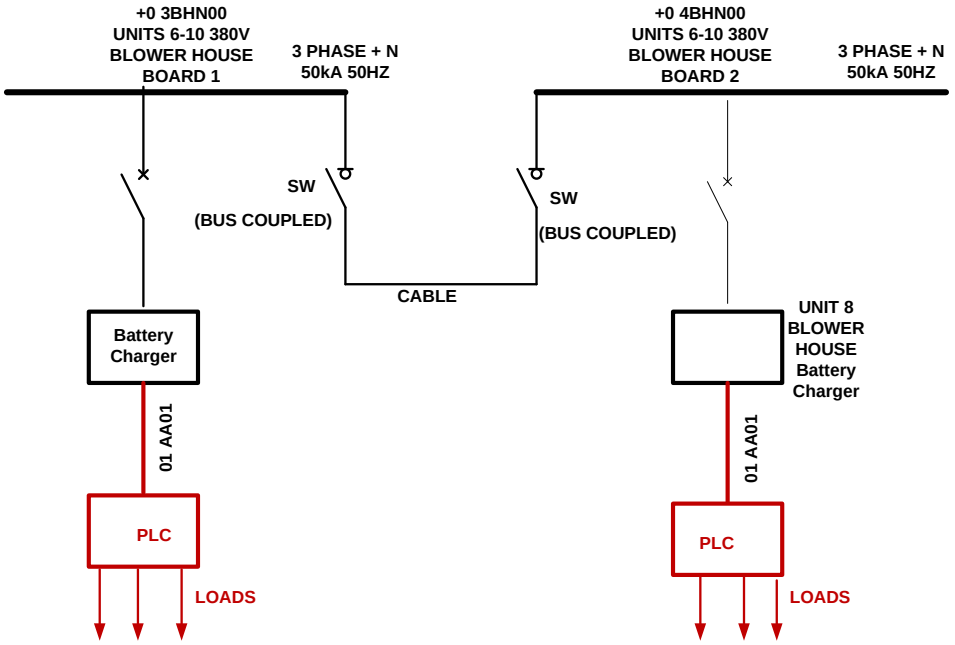

Figure 3-7: As Is Unit 6-10 power supply reticulation configuration for new PLCs

(1) Figure 3-6 and 3-7 show the *Employer's* design for Unit 1-5 and 6-10 respectively. In Figure 3-6, the proposed *Contractor*'s scope of work is depicted in red and is required to be further developed by the *Contractor* as per the intended C&I PLCs design requirements. In Figure 3-7, this design is complete; however, the *Contractor* is required to demonstrate that the integrity of the existing reticulation system is adequate prior to the installation and commissioning of the PLCs. All works performed by the *Contractor* shall comply with the *Employer's* (Eskom) standard and the relevant international standard as prescribed within the *Employer's* standard for all system(s) or components.

(2) Existing cable routing design shall be maintained as far as possible and shall comply with section 3.2.6 of 474-11542 Gx Plant General Electrical Specification and its applicable normative.

(3) New electrical components shall be engineered to comply with the relevant section of 474-11542: Gx Plant General Electrical Specification and its applicable normative, where applicable.

(4) It is the *Contractor*'s responsibility to select the adequate UPS (A/B) for the supply of the loads requirement of the new PLCs for unit 1-5. This shall be clearly demonstrated in the form of a measurement report and or calculations.

(5) The following schematic diagrams shall be made available to the *Contractor* as information to assist the *Contractor* to further develop the *Employer's* design or provide an alternative detail design as per the intended *Employer's* C&I requirements: 25.15/23751 rev 0, 25.15/23751 rev0, 25.15/38811, 25.15/38810, 25.15/38809, 25.15/38775 and 25.15/36599.

(6) At completion of the *Contractor's* signed detail design by a professional registered engineer, the *Contractor* submits its design to the *employer* for acceptance prior to the commencement of the next phase. The following documents are required to be submitted by the *Contractor* in the detail design phase :

i. AC/DC certificates/report.

ii. AC/DC OEM Technical Manual.

iii. Technical schedule B of Schedule A and B as per Annex C of the attached *Employer*'s 240-53114248 Thyristor and Switch mode chargers, AC/DC to DC/AC Converters and Inverter/Uninterruptible Power Supplies standard for AC/DC converter.

iv. AC/DC Equipment List designation.

(7) Submission of design documents shall be in accordance with section 3.4.5 of document 474-11542 Gx. Plant General Electrical Specification and its applicable normative.

(8) Electrical schedules applicable to the *Contractor*'s design shall be in accordance with section 3.4.4 of 474-11542: Gx Plant General Electrical Specification Revision 1 and its applicable normative. .

(9) Where applicable, terminations, junctions and distribution boxes designs shall be in accordance with section 3.2.7 of 474-11542 Gx Plant General Electrical Specification Revision 1 and its applicable normative.

(10) The *Contractor* shall perform design review of its design as per Section 3.5 of the document 474-11542 Gx Plant General Electrical Specification and its applicable normative

3.6 HUMAN FACTORS ENGINEERING REQUIREMENTS

The guideline "240-56355808 Ergonomic Design of Power Station Control Suites" shall be used specify any human factor engineering requirements imposed on the intended system.

3.7 DOCUMENTATION

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

(1) The basis for the completion of all engineering activities is documentation as defined in:

i. Appendix 1 – C&I Documentation Requirements from Vendors.

ii. Works Information.

(2) The documentation, as defined in Appendix 1 – C&I Documentation Requirements from Vendors is prepared by the *Contractor* for the technical clarifications and provided to the *Project Manager* five working days prior to the start of the respective technical clarification.

(3) Technical clarification is where the *Contractor* clarifies with the *Project Manager* all the technical issues.

(4) The *Contractor* is responsible for maintaining the minutes of the meetings, a deviation schedule and list of open points (LOP) for all engineering activities and records of changes to scope during the engineering phases.

(5) Immediately after the technical clarification meetings, the *Contractor* provides two soft copies of the updated documentation as defined in Appendix 1 – C&I Documentation Requirements from Vendors.

(6) The *Project Manager* reviews the updated performance, functional, and equipment specifying documentation.

(7) The *Contractor* prepares the formal documentation for the engineering design freeze.

3.7.2 As-built drawings, operating manuals and maintenance schedules

3.7.2.1 General Requirements

(1) The documentation requirements cover the various stages of the works, from the engineering stages; through installation and commissioning; and operating, maintenance and training stages of the project.

(2) All technical documentation is numbered and classified as specified in the C&I Documentation Requirements from Vendors.

(3) Soft copies and hard copies of each document specified in Appendix 1 are provided at the stages defined in Appendix 1– C&I Documentation Requirements from Vendors.

(4) All documentation is accessible in paper form and addressable in databases.

(5) All documentation is in English

3.7.2.2 As-Built Documentation Package

(1) 'As Built' documentation, as listed in Appendix 1 – C&I Documentation Requirements from Vendors, is supplied by the *Contractor* to the Project Manager upon sectional completions of works.

(2) 3 hard copies and 2 soft copies of As-built documentation are provided by the *Contractor* as part of the works.

(3) Acceptance of the As-built' documentation is a pre-requisite for the Sectional Completion of the upgrade of the Control System concerned.

(4) The documents are reviewed by the Project Manager for correctness and conformance to the accepted design.

(5) The OEM signs of on the completeness of the As Built documentation package

3.7.2.3 Documentation Modification

(1) The *Contractor* provides additional and amended pages, sufficient for all copies of manuals or document sets to ensure that they are complete, inclusive of detail such as final settings and modifications.

(2) The *Contractor* updates the soft copies of all documentation on the engineering system to ensure that they are complete, inclusive of detail such as final settings and modifications

(3) Amendment information is forwarded to the Project Manager, within the period for reply, following receipt of agreement to equipment or system design modifications

3.7.2.4 Vendor Document Submittal Schedule

(1) Appendix 1 – C&I Documentation Requirements from Vendors Schedule specifies the following:

i. The type of documentation which is provided.

ii. The native/original format in which the soft copy of the documentation is provided in addition to the .pdf soft copy.

iii. The limits of supply of the documentation (clarifying the provider and maintainer of the documentation).

iv. The stage in the project execution during which the documentation is provided as a deliverable.

v. Live documents that are generated and maintained by the engineering tools and the Document Management System.

(2) Appendix 1 – C&I Documentation Requirements from Vendors defines the type of technical documents that are exchanged during the project execution only. It is not a document index that lists each and every document technical document.

(3) Hardcopies, .pdf soft copies and native/original softs of each document specified in Appendix 1 are provided at the stages defined in Appendix 1 – C&I Documentation Requirements from Vendors.

(4) All documentation submitted by the *Contractor* conforms to all the requirements of the technical documentation index and are in an adequate state of completeness

3.7.2.5 Scope, Interface and Construction Definition Documents

(1) The *Contractor* produces and supplies the scope, interface and construction definition documents defined in Appendix 1 – C&I Documentation Requirements from Vendors.

(2) The *Contractor* consolidates all of the relevant process input information for scope, interface and construction definition documents and incorporates the *Contractor*'s own design information where applicable in a consistent manner.

(3) It is expected that the scope, interface and construction documents are updated and refined throughout the execution of the works.

(4) The *Contractor* uses the relevant schedule templates provided by the *Employer*. Any modifications must be approved by the Project manager

(5) The *Contractor* is able to create sub-schedules for particular plant areas/function groups by filtering/extracting information from the master schedules.

The full description of the documents is found in Appendix 8

3.7.2.6 Operating and Maintenance Manuals

(1) The *Contractor* provides 5 hard copies and 5 electronic cd copies of operating and maintenance manuals prepared by suitably experienced personnel indicating all the maintenance and operational requirements.

(2) Manuals contain, as a minimum, the following:

i. Design data including descriptions of control philosophy with alarms, set-points, interlocks and logics clearly explained

ii. Process and instrumentation diagrams

iii. Range, calibration factors, calibration certificates, data sheets, etc. for all control and instrumentation equipment

iv. Electrical diagrams

v. General arrangement and installation drawings and instructions

vi. Operating procedures and instructions for normal and emergency conditions

vii. Commissioning and maintenance procedures and instructions for specific plant and equipment

viii. All drawings required for component location, dismantling and re-assembly for maintenance

ix. Equipment details such as make, model, type, specifications, etc.

x. Detailed parts lists and ordering instructions pertaining to storage of spare parts or to their shelf life

xi. Exploded view type drawings clearly detailing the part and uniquely identifying it, technical descriptions of the equipment and component parts

xii. Catalogues, schedules and other product support documents

xiii. Troubleshooting and fault finding guide

xiv. Safety procedures and instructions

xv. All special tools and equipment required for maintaining and operating the works

(3) The maintenance instruction manuals are required to give a full technical description of the equipment concerned and to cover all aspects of erection, commissioning, operation and maintenance.

3.7.3 Packaging, Handling and Transporting Requirements

3.7.3.1 Packaging

i. All the identified equipment that will be re-used must be packaged such that it can be easily transported without being damaged.
ii. The equipment that needs to be packaged is clearly marked by the *Contractor* before decommissioning starts.
iii. The packaging material and specifications are supplied by the *Employer*.
iv. Equipment not marked for re-use is removed and transported to the dedicated disposal areas.

3.7.3.2 Storing of equipment

i. Dedicated equipment storage areas are provided by the *Employer* either as temporary or permanent storage areas.
ii. The temporary storage area is an area where the equipment may be gathered and packaged before it is transported to the permanent storage area.
iii. All storage areas are located within the boundaries of Hendrina Power Station.
iv. The *Contractor* maintains a detailed inventory of all equipment that has been removed from the plant and stored in the temporary or permanent storage areas.
v. For the duration of the *works*, the *Contractor* updates the inventory as and when equipment is removed or added to the storage areas.

3.7.3.3 Transporting

i. The *Contractor* is required to transport all the equipment to the temporary storage or to the disposal area.
ii. The *Contractor* is also required upon completion of packaging to transport the equipment to the permanent storage area.

3.8 SYSTEM FUNCTION AND PERFORMANCE REQUIREMENTS

3.8.1 Functional Specifications and Functional Design Philosophies

(1) The *Contractor* produces Functional Specifications and Functional Design Philosophies for the aspects/sub-systems of the Blower Control & Protection System as defined in Appendix 1 – C&I Documentation Requirements from Vendors.

(2) A Functional Specification or Functional Design Philosophy is a written narrative that describes the design and specific configuration of the concerned system(s). The functional specification(s) is created during the basic engineering phase and is updated as necessary during the project implementation.

(3) The functional specification or functional design philosophy fulfils the following objectives:

i. Define how the contractual requirements related to the system are met.

ii. Clearly define the specific system configuration provided.

iii. Clearly describe the design principles followed and design choices made.

iv. Clearly define the system limitations.

v. Provide basic technical information on the system's various software and hardware components.

vi. Provide references and links to detailed technical information of each system components.

vii. Define the characteristics of the system under normal conditions.

(4) The principles defined in the functional specification and design philosophy documents are applied throughout the execution of the works.

(5) The functional specifications are aligned with the OEM internal specifications, best practices and guidelines.

(6) The design and performance of the Blower plant Control & Protection System will be assessed in part against the criteria defined in the relevant functional specification and functional design philosophy documents

3.8.2 Cabling Functional Specification

(1) The *Contractor* shall provide new field cabling from the field to the PLC cubicle and to remote SCADA.

(2) The *Contractor* shall provide the cabling functional specification document that describes the following as a minimum:

i. Methodology followed for cabling designs.

ii. Installation of cabling within cabinets.

iii. Installation of cabling on racking.

iv. Use of redundant process and network cable routes.

v. Copper and fibre cable specifications.

vi. Testing of cabling.

3.8.3 Field Equipment Functional Specification

(1) The *Contractor* shall provide the field equipment functional specification describes the following points as a minimum:

i. General description of equipment, materials and installation requirements or standards for all field equipment including:

- Instrumentation.
- Instrument stands
- Instrument manifolds
- Instrument piping
- Instrument piping supports
- Material specification
- Junction boxes
- Cables

- Cable glands
- Cable supports
- Terminal blocks
- Field equipment labels

ii. Instrument installation and measurement principle.

3.8.4 Reliability and availability

i. The availability of the hardware over its lifetime is 99% or greater, calculated annually.
ii. The availability excludes hardware upgrades.

3.9 INTERFACE WITH OTHER PLANTS OR SYSTEMS

3.9.1 Blower Plant Interface

The FFP system is using pulsing air from the Blowers for cleaning of its filter bags. The Blowers supply pulse air to the pulse tanks located on top of the FFP casings.

There are six blowers supplying pulse air to Units 6 – 10 on the south. Three of six blowers are in the blower house behind unit 7 (7 0UHP00) and the other three are housed in the blower house behind unit 8 (8 0UHP00).

There are seven blowers housed in the blower house behind unit 3. These blowers supply pulse air to units 1 – 5 for cleaning of the filter bags. The filter unit supplies clean air to the blower house, providing intake air for the blowers and pressuring air for the blower building

3.9.2 South Fuel Oil Plant Interface

i. Hendrina has two distinct Fuel oil systems referred to as the North and South Fuel oil systems. The North fuel oil system supplies Boilers 1 to 5 and the South side supplies Boilers 6 to 10. The two systems are interconnected to allow fuel to be transferred from North to south or South to North.

ii. Each one of the two Fuel oil plants (North and South) has an off-loading system and a service system.

iii. The fuel oil off-loading system receives oil from delivery tankers and transfers to the bulk storage tanks.

iv. The Fuel oil service system receives oil from the bulk storage tanks and transfers it to the boiler burners.

3.9.3 SCADA Interface

Figure 3-5 shows the proposed SCADA upgrade interface setup. The Diesel Generators interface to the SCADA will not form part of works in this project.

3.9.4 Spares and consumables

i. The *Contractor* shall provide a list of critical spares to be kept on site at all times.

ii. The *Contractor* supplies the spare parts necessary for the installation, pre-commissioning and commissioning of the plant and equipment. Such parts are packaged and protected against damage, corrosion and deterioration. All such parts are labelled properly.

iii. The *Contractor* provides a recommended spares list before any work commences. This list includes individual descriptions of the spares, types, part ordering numbers, supplier information as well as shelf life information.

iv. The *Contractor* ensures that all spares are available for the negotiated life expectancy of the system and notifies the *Employer* in writing if such parts become obsolete.

3.10 TESTING AND COMMISSIONING

Testing and Commissioning of the upgraded Control system shall be performed to ensure that the relevant Control and Instrumentation system meets the functional requirements and performance criteria required for the plant. It will include the following steps:

i. Checking the hardware

Each sensor is connected to a specific input and each final control element to an output. During engineering process addresses and wires must not be mixed up. Also, the sensors and final control element placing should be checked (that they are where they have to be in the automated system)

During checking procedure, the outputs are set in a test mode. The final control elements must then meet the specified requirements (functions).

If changes are made, then the documentation (allocation list, drawings, etc.) must also be updated to respond to reality

ii. Transferring and testing the software

All available off-line and virtual PLC program testing tools should be used to find program faults.

The input signal changes are to be simulated to verify how the outputs will react to them. Some PLCs offer simulation in a real PLC: the entire program is executed in a PLC without the real inputs and outputs being connected. Processing of the PLC outputs thus only takes place in the PLC image table. The physical PLC I/Os are not updated to/from the PLC I/O images.

The individual user program parts and system functions are to be tested: manual operation, setting, individual monitoring programs etc. and finally the interaction of the program parts with the help of the main program.

The system should be commissioned step-by-step. Important aspects of commissioning and fault detection are the test functions of the programming system, such as the single-step mode or the setting of stop points. The single-step mode is recommended, whereby the program in the PLC memory is executed line-by-line or step-by-step. In this way, any program faults which may occur in the program can be immediately located.

iii. Optimisation of the entire system

The programs often require improvement after the first test run. It is recommended that any corrections or modifications are made not just in the PLC user program, but are also taken into account in the documentation.

iv. Commissioning of the entire system

Once the final status of the PLC user program and the documentation is established, all the controller functions (in accordance with the automation task) need to be executed step-by-step again.

If no faults are detected in the entire system commissioning, then the system is ready to be handed over to the client

3.11 TESTS AND INSPECTIONS BEFORE DELIVERY

i. All material/ equipment are inspected in the Contractor's workshop before delivery.
ii. The Contractor provides the Employer with all the certificates and test results (Factory Acceptance Tests) before proceeding with any installation

3.12 EXTERNAL ENVIRONMENTAL REQUIREMENTS

The *Employer's* standard 240-56355731 Environmental Conditions for Process Control Equipment Used at Power Stations Standard should be referenced.

i. The *Contractor* ensures that all equipment used in the designs/ solution offered conforms to all applicable environmental legislation.
ii. The *Contractor* adheres to Hendrina Power Station Environmental Management System that must meet the requirements for the Code of Practice for EMS, ISO 14001:2004.
iii. The EMS requirements are detailed in the latest revision of the following documents, which are available from the *Project Manager* on request, and include:
   a. The Hendrina Power Station Environmental Policy (HSPPPIN005).
   b. The Hendrina Power Station Identify & Update Environmental Aspects Procedure (HSPPIN024).
   c. The Objectives & Targets Procedure (HSPPIN026].
   d. The Environmental Emergency Preparedness Procedure (HSPPIN032).
   e. The Training, Awareness & Competence Procedure (HSPPIN029).
   f. The Prevention & Cleaning of Oil Spills Procedure (HSPPON003).
   g. The Waste Management Procedure (HSPPIN003).
   h. The Roles and Responsibilities Procedure (HSPPIN028).
   i. The EMS Non-Conformance, Corrective and Preventative Action (HSPPIN034)
   j. The relevant Environmental Management Programmes (EMP's) and Aspects on the EMS database - this is continually changing and is available from the *Employer*s Representative.
   k. Compliance to all relevant environmental legislation, as detailed in the latest version of the Hendrina Power Station Legal Register available from the *Employer*s Representative.
   l. All operational procedures that include environmental requirements, relevant to the Works Information or Scope of this contract.
iv. The *Contractor* is responsible to comply with any new environmental requirements, relevant to the *Works* Information or Scope that may come into effect as part of Hendrina Power Station's EMS during the duration of this contract.
v. The *Contractor* is responsible to ensure representation at Environmental meetings that may require input for the updating of the EMS as well as training on an ad-hoc basis.
vi. If there is uncertainty around any environmental issues, the Environmental Department at Hendrina Power Station may be contacted on (013) 296 3011 or (013) 296 3910 or (013) 296 3013

3.13 SAFETY

i. The *Contractor* shall comply with the latest revision of Eskom Hendrina Power Station's Health, Safety and Environmental Specifications for Principal *Contractor's* requirements as mentioned in HSPHO 058 "*Safety, health and environmental specifications for principal Contractors*".
ii. The *Contractor* shall comply with any other SHE requirements not stated in HSPHO 058, but required by the *Employer*.

3.13.1 General

i. The *Contractor* complies with the Occupational Health and Safety Act no 85 of 1993 and its regulations, Eskom SHE Policy, Standards, Procedures, Guidelines, Specifications and Regulations.
ii. The *Contractor* ensures safety awareness at all time through continuous training
iii. The *Contractor* is at all times responsible for the supervision of his employees, agents and Sub-*Contractor*s and takes full responsibility and accountability for ensuring that they are competent, compliant and aware of the legal requirements and other requirements and execute the *works* accordingly.
iv. The *Contractor* ensures that all statutory appointments and appointments required by any Eskom Regulations are made in writing and that all appointees fully understand their responsibilities and are trained and competent to execute their duties.
v. The *Employer*, or any person appointed by the *Employer*, may, at any stage during the term of the contract:
   a. Conduct health and safety audits by a competent person regarding all aspects of compliance with the SHEQ Requirements, at any off-site place of work, or the site establishment of the *Contractor*
   b. Refuse any employee, Sub-*Contractor* or agent of the *Contractor* access to the premises if such a person has been found to commit an unsafe act or any unsafe working practice or is found not to be competent or authorised
   c. Issue the *Contractor* with a stop order, should the *Employer* become aware of any unsafe working procedure or condition or any non-compliance.
vi. The *Contractor* immediately reports any incidents, disabling injury, near miss, first aid incident as well as any threat to health and safety of which it becomes aware at the *works* or on the Site to the Project Manager.
vii. The *Contractor* agrees that the *Employer* is relieved of any and all of its responsibilities and liabilities in terms of the Occupational Health and Safety Act no 85 of 1993 in respect of any acts or omissions of the *Contractor*, and the *Contractor*'s employees, agents or Sub-*Contractor*s, to the extent permitted by the Occupational Health and Safety Act no 85 of 1993.
viii. The *Contractor* ensures that all his personnel attend a Health and Safety Induction Course presented by ETD, Monday to Friday – 09:00 to 11:00, free of charge prior to commencement of any works. This is a two (2) hour course and is valid for the duration of one (1) year at Hendrina Power Station.
ix. The *Contractor* works strictly to regularly updated risk assessment.
x. The *Contractor* ensures supervised and authorised entry into the plant.
xi. The *Contractor* barricades the entire perimeter of the site.
xii. The *Contractor* ensures at all times compliance with the safety regulations imposed by any act of parliament, or any regulation or by law of any statutory authority.
xiii. The *Contractor* complies with the Occupational Health and Safety Act and Regulations, 1993 and all regulations made there under as well as the *Employer*'s safety and operating procedures.
xiv. The *Contractor* acknowledges that he is fully aware of the requirements of all the above and undertakes to employ people who have received sufficient training that they can comply therewith. The *Contractor* undertakes not to do, or not to allow anything to be done which will contravene any provisions of the act, regulations or operating procedures.
xv. All employees of the *Contractor* must attend a safety induction course before they are allowed to work on site.
xvi. It is the responsibility of the *Contractor* to ensure that all employees have attended the safety induction.
xvii. The *Contractor* holds a Toolbox Talk and inspects all PPE before any work commences and keep written proof of such actions.
xviii. The *Contractor* complies with all of the applicable procedures as required by the *Employer*; Procedures are available from the *Employer's* Documentation Centre on request.

xix. The *Contractor* familiarizes himself with all permit requirements for work to be done on all plant systems and ensures that permits are applied for accordingly.

xx. The following risks are identified by the *Employer*, and the *Contractor* includes these in his risk assessment:
   a. Injury caused by hand tools.
   b. High noise level.
   c. Falling when working at heights.
   d. Welding which may result in burning.
   e. Movement of stairs while walking.
   f. Falling objects.
   g. Dust

xxi. Any tampering with the *Employer's* fire equipment is strictly forbidden.

xxii. All work done by the *Contractor* shall comply with the latest revision of *Employer's* SHEQ requirement as stated in the Safety, Health and Environmental Specifications for Principal *Contractor*s Ref. No.: HSPHO/058 and all other *Employer* safety requirements.

xxiii. *Employer* compiles a baseline safety risk assessment to identify all the possible risks during the implementation of the project.

xxiv. The risk assessment includes all the mitigating strategies in order to minimise all the possible risks.

xxv. *Employer* provides the *Contractor* with the baseline risk assessment to use it as a minimum requirement to compile a risk assessment identifying all the risks before the implementation commences, the risk assessment compiled by the *Contractor* will clearly show all the mitigating strategies in order to minimise all the possible risks.

xxvi. No work shall be carried out without the risk assessment identifying all the risks and the mitigating strategies in place in order to address the identified risks.

3.13.2 Safety of workers

i. The *Contractor* ensures the safety of all persons working in the Site. Any hot work, including welding, will be applied for in accordance with the permit to work system. No welding will be allowed on site unless permission is granted in writing by the Project Manager.

ii. All welding, flame cutting and grinding work is properly screened to protect persons from arc flash or eye injuries. Fire blankets are fitted over the scaffolding planks and platforms. Precautions are taken to prevent any objects, welding or grinding splatter from falling.

3.13.3 Fire protection

i. The *Contractor* ensures that adequate firefighting apparatus is provided at all his work sites, and that his employees are trained in the use of the apparatus.

ii. The *Contractor* takes precautions to prevent any occurrence of fires or explosions while carrying out any work near flammable gas and liquid systems. Any tampering with the *Employer's* fire equipment is strictly forbidden.

iii. All exit doors, fire escape routes, walkways, stairways, stair landings and access to electrical distribution boards must be kept free of obstruction and not be used for work or storage at any time. Firefighting equipment must remain accessible at all times.

iv. In case of a fire, report the location and extent of the fire to the Electrical Operating Desk at 086 123 7566, 082 677 5295 or extension 5555 if phoning from an internal landline.

v. Take action to safeguard the area to prevent injury and spreading of the fire.

3.13.4 First aid

i. The *Contractor* provides a first aid service to his employees and Sub-*Contractor*s. In the case where these prove to be inadequate, like in the event of a serious injury, the *Employer's* Medical Centre and facilities will be available.

ii. Outside the *Employer's* office hours, the *Employer's* First Aid services are only available for serious injuries and life threatening situations.
iii. The *Employer* recovers the costs incurred, in the use of the above *Employer's* facilities, from the *Contractor*.

3.13.5 Hazardous substances

i. The *Contractor* manages hazardous substances in accordance with the requirements of the Occupational Health and Safety Act no 85 of 1993 and the NEMWA Act. The *Contractor* declares all hazardous chemical substances brought to Site.

3.13.6 Plant safety regulations

i. The *Employer*, on request from the *Contractor*, isolates required plant from all sources of danger as described in the Plant Safety Regulations.
ii. The Project Manager, on request, makes available a copy of the latest revision of the Plant Safety Regulations to the *Contractor*.
iii. The *Contractor* complies with all rules and regulations applicable to plant safety and completes the Workman's Register prior to working on the plant.
iv. The *Contractor* declares any grinding and welding to be carried out on the workers register.
v. At every permit change, the *Contractor* withdraws himself/herself/his staff for that period of permit suspension/revocation and thereafter only proceeds with the *works* after signing onto the new permit.
vi. The *Contractor* ensures that he/she/all Sub-*Contractors*/personnel/staff/his visitors are medically, physically and psychologically fit to enter Hendrina Power Station and especially any confined space.
vii. The *Contractor* is prohibited from entering Restricted Areas.
viii. The responsibility is on the *Contractor* to ensure that the correct confined/hazardous space requirements and tests have been met and done by the *Employer* prior to entry into any confined space or hazardous plant areas.
ix. The *Contractor* ensures that all personnel are competent to carry out the *works*.

The *Contractor* provides proof of competency for technical and safety aspects and must be available as and when required on site.

3.14 SYSTEM LIFE-EXPECTANCY

The PLC technology should be supported by the market for at least fifteen years.

3.15 SECURITY

Not applicable.

3.16 ADDITIONAL REQUIREMENTS AND PREREQUISITES

3.16.1 APPLICABLE NATIONAL STANDARDS

The *Contractor* is required to adhere to the latest editions of, and the normative references and national standards referenced within Appendix 1 – C&I Documentation Requirements from Vendors.

3.16.2 General

(1) The *Contractor* is required to submit a comprehensive method statement of the works to the Project Manager for acceptance prior to the start of the works

(2) The *Contractor* is responsible for the design, erection, maintenance and removal of all temporary bracing or propping required for the execution of the works.

(3) The *Contractor* takes full professional accountability and liability for all temporary items required for the execution of the works.

3.17 PLANT CODING AND LABELLING

(1) During the design review stage(s) and cross referenced to all arrangement drawings, schematics, wiring diagrams, instructions and manuals and where practical to spare parts list of *Contractor* to manufacture and install KKS coded equipment's labels in the plant. Labels are manufactured and installed according to Plant Labelling Standard (240-71432150).*Contractor* will label all KKS coded equipment. The Coding Technician shall facilitate base-lining of all provider as a reference for the creation of equipment lists.

(2) Labelling of components inside electrical and C&I panels shall be done by the *Contractor*.

3.17.1 Plant Identification Labelling

(1) The *Contractor* supplies and installs codification as per the *Employer*'s procedure, KKS CODING AND LABELLING, in accordance with Hendrina Power Station Labelling Specification and Plant Coding Procedure.

(2) The *Contractor* requests KKS numbering from the *Employer*.

(3) The *Contractor* updates the *Employer's* P&ID`s accordingly.

4. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Jeanne Fourie	LDE: Boiler Auxiliary CoE
Azwianawi Mudzunga	System Engineer: C&I Engineering Hendrina PS
Silibaziso Gwafa	LDE: C&I CoE
Claude Chetty	Plant EDWL: System Integration CoE
Zesizwe Ncane	LDE: Electrical CoE
Wayne Theunissen	System Engineer: C&I Engineering Hendrina PS
Paul Du Plessis	PEI: Senior Consultant

5. REVISIONS

Date	Rev.	Compiler	Remarks
March 2019	0.0	Silibaziso Gwafa	First Draft
June 2019	0.4	Silibaziso Gwafa	IDR comments addressed
July 2019	1	Silibaziso Gwafa	CCCC presentation

6. DEVELOPMENT TEAM

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

S. Gwafa

K. Victor

7. ACKNOWLEDGEMENTS

8. APPENDICES

As a minimum, during scope definition activities the following items that have been provided by the *Employer* are verified, reviewed and completed by the *Contractor* to implement the works:

Appendix 1: C&I Documentation Requirements from Vendors

Appendix 2: North Blower Plant design

Appendix 3: South Blower Plant design

Appendix 4: South Fuel Oil Plant design

Appendix 5: South Fuel Oil Plant Operating Technical Specification

Appendix 6: Blower Plant Operating Technical Specification

Appendix 7: Existing SCADA IO List

Appendix 8: Scope, Interface and Construction Definition Documents: Descriptions

Appendix 9: Existing CitectSCADA Technical Overview document