Eskom	Specification	Engineering

Title: **Camden Power Station Second Diesel Fire Pump Project - Electrical Technical Specification**

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1. INTRODUCTION

This document contains the Electrical Plant Design Technical Specification for Camden Power Station's upgrade of the fire pumping system and piping as stated in the executive summary of this document. The project will see the installation of a new pump and pipework changes in the fire pump house, modification to the fuel oil valve station at the boiler burner fronts and modification to the coal bunker gallery hydrants.

The audit findings and recommendations to ensure compliance accordingly and prevent possible loss of power station insurance are as follows:

- Camden fire protection systems were refurbished and upgraded as part of the return to service with a number of new fixed fire protections systems installed. The fixed fire protection systems are now considered good and generally in accordance with NFPA 850 however the **fire pump redundancy is a cause for concern.** The fire water systems are fed by a single diesel driven fire pump rated at 3,000 US GPM / 130m head with two electric booster pumps to maintain system pressure. The electric booster pumps provide some back-up in the event of diesel fire pump maintenance or emergency but will not provide either the required flow or pressure for the bigger and more remote systems including the steam turbine fire protection. Having a single fire pump is highly unusual in this type of occupancy and the lack of redundancy during periods of routine maintenance, repair, breakdown or emergency leaves the Station at risk of periods with an inadequate fire water pumping capacity.

2. SUPPORTING CLAUSES

2.1 SCOPE

The document provides details of the technical specification for Camden Power Station's electrical installation of the Second Diesel Fire pump. This document includes standards and guidelines that should be adhered to. The technical specification is applicable and incorporates the following scope:

- Battery charger power supply Interface to DCS
- Remote operation via DCS – Pump motors, alarms, trips signals.
- Electrical supply and lighting for new pump house or containerised with DB and MCB's
- Hot and cold commissioning
- Motor performance tests
- Training and manuals
- Quality control for building construction
- Coding and Plant labelling

2.1.1 Purpose

This document shall describe the scope in order to appoint an engineering, procurement and Construction contractor to perform the detailed design, manufacturing and construction of the Installation of the Second Diesel Fire Pump Electrical Works. The Mechanical plant information is included.

2.1.2 Applicability

This document shall apply to Camden Power Station only.

2.2 NORMATIVE/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] ISO 9001 Quality Management Systems.

[2] 240-53113685 Design Review Procedure

[3] 240-54937450 Fire Protection and Life Safety Design Standard

[4] 240-56737448 Fire Detection and Life Safety Design Standard

[5] 383-CMDN-AABZ28-SP0008-3 SRD for Camden PS-Installation of Second Diesel Pump.

[6] 383-CMDN-AABZ26-RP0000-23 Detailed Concept Design Report for the Installation of Second Diesel Fire Pump

[7] 0.36/16477 Fire System Pump House P&ID revision 08

[8] Fire Protection Plant P&ID 15566 revision 4

[9] Boiler Face P&ID 16483 revision 4 Unit 1 to unit 8

[10] 240-56364545 Structural Design and Engineering Standard

[11] 240-107981296 Constructability Assessment Guideline

[12] 36-681 Generation Plant Safety Regulation

[13] NFPA 13 Standard for Installation of Sprinkler System

[14] NFPA 15 Standard for spray Fixed Systems

[15] NFPA 20 Stationary Pumps for Fire Protection.

[16] NFPA 850 Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations

[17] SANS 10164-1The structural use of masonry Part 1: Unreinforced masonry walling

[18] SANS 10164-2 The structural use of masonry Part 2: Structural design and requirements for reinforced and prestressed masonry

[19] SANS 1123 Pipe Flanges

[20] SANS 2001-CM2 Construction works Part CM2: Strip footings, pad footings and slab-on-the-ground foundations for masonry walling

[21] SANS 2001-CM1 Construction works Part CM1: Masonry walling

[22] SANS 10142-1 The wiring of premises Part 1: Low-voltage installations

[23] 240-56360086 Stationary Vented Nickel Cadmium Batteries

[24] 240-56227516 LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltage up to and including 1000V AC and 1500V DC Standard

[25] IEC 60364-4-41 Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock

[26] SANS 156 Moulded-case circuit-breakers

[27] 240-56227443 Requirements for Control and power cables for power stations standard

[28] 240-76992014 Project / Plant Specific Technical Documents and Records Management Work Instruction

[29] 240-66920003 Documentation Management Review and Handover Procedure for Gx Coal Projects

[30] 240-65459834 Project Documentation Deliverable Requirement Specification

[31] 240-54179170 Technical Documentation Classification and Designation Standard

[32] 383-CMDN-AABZ28-SP0004-26 Installation of Additional Diesel Fire Water Pump -C&I Technical Specification

[33] 240-105020315 Standard for low pressure valves

[34] 240-123801640 Standard for Low Pressure Pipelines

[35] 240-106628253 Standard for Welding Requirements on Eskom.

[36] 240-83539994 Eskom NDT personnel Approval (NPA) for Quality Related Special Processes on Eskom Plant Standard.

[37] 240-106365693 Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings

[38] 240-101712128 Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings

[39] 240-85549846 Standard for Design of Drainage and Sewerage Infrastructure

[40] ISO 6182 Fire Protection – Automatic Sprinkler Systems.

[41] 240-56356376 On-Site Commissioning for Low pressure Systems Standard

[42] SANS 10100-2 The Structural use of Concrete

[43] SANS 1632, Batteries

[44] SANS 1652, Battery chargers – industrial type

[45] SANS 10089, The Petroleum Industry: Storage and distribution of petroleum products in above-ground bulk installation

[46] 240-139282493 - Security Lighting for Eskom Applications

[47] 240-57617975 - New Low Voltage Motors Procurement Standard

[48] 240-55714363 - Coal Fired Power Stations Lighting and Small Power Installation Standard

[49] 240-83382122 - Emergency Lighting in substations

[50] SANS62031 - LED modules for general lighting - Safety specifications

[51] SANS62560 - Self-ballasted LED-lamps for general lighting services by voltage 50 V - Safety specifications

[52] SANS62612 - Self-ballasted LED lamps for general lighting services with supply voltages 50 V - Performance requirements

[53] SATS17576 - Light-emitting diode products for interior lighting, streetlighting and floodlighting - Performance requirements

2.2.2 Informative

[54] SANS 10287 Automatic Sprinkler Installations for Fire Fighting Purposes

[55] 240-86973501 Engineering Drawing Standard – Common Requirements

[56] 240–53114002 Eskom Project Engineering Change Management Procedure

[57] 240-71432150 Plant Labelling Standard

[58] 240-109607736 Eskom KKS Key Part Standard

2.3 DEFINITIONS

Definition	Description
Basic Design	In general, a process to establish an agreed basic design baseline that complies with the concept design baseline and stakeholder requirements. For the Camden fire protection project, the intent of the basic design is to establish scope elements within a fully functional design after optimization in order to proceed to design detailing and/or compilation of specifications.
Concept Design	Process to establish an agreed concept design baseline that complies with stakeholder requirements. The intent of the Concept design is to twofold: firstly, to select the most appropriate technology; and secondly, to establish the basic configuration requirements for the selected technology.
Critical	Any part or area of plant/facility is seen to be critical if its loss during a fire incident has the potential to cause the following, either immediately or within a 6 – 12 hour period after the incident: A multiple-unit load loss or trip Loss of transmission or distribution capability Permanent loss of production or products or Danger to fire-fighting personnel involved in fighting the fire
Fire Detection	A device designed to automatically detect the presence of fire and initiate an alarm system and other appropriate action – See SANS 10139 (also see NFPA72). Some typical fire detectors are classified as follows: • Heat detector – a device that detects a pre-determined (fixed) temperature or rate of temperature rise. • Smoke detector – a device that detects products of combustion • Flame detector – a device which detects the infrared or ultraviolet, or visible radiation produced by fire.
Fire Protection	A Method to providing for fire control or fire extinguishment.
Fire Hydrant	A valve connection on a water supply system having one or more outlets and that is used to supply hose and fire department pumpers with water.
Stakeholder	Is considered to be anyone that has an interest in the outcome of the project.
System	An integrated set of constituent pieces that are combined in an operational or support environment to accomplish a defined objective. These pieces include people, hardware, software, firmware, information, procedures, facilities, services and other support facets

2.3.1 Disclosure Classification

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

2.4 ABBREVIATIONS

Abbreviation	Description
ASME	American Society of Mechanical Engineers
AP	Automation Processor
C&I	Control and Instrumentation
CoE	Centre of Excellence
D	Diameter
DCS	Distributed Control System
DPSH	Dynamic Probe Super Heavy
EDWL	Engineering Design Work Lead
FM/UL	Factory Mutual and Underwriters Laboratory
FNPT	Female National Pipe thread Tapered
HMI	Human Machine Interface
I/O	Input/Output
KKS	Kraftwerk- Kennzeichen-System
LDE	Lead Design Engineer
MJC	Multi Jet Control valve
NEMA	National Environment Management Authority
NFPA	National Fire Protection Association
OEM	Original Equipment Manufacturer
OPS	Operations
P&ID	Pipe & Instrument Drawings
SANS	South African National Standards
SIL	Safety Intrinsic level
SRD	Stakeholders Requirements Definition

2.5 ROLES AND RESPONSIBILITIES

- The EDWL will ensure that governance is followed during the design process leading up to construction. The EDWL will facilitate and ensure continuous management of the requirements for plant design and will ensure the requirements set out in this report are met during plant design.
- The Authoriser checks that the EDWL has applied the right procedures and governances during the design process.
- The Site Representative will collaborate between engineering and site to ensure that the information and data used during design are according to the client's requirements.
- The LDE/s will ensure that the work required for the designs are carried out and that the correct procedures and governances are adhered to.

2.6 PROCESS FOR MONITORING

Eskom Design Review Procedure [2].

2.7 RELATED/SUPPORTING DOCUMENTS

The following supporting document shall form part of the tech spec:

- Diesel Fire Pump curve (see figure 2)
- Camden's Fire Pumping System Control Philosophy 383-CMDN AABZ26-RP0000
- Fire System Pump house P&ID 0.36/16477 revision 8
- Fire Protection Plant P&ID 15566 revision 4
- Boiler Face P&ID 16483 revision 4 Unit 1 to unit 8
- LED Light fitting quality detail guideline (Annexure to the technical specification - Fire Pump House)

3. TECHNICAL SPECIFICATION

3.1 SYSTEM DESCRIPTION- EXISTING PLANT OVERVIEW

3.1.1 Fire Pump House

The fire system is automatically controlled. In the event of fire or incident, whereby the bulb detector breaks to release water or air, the control valve opens automatically to allow water flow. The pressure is supplied by three pumps, namely: two jockey pumps A and B [00 SGA 71 GH001 & 00 SGA 72 GH001] and a diesel driven pump A [00 SGA 80 AP001]. The diesel driven pump is the main fire water pump for the system. The main functionality of the jockey pumps is to keep the system pressurised. The two jockey pumps will run until the pressure is 1000 kPa, because it is a closed system, both pumps will automatically stop running.

When the system line pressure drops to 900 kPa, the first jockey pump will start, to pressurise the line pressure to 1000 kPa, however if the line pressure continues to drop, at 800 kPa the second jockey pump will start. If the system drops further to 680 kPa the diesel engine will automatically start.

Figure 1 and Table 1 gives the details of the existing diesel driven fire water pump.

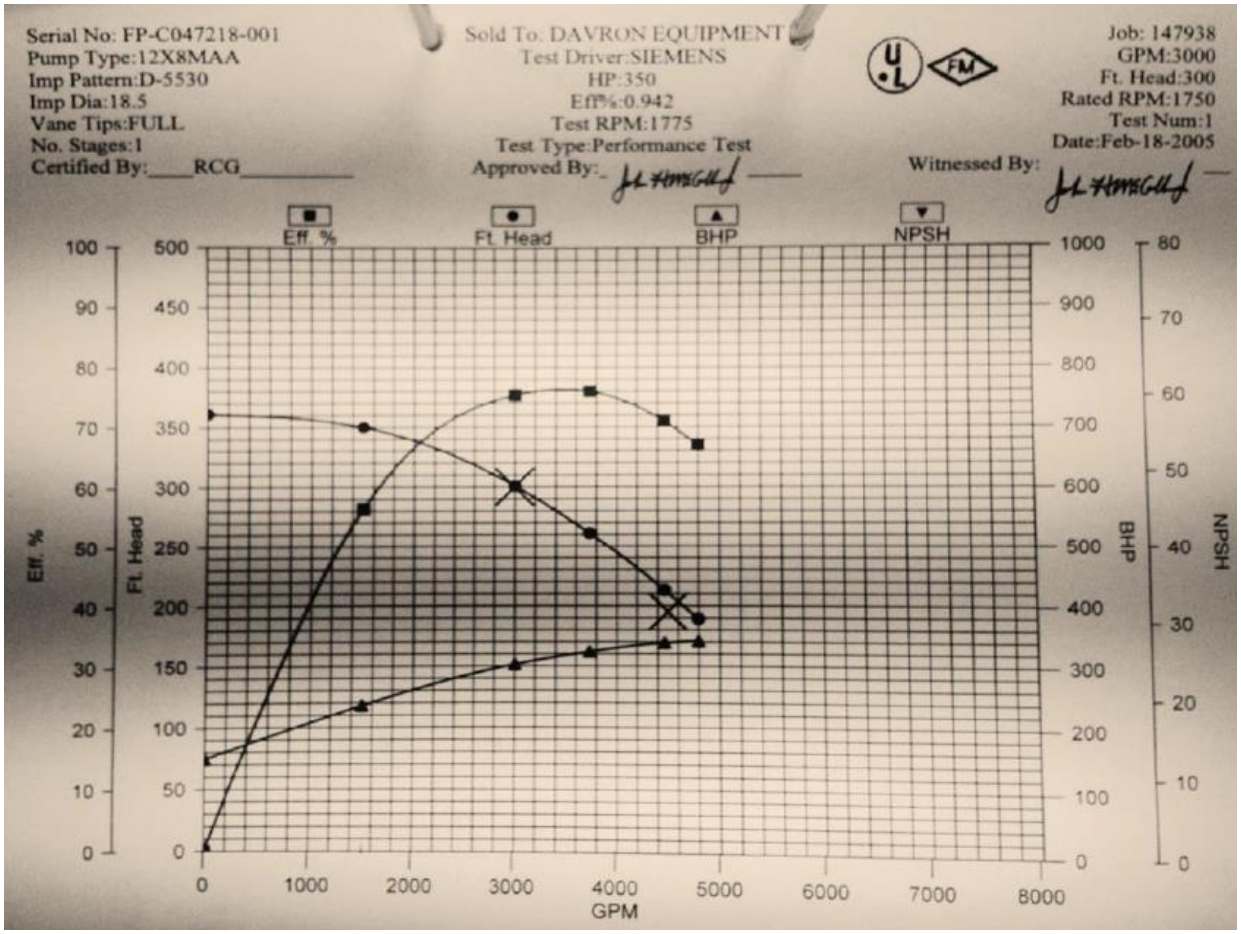

Figure 1: Pump Curve - Main Diesel Driven Pump

Table 1: Existing Diesel Fire Pump Specification

Diesel Fire Pump A			Diesel Engine Details	
KKS Number	00 SGA 80 AP001		**Model**	(turbo Charged)
Pump Head	896 kPa		**Rated Power**	313 kW
Flow Rate	189 l/s [3 000gpm]			
Rated Speed	1750 rpm			

Figure 2 and Table 2 gives the details of the existing diesel driven fire water pump.

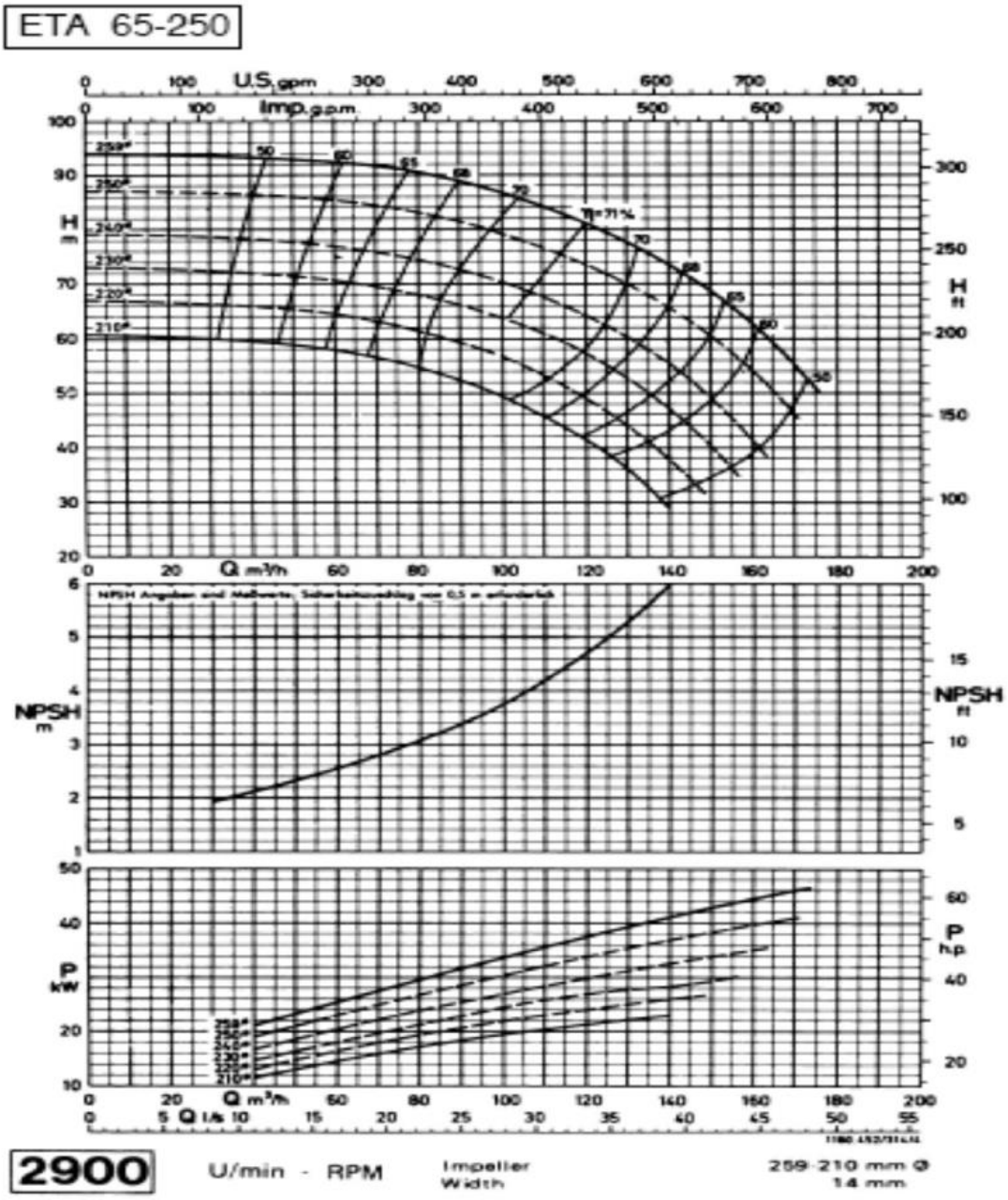

Figure 2: KSB ETANORM 65-250 pump curve- for the Jockey Pumps

Table 2: Existing Electrical Jockey Pumps Specification

The Contractor ensures all motors are designed, procured or manufactured; factory acceptance tested (FAT), supplied, delivered, off loaded, installed, site acceptance tested (SAT), and commissioned in accordance with the latest revision of the following Eskom standards:

• 240-57617975 - Procurement of Power Station Low Voltage Motors Specification.

• 240-56360387 - Storage of Power Station Electric Motors

• 240-56361435 - Transport of Power Station Electric Motors Standard

The Contractor takes into consideration all relevant characteristics and operating conditions pertaining to the driven machine and the motor environment. The Contractor is responsible for designing or selecting

from a standard range, a motor that will perform as required by the Project Manager.

The preference is for motors to be selected from a standard range. Where this is not possible, the Project Manager is notified for approval on non-standard motor design.

Reliable motors with high efficiency, high power factor and low input power consumption values are required to support the Eskom Energy Efficiency drive.

The Contractor confirms all the interfacing with related equipment and Subcontractors to ensure the motors will function reliably within the required environment. The Employer is made aware of all shortcomings and risks which may affect the functioning of the motors.

The technical specification below to have the minimum efficiency class code of IE3 equivalent fitted and commissioned:

(See attached listed normative/informative references)

Electric Jockey Pumps A [KKS: 00 SGA 71 GH001] and B [KKS: 00 SGA 72 GH001]				
Pump Details			**Electrical Motor Details**	
Make	KSB pump		**Motor manufacturer**	Zest
Model ETA	65 -250		**Type**	Three-phase induction motor
Impeller Diameter	259Φ mm		**Rated Motor Output**	37 kW
Pump head	90 m		**Electrical Supply**	400 V/3 phase/ 50 Hz
Flow rate	23 l/s		**Full load Current**	67.9 A
			Rated speed	2 960 rpm
			Pole	2 poles

3.2 WORK TO BE PERFORMED BY THE CONTRACTOR

3.2.1 Responsibility for Design

- The *Contractor* takes full professional accountability and liability for all designs done by the *Contractor*.
- The *Contractor* is responsible for the design of all temporary works required for the execution of the *works*.
- All designs, design reports and Construction drawings prepared by the *Contractor* are signed off by an ECSA Professionally registered Technologist or Engineer who takes full professional accountability for the designs.
- The *Contractor's* design is required to be in accordance with all National Standards and Specifications referenced in this Works Information as well as the *Employer's* Standards referenced in this Works Information Specifications referenced within referenced documents and its normative references are also adhered to.
- The *Contractor* ensures that all electrical plant requirements that are required by the Second Diesel Fire Pump Project's mechanical, C&I and civil plant interfaces and changes are met in order for this project to succeed. Compliance to Eskom, SANS, IEC and the Occupational Health and Safety Act 85 of 1993 of South Africa are required.

3.2.2 Scope of Works

The contractor shall design, procure, supply, install, certify and commission all items discussed in this document according to the applicable codes and standards and taking account of:

- Required design life of 25 years
- The additional pump that is supplied must have similar flow rate as the current pump

3.2.3 Mechanical Plant Information

3.2.3.1 Diesel fire Pump

Diesel engine coupled to a fire pump both commonly mounted on a base plate

- **All equipment shall comply with NFPA 20 and FM/UL Approved**

3.2.3.1.1 Fire Pump Diesel Engine

- 313kW @ 1750rpm turbo charged

3.2.3.1.2 Fire Pump

- Pump head 896 kPa
- Flow rate 189 l/s [3 000gpm]
- Rated Speed 1750 rpm
- Split case

3.2.3.1.3 Pump Controller

Pump controller have the following minimum components

- Manual-Off-Auto Selector Switch
- Manual Test Push Button
- Two Battery Charger Push Button
- Two Manual Crank Push Button
- Main Pressure switch for automatic start function
- Door Mounted digital display unit with password functionality which can display pump status indication as follows
    - Main switch on auto LED
    - Engine Fail to Start LED
    - Battery Charger Malfunction LED
    - Battery 1 trouble LED
    - Battery 2 trouble LED
    - Engine Running LED
    - System Pressure Low LED
    - Engine Coolant Temp High LED
    - Engine Oil Pressure Low LED
    - Engine Over speed LED
    - Low Fuel Level LED
    - Error messages
- The controller must be based plate mounted and FM/UL approved
- The controller must have an accessible event log and self-diagnostic functionality for future trouble shooting

- The controller must have high speed open serial communication port
- Enclosure type: NEMA Type 2
- **Voltage Power Supply: 220V AC**
- Connection fitting type for the system pressure:1/2 inch FNPT

3.2.3.2 Construction Monitoring during Execution

- The *Contractor* is mandated in terms of Construction Regulations 2014: Duties of Designer, 6(1) to fulfil the duties described therein for the detailed designs done by the *Contractor*. The required level of construction monitoring is provided in order to certify that the works are constructed in accordance with the *Contractor's* design.

3.2.3.3 Additional Requirements and Prerequisites

3.2.3.3.1 General

- The *Contractor* is required to confirm all site dimensions, levels and cast-in items positions on site prior to any fabrication of steel or casting of concrete.
- 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*
- The *Contractor* is responsible for the design, erection, maintenance and removal of all temporary bracing or propping required for the execution of the *works.*

3.2.3.3.2 Concrete

- All concrete work is required to be in accordance with SANS 2001-CC1 **Error! Reference source not found.** and SANS 10100-2 [42] unless otherwise stated.
- All concrete surfaces and cast-in items is required to be inspected and accepted by the *Project Manager* in writing before casting of concrete may commence.
- The *Contractor* is required to obtain written acceptance from the *Project Manager* for the use of any add-mixture or the use off ready mixed concrete, to pump concrete, or to use cement or cement blends other than ordinary Portland cement (OPC).
- Compaction of concrete is required to be done by means of mechanical vibrators only.
- The *Contractor* is required to submit the concrete mix design to the *Project Manager* for acceptance.
- The *Contractor* is required to demonstrate, by means of a report from an approved laboratory, that the aggregates do not exhibit excessive shrinking properties in accordance with SANS 1083 **Error! Reference source not found.** and is also required to demonstrate that the aggregates do not have a potential alkali silica reaction.
- The *Contractor* is required to perform a slump test on the same batch of concrete every time a sample is taken and the result recorded.

The table below indicates particular specifications pertaining to SANS 2001-CC1 **Error! Reference source not found.** and must be read in conjunction with the code.

3.2.3.3.3 Steelwork

- All work is required to be in accordance with the latest edition of SANS 2001-CS1 **Error! Reference source not found.**
- The *Contractor* is responsible for the stability of the entire structure and all structural elements during all the erection stages.

- All dimensions are required to be verified on site by the *Contractor* before any fabrication of steelwork commences.
- All welding is required to be conducted by coded welders. Supporting documentation is also required to be submitted to the *Project Manager* for acceptance. All welding is required to comply with Standard for Welding Requirements on Eskom. [35].
- All welds are required to be inspected using visual aids
- The *Contractor* is required to supply all bolts, washers, nuts etc. for the structural steelwork.

The table below indicates particular specifications pertaining to SANS 2001-CS1 **Error! Reference source not found.** and must be read in conjunction with the code.

3.2.3.4 Corrosion protection

All structural steel is required to be hot dipped galvanised and comply with:

- Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings [37].

3.2.4 Electrical Requirements

All the electrical installation and earthing work that will be executed in the Fire Pump House shall be complaint with “The structural use of masonry Part 1” [17].

*Contracto*r to develop Employers design into a detail design for the Scope of Work including the detail design, manufacture, transport, factory acceptance testing, storage, installation, testing, commissioning, site acceptance testing, certification and handover.

The main supply feeders to the 2x 37kW pump motors shall be supplied from two separate dedicated supply feeders on the 380V Substation Boards.

Modification are required of Siemens switchgear via Siemens (OEM) to equip the switchgear in order to provide remote operated 2x 37kW pump motor electrical supplies. The modifications shall be similar to the existing supplied on the Siemens Substation electrical boards.

The lighting and plugs distribution board shall be fed from a separate dedicated supply feeder on the 380V Substation boards.

The cable, switchgear, lighting and motor installations shall comply to the relevant Eskom and SANS standards. Electrical design calculations, drawings and cable route design shall be done by the Contractor and shall be approved by Eskom before it is procured and installed.
Factory acceptance tests, Site acceptance tests and Eskom quality requirements and documentation are applicable.

3.2.4.1 Diesel Engine starter battery bank (bank A and B)

The battery bank selection and installation shall be executed in accordance with Stationary Vented Nickel Cadmium Batteries [23].The batteries must be able to allow fast charge and discharge during operation of the diesel engine starter without significantly affecting the life of the batteries.

The battery bank shall meet the requirement defined below:

- Each battery bank shall comprise of twenty Pocket plates, Type H Ni-Cd batteries with a nominal voltage of 1.2V and capacity of 100Ah.

- The battery bank shall be connected in series to provide a terminal voltage of 24V and capacity of 100 Ah for a single bank. The battery banks are divided into two namely battery bank 1 and 2, which bank 2 is a back-up of bank 1 and vice versa.
- The batteries shall be housed in separate battery cabinets to prevent any electrical failure cascading to the opposite battery bank.
- The batteries shall be connected using flexible cable links to allow easy connection to diesel engine starter.
- The DC cables connectors shall be adequate to prevent loose connections.
- The selected fire pump controller charger circuit shall be selected to comply with above DC supply requirements.

3.2.4.2 Distribution Box/Board

The distribution box and associated MCBs shall be installed and tested in accordance with LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltage up to and including 1000V AC and 1500V DC Standard. This distribution box shall be installed in the fire pump house that will be supplying the existing and new electrical equipment.

- The distribution box shall contain a two pole MCB rated at 64 A; residual current detector (RCD). The RCD shall have a residual current of not more than 30 mA leakage earth fault detection and shall be in accordance with Low-voltage electrical installations for protection against electric shocks.
- The distribution box shall also be fitted with two pole MCB's. There shall be separate MCB's for the external and internal building lighting.
- The distribution box shall be fitted with two pole MCB for the diesel engine heater.
- There are four 220V plugs that are installed, which require two double pole MCB's.
- All the MCB shall be of Class C and the main incomer will have a breaking capacity of not less than 10 kA; while other electrical loads breaking capacity is not less than 6 kA.
- The distribution box shall be fitted with four double pole MCB rated 16A as spares.
- The distribution box shall be fitted with an external load transfer switch to ensure alternative power supply to the distribution box from the Demin Distribution board spare. Cabling to this board is required.

The entire distribution panel shall be fitted with a 100 A isolation switch for the main incomer to completely isolate the board from supplying loads.

MCB's and MCCB's shall have padlock lockable lockout facility.

Surge protection shall be fitted.

Earth leakage protection shall be fitted on all light and domestic plug circuits.

Welding Switch Socket 5 Pin 63A shall be fitted on the lighting and plug distribution board.

The supplier shall provide a schematic diagram and single line diagram showing the layout and connection of all the electrical equipment in the Fire Pump House.

3.2.4.2.1 General

The contractor undertakes as part of the works to supply correctly dimensioned bolts, washers (contact, flat and spring) and nuts suited for the purpose to which it shall be applied as required. All outdoor materials shall either be hot dipped or electro galvanised whereas indoor materials shall be cadmium plated and passivated.

3.2.4.3 LV Cabling

All the cabling shall be executed in accordance with Requirements for Control and power cables for power stations standard [27]. The cabling for the distribution box shall utilise serving and core insulation made from PVC. The cables shall be single phase three core cable with live, neutral and earth. The cable sizes for each electrical system supplied from the distribution box are defined below:

The cables shall be enclosed in liquid tight metal conduits type LFNC-B per NEC Sec. 695-6 to prevent mechanical damage and water contact with electrical parts.

All terminations for LV cabling shall be wholly compliant with “The wiring of premises Part 1” [21] and Requirements for Control and power cables for power stations standard [26].

The metal conduit supports shall be utilised and both the conduits and supports should be earthed to prevent any exposed conductors livening the conduits.

The colour coding of cables shall be in accordance with “The wiring of premises Part 1” [21] and Requirements for Control and power cables for power stations standard [26].

Associated lugs and tools to be used in service of and part of the works shall be wholly compliant with “The wiring of premises Part 1” [21] and “Requirements for Control and power cables for power stations standard” [26].

The electrical wiring system will be in accordance with “The wiring of premises Part 1” [21] and “Requirements for Control and power cables for power stations standard” [26].

Furthermore, the diesel engine, controller panel and distribution box shall be bonded to earth through an earth conductor to create an equipotential zone for earth fault currents.

A cable schedule shall be provided that indicates the routes of the cables from the incoming supply to the terminating electrical equipment, describing the protection devices and rating.

Cable Routes:

a. The employer shall provide drawings detailing the main routes, reserves and servitudes provided for cables.
    - The Contractor shall perform underground scanning in order to locate any underground services, conductive or non-conductive. The scanning method and equipment shall determine depth of piping, electricity cables & telecoms running underground up to 10m.
        - Geophysical testing is adopted to locate sub-surface utilities both metallic and non-metallic prior to excavation.
        - The Contractor makes written recommendation to the Project Manager should the Contractor be of the opinion that geophysical testing be implemented to a greater depth that outlined within this document.
        - All existing underground infrastructure which lies in the footprint of any new infrastructure is exposed by hand excavations.
    - The provided routes shall be taken as the preferred routes unless environmental conditions on site do not permit execution of scope.
    - Contractor shall undertake to modify the route and accurately indicate such change on employer’s initial drawings.
    - Amendments shall subsequent to changes be forwarded to the Employer for approval prior to any works being undertaken.
b. Cables schedules detailing the cable types, sizes, source, destination earthing requirements and unique identification alpha numeric number shall be provided by the employer.

c. All necessary diligence should be exercised when preparing the trench as unidentified services may be scattered along the selected route and the requirements of SANS and OSHA shall be strictly followed.

Cable calculations to be performed and verified by Camden Electrical Engineering to ensure compliance to SANS 10142-1. Prospective cable route to be determined by contractor and all methods of installation to be approved by Electrical Engineering and be in accordance with SANS and Eskom standards. Cable shall be made from stranded copper conductors and shall be 600/1000V rated at the minimum. Cables shall be PVC insulated, single wire armoured and PVC sheathed. Contractor to determine cable size and number of cores as per Contractor design. Separate green and yellow earth cables shall be installed from point of supply to load. Cable joints shall not be permitted unless prior approval is obtained (Cable joining methodology and installation shall be approved by Electrical Engineering and perform by qualified personnel). Cables to be firmly affixed to assembly and (or) support structure to which they are mounted to prevent damage from any reasonable or foreseeable forces that may act upon them.

Wire colouring scheme to be:

• Red, white (or yellow) and blue for the 3 phases.

• Black for neutral.

• Green with yellow tracer for earth.

All cables to be fitted with glands and shrouds. Glands to be of the threaded type. Blanks shall be utilised to maintain IP rating of enclosure.

3.2.4.4 Lighting

Note that permanent emergency lighting with adequate backup power shall be designed, fitted and commissioned for inside and outside of the fire pump house by the *Contractor*.

Outside entrance of the Fire Pump House:

The technical specification below to have the LED lighting equivalent fitted and commissioned:

(See attached listed normative/informative references and LED Light fitting quality detail guideline)

- The two entrances shall be fitted with flood lights with halogen tubes.
- The lights shall be fitted with a motion detection sensing device to turn on and off the lights automatically during the night. The switching of the sensor shall be adjustable after 5 minutes.
- The bulb shall have survival rate of 100% for not less than 4000 hours.
- The halogen tube lights shall have mag screw type bases.
- Outside Lighting system shall be rated at IP 65.
- All lights to comply with Coal Fired Power Stations Lighting and Small Power Installation Standard**Error! Reference source not found.**.

Inside lighting of the Fire Pump House:

The technical specification below to have the LED lighting equivalent fitted and commissioned:

(See attached listed normative/informative references and LED Light fitting quality detail guideline)

- The inside of the extended building of the Fire Pump House shall be fitted with 1000 W high pressure sodium lighting of elliptical diffuse type.
- The high pressure sodium lighting will be of hard bulb type.
- The bulb shall have a survival rate of 100% for not less than 8000 hours and must be able to last for at least 3 years.
- The high pressure sodium lighting shall have rated lumens of not less than 48000 lm.
- The control gear utilised for the bulb shall be of impulse igniter ballast type and shall be compatible with the high pressure sodium bulb.
- The high pressure sodium light shall have a mag screw type base.
- A rotary switch shall be utilised for lights switching.
- Inside lighting system shall be rated at IP 4X.

3.2.4.5 Battery chargers in the fire pump controller

Battery charge shall be in accordance with NFPA 20 -12.5

- A switch mode type charger shall be utilised.
- Each battery charger shall have a current rating of 10 A.
- The input AC supply to the battery charger shall be 110/220V AC.
- Each battery charger shall have selectable DC (12/24V).
- The battery charger shall allow selection of the battery type (Ni-Cd or Lead Acid batteries).

3.2.5 Earthing and Lightning Protection

The Contractor adheres to 240-56356396 Earthing and Lightning Protection Standard and 054-393 Earthing Standards regarding the design, supply, installation and testing of earthing and lightning protection for all scope of work of the project.

The Contractor takes into consideration all relevant characteristics and operating conditions pertaining to the respective bonding points and environment of the earthing and lightning protection system.

3.2.6 Electrical Control and Power Cabling

The Contractor adheres to 240-56227443 Requirements for Control and Power Cables for Power Stations Standard, regarding the selection, design and execution of cabling for all scope of work of the project.

The Contractor takes into consideration all relevant characteristics and operating conditions pertaining to the respective connected loads and environment of the control and power cables.

3.2.7 Pump Motor Control Panels

The two panels shall each be equipped with the following:

- Pump run indication lamp (red)
- Pump fault indication lamp (white)
- Pump stopped indication lamp (green)
- Pump remote/local control selector switch
- Pump stop push button (red)
- Pump start push button (green)
- Local fused isolator with lockout capability with padlock.
- Running hour meter
- Alarms and controls shall be interfaced with the DCS via C&I. All interface requirements shall be provided.

3.2.8 Control and Instrumentation Requirements

Refer to Installation of Additional Diesel Fire Water Pump - C&I Technical Specification and Scope of Works.

3.2.9 Maintenance and Operating

The Contractor is to provide Eskom with the maintenance and operating procedure for all the works which will be performed as part of this document. The procedure is to include the recommended maintenance intervals and maintenance to be carried out on the fire system and components, test procedure and list of recommended spares to ensure reliable operation of the fire protection system.

3.3 QUALITY MANAGEMENT

The Contractor shall develop and implement a system for collation or quality verification records, including change management records, Inspection Test Plans, Manufacturing, Construction and Commissioning Record Books (Data Books) as specified in the Camden Quality Specifications.

3.3.1 Data Books

Data Books shall be maintained by the Contractor to substantiate conformance to product specifications and requirements. All records shall be safely stored (easily retrievable) following the final completion of the works at takeover. These records shall include as a minimum:

- Quality Management documentation, QCP's, ITP's.
- Safety clearances (to be granted prior commissioning)
- Construction, layout and component approvals
- Routine test certificates
- Construction and as-built drawings and approvals
- Welding procedure specifications
- Welder qualifications

- Weld test certificates
- Steel grade certificates
- Data Books (Record Books)

The data books shall be reviewed by the employer for 10%, 30%, 50%, 70% and 100%. All manufacturing and construction data books shall be completed and approved when the Contractor apply for final inspection at construction completion. At takeover application, all manufacturing, construction and commissioning data books shall be completed and approved and handed over to the Employer.

Note: No procurement, manufacturing or off site or on site work shall start without approved ITP's/QCP's.

3.3.2 Inspection and Testing

The *Contractor* shall include as a minimum the following activities and interventions on Inspection and Test Plans (ITP):

- Approval of ITP – hold point for *Contractor* and *Engineer*
- Approval of construction drawings (cable works and routes included) – hold point for *Contractor* and *Engineer*
- Approval of method statements – hold point for *Contractor* and *Engineer*
- Confirmation of the Permit to Work (refer to 36-681 Generation Plant Safety Regulations) – hold point for Contractor
- Approvals – hold point for *Contractor* and *Engineer*
- Conduct specified tests (FAT's and SAT's) – hold point for *Contractor* and *Engineer*
- Data Book review – hold point for *Contractor* and *Engineer*
- Punch list – hold point for *Contractor* and *Engineer*
- Final inspection – hold point for *Contractor* and *Engineer*
- Hand-over – hold point for *Contractor* and *Engineer*

3.4 DOCUMENTATION MANAGEMENT AND CONFIGURATION MANAGEMENT

The contractor and Camden configuration management shall be responsible for the following during the design change:

- As-built plant drawings;
- Document Management
- Plant coding and Labelling;
- Design change management.

3.4.1 Document Management

All documents supplied by the *Contractor* shall be subject to Eskom's approval. The language of all documentation shall be in English. The *Contractor* shall include the *Employer*'s drawing number in the drawing title block. This requirement only applies to design drawings developed by the *Contractor* and his or her Subcontractors. Drawing numbers will be assigned by the Employer as drawings are developed.

3.4.1.1 Document identification

3.4.1.2 Drawings Format and Layout

The creation, issuing and control of all Engineering Drawings will be in accordance to the latest revision of Engineering Drawing Standard [55]. Drawings issued to Eskom will be a minimum of one hardcopy and an electronic copy. All *Contractors* are required to submit electronic drawings in Micro Station (DGN) format, and scanned drawings in pdf format. No drawings in TIFF, AUTOCAD or any other electronic format will be accepted. Drawings issued to Eskom may not be "Right Protected" or encrypted.

3.4.1.3 Document Submission

All project documents must be submitted to the delegated Eskom Representative with transmittal note according to Project / Plant Specific Technical Documents and Records Management Work Instruction. In order to portray a consistent image it is important that all documents used within the project follow the same standards of layout, style and formatting as described in the Work Instruction. The *Contractor* is required to submit documents as electronic and hard copies and both copies must be delivered to the *Eskom Representative* with a transmittal note.
In addition, the Contractor shall be provided with the following standards which must be adhered to:

- Documentation Management Review and Handover Procedure for Gx Coal Projects.
- Project Documentation Deliverable Requirement Specification.
- Technical Documentation Classification and Designation Standard.

3.4.2 Engineering Change Management

All Design change management shall be performed in accordance to the latest revision of the Eskom Project Engineering Change Management Procedure [56] and the Employer shall ensure that Contractor is provided with latest revisions of this procedure. Any uncertainty regarding this procedure should be clarified with the Employer. All design reviews will be conducted according to the Design Review Procedure [2].

3.4.3 As-Built Plant Drawings

The contractor shall be responsible to update all existing drawings of the "as-built plant" with the new system information in accordance Eskom, SANS and IEC standards and requirements.
New drawings are to be supplied where changes have been made to the plant.
The following drawings/diagrams will be required:

- Datasheets of all new equipment
- Piping and Instrumentation drawings of as is plant
- Design calculations
- Isometric drawings
- Electrical detail design report
- Cable route and construction works
- Electrical DB single line and general arrangement drawings.

3.4.4 Plant Coding & labelling

3.4.4.1 Plant Coding

Employer will only code the KKS code defining Documentation listed above. The employer will assign a coding practitioner who will interact with the Service Provider in coding the plant as listed above. It may be required that the person be based at the Service provider's offices full time. The Service Provider will then

be required to include allocated codes to all other designs and related documentation. It is also the responsibility of the Service Provider to consistently apply the KKS codes throughout the rest of the technical documentation.
The Service provider shall ensure that all documentation is coded (as per the codes assigned by the Practitioner) prior submission to Employer for review.
Camden power station coding and plant labelling shall conform to the following Plant standards:

- Camden KKS Coding Procedure.

The Contractor shall label the plant equipment according to Camden Power Station requirements.

3.4.4.2 Plant Labelling

It is the responsibility of the Contractor to manufacture and install labels according with Plant Labelling Standard.
The Coding practitioner shall facilitate base-lining of all equipment lists from the contractor, and only baseline equipment lists shall be used as a basis for the production of labels. Coding and labelling of components inside electrical and C&I panels shall be done by the Service provider.

3.4.5 Procedure, Guidelines & other Documents

The applicable procedures, guidelines and other relevant documentation to commission, operate, maintain and engineer the plant/system shall be supplied with the system, by the contractor. This will include as a minimum the following:

- Piping and instrumentation diagrams
- General arrangement and layout drawings
- System description providing all technical specifications
- Operating and control philosophy
- Data sheets and equipment lists
- Temperature rating of detection bulbs
- Testing and commissioning procedures.
- Quality Control Plan

4. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Steyn Drotsky	Electrical Engineering Manager – Camden Power Station
Al Khumalo	Lead Project System Engineer

5. REVISIONS

Date	Rev.	Compiler	Remarks
2021/04/23	01	Riaan Grobler	Initial Specification Document

6. DEVELOPMENT TEAM

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

- R Grobler

7. ACKNOWLEDGEMENTS

Not Applicable