	Specification	Engineering
---	----------------------	--------------------

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

Unique Identifier: **EED-DFPSP01**

Alternative Reference Number: **N/A**

Area of Applicability: **Engineering**




Documentation Type: **Specification**

Revision: **02**

Total Pages: **25**

Next Review Date: **N/A**

Disclosure Classification: **CONTROLLED
DISCLOSURE**

Compiled by	Functional Responsibility	Authorised by
		
.....
R. Grobler	S.D. Drotsky	Mokgoba Mathabatha
Senior Technologist	Manager	Manager
Electrical Engineering	Electrical Engineering	Engineering
Date: 2023-02-17	Date: 17/02/2023	Date: 17/02/2023

CONTENTS

	Page
1. INTRODUCTION	4
2. SUPPORTING CLAUSES	4
2.1 SCOPE	4
2.1.1 Purpose	4
2.1.2 Applicability	4
2.2 NORMATIVE/INFORMATIVE REFERENCES	5
2.2.1 Normative	5
2.2.2 Informative	6
2.3 DEFINITIONS	7
2.3.1 Disclosure Classification	7
2.4 ABBREVIATIONS	8
2.5 ROLES AND RESPONSIBILITIES	8
2.6 PROCESS FOR MONITORING	9
2.7 RELATED/SUPPORTING DOCUMENTS	9
3. TECHNICAL SPECIFICATION	9
3.1 SYSTEM DESCRIPTION- EXISTING PLANT OVERVIEW	9
3.1.1 Fire Pump House (Extended Fire Pump House)	9
3.2 WORK TO BE PERFORMED BY THE CONTRACTOR	13
3.2.1 Responsibility for Design	13
3.2.2 Scope of Works	13
3.2.3 Mechanical Plant Information	13
3.2.3.1 Existing Diesel fire Pump	13
3.2.3.1.1 Fire Pump Diesel Engine	13
3.2.3.1.2 Fire Pump	13
3.2.3.1.3 Pump Controller	13
3.2.3.3 Additional Requirements and Prerequisites	14
3.2.3.3.1 Steelwork	14
3.2.3.4 Corrosion protection	14
3.2.4 Electrical Requirements	15
3.2.4.1 Diesel Engine starter battery bank	15
3.2.4.2 Distribution Box/Board	15
3.2.4.2.1 General	16
3.2.4.3 LV Cabling	16
3.2.4.4 Lighting	17
3.2.4.5 Battery chargers in the fire pump controller	20
3.2.5 Earthing and Lightning Protection	20
3.2.6 Electrical Control and Power Cabling	21
3.2.7 Alarm requirements	21
3.2.8 Maintenance and Operating	21
3.3 QUALITY MANAGEMENT	21
3.3.1 Data Books	21
3.3.2 Inspection and Testing	22
3.4 DOCUMENTATION MANAGEMENT AND CONFIGURATION MANAGEMENT	23
3.4.1 Document Management	23
3.4.1.1 Document identification	23
3.4.1.2 Drawings Format and Layout	23
3.4.1.3 Document Submission	23
3.4.2 Engineering Change Management	23
3.4.3 As-Built Plant Drawings	23
3.4.4 Plant Coding & labelling	24
3.4.4.1 Plant Coding	24
3.4.4.2 Plant Labelling	24

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

3.4.5 Procedure, Guidelines & other Documents	24
4. AUTHORISATION	25
5. REVISIONS	25
6. DEVELOPMENT TEAM	25
7. ACKNOWLEDGEMENTS	25

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

1. INTRODUCTION

This document contains the Electrical Plant Design Technical Specification for Camden Power Station's upgrade of the fire pumping system.

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 electrical works scope to design, transport, supply, fitment, safety clearance and commissioning of:

- 24V DC Battery bank, equipped in battery cabinet, connected with a fused isolator to the charger and 24V circuit. Ultra-High Performance Nickel Cadmium. Must cater for the following two diesel engine start scenarios:
 - 1) Start Initiation option 1: 3 attempts of maximum duration of 15 s each, with rest periods of not more than 10 s between attempts (minimum requirement).
 - 2) Start Initiation option 2: 5 attempts of maximum duration of 8 s each, with rest periods of not less than 10 s between attempts.
- 24V DC Battery charger (industrial type) with programmable settings function for output voltage and current, charging time, float/bulk/charge settings. Overcharge and short circuit protection.
- 24V DC based beacon siren alarm system.
- The electrical installation, cabling and earthing.
- Electrical supply for lighting for new pump house section. The source of supply will be within the existing pump house DB. The DB to be equipped and rewired to cater for the existing plugs, lighting, charger and to cater for the new diesel engine battery bank charger, LED lights.
- All designs, design reports by the Contractor are signed off by an ECSA Professionally registered Technologist or Engineer who takes full professional accountability for the designs.
- All equipment shall comply with NFPA 20 and FM/UL Approved
- Hot and cold commissioning
- Training and manuals
- Quality control, inspection, and test plans (ITP's), quality control plans (QCP's).
- 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.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

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 10164-1 The 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

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

- [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
- [54] Eskom 054-393 Earthing Standards

2.2.2 Informative

- [55] SANS 10287 Automatic Sprinkler Installations for Fire Fighting Purposes
- [56] 240-86973501 Engineering Drawing Standard – Common Requirements
- [57] 240-53114002 Eskom Project Engineering Change Management Procedure

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

[58] 240-71432150 Plant Labelling Standard

[59] 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: <ul style="list-style-type: none"> • 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).

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

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.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

2.6 PROCESS FOR MONITORING

Eskom Design Review Procedure [2].

2.7 RELATED/SUPPORTING DOCUMENTS

- Refer to drawings and data tables included in this document

3. TECHNICAL SPECIFICATION

3.1 SYSTEM DESCRIPTION- EXISTING PLANT OVERVIEW

3.1.1 Fire Pump House (Extended 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.

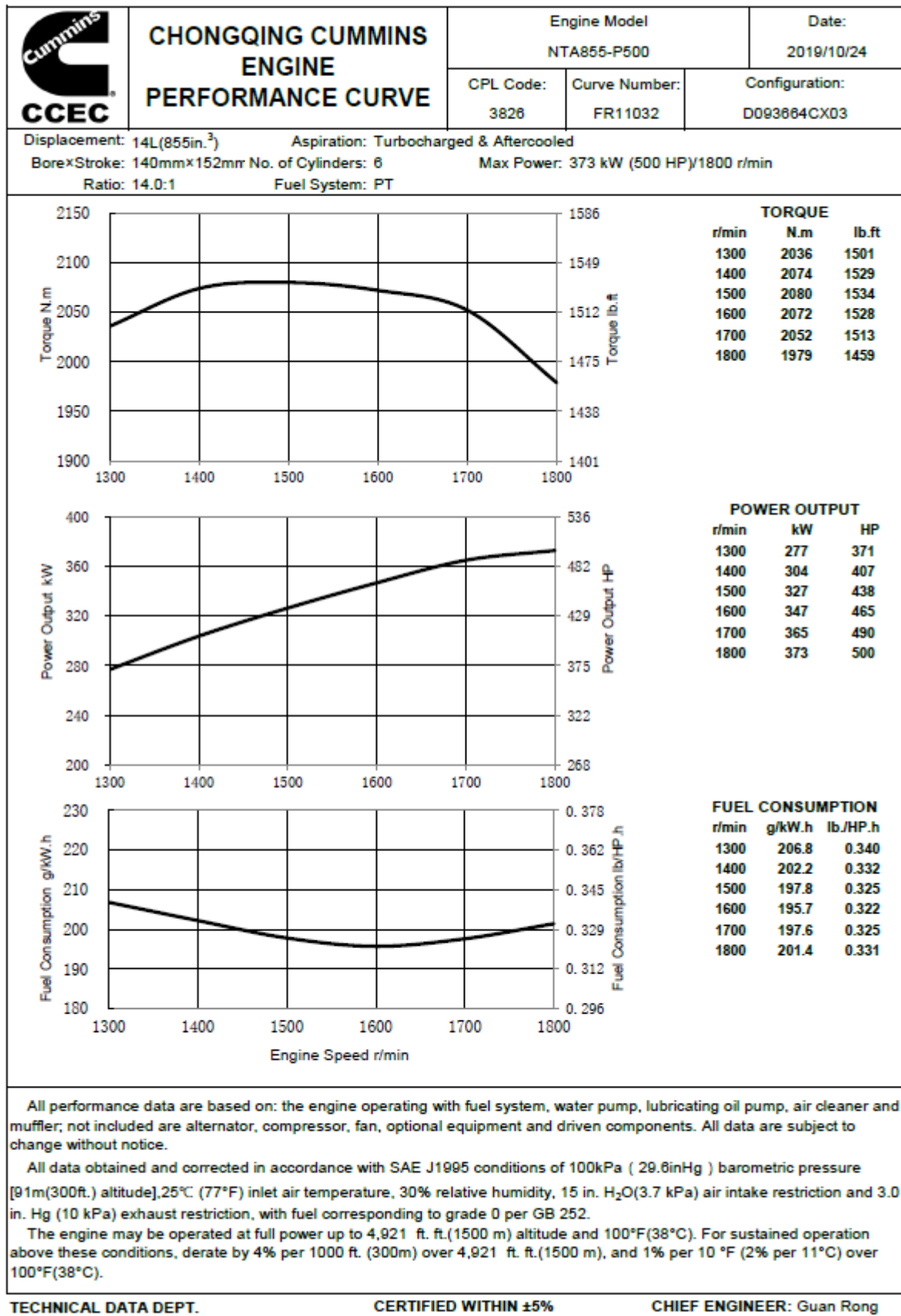
Figure 1,2,3: NEW DIESEL FIRE PUMP ENGINE indicates the new additional Diesel Pump Engine to be installed at the extended Fire Pump House that is equipped with the above-mentioned plant.

This specification for the electrical works is for the required electrical installations in order to enable successful operation of the electrical systems for the Fire Pump House.

The Contractor shall liaise with the Camden Eskom Personnel and the appointed Civil and Mechanical Contractors to ensure compatibility, successful implementation, and commissioning of the electrical works.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.



CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.



Chongqing Cummins Engine Co., Ltd. Engine Data Sheet

ENGINE MODEL: NTA855-P500

DATA SHEET: FR11032

CPL Code: 3826

CONFIGURATION NO.: D093664CX03

MAX POWER: 373 kW (500 HP)/1800 r/min

DATE: 2019/10/24

GENERAL ENGINE DATA

Type	4-Cycle; In-line; 6-Cylinder	
Aspiration	Turbocharged & Aftercooled	
Bore x Stroke - mm x mm (In. x In.)	140 x 152	(5.5 x 6.0)
Displacement - L (In. ³)	14	(855)
Compression Ratio	14.0:1	
Firing Order	1-5-3-6-2-4	
Dry Weight		
- Engine Only - kg (lb.)	1303	(2870)
Wet Weight		
- Engine Only - kg (lb.)	1348	(2970)
Moment of Inertia of Rotating Components (Without flywheel) - kg-m ² (lb.-ft. ²)	4.99	(118.5)
Center of Gravity from Front Face of Flywheel Housing - mm (In.)	549	(21.6)
Center of Gravity Above Crankshaft Centerline - mm (In.)	140	(5.5)

ENGINE MOUNTING

Maximum Allowable Bending Moment at Rear Face of Block - N-m (lb.-ft.)	1356	(1000)
--	------	--------

EXHAUST SYSTEM

Maximum Allowable Back Pressure - kPa (In. Hg)	10	(3)
Acceptable Exhaust Pipe Diameter (Internal diameter) - mm (In.)	127	(5.0)

AIR INDUCTION SYSTEM

Maximum Allowable Engine Inlet Temperature Rise - °C (°F)	17	(30)
Maximum Allowable Intake Air Restriction (With Heavy Duty Air Filter)		
- With Heavy Duty and Clean Filter Element - kPa (In. H ₂ O)	3.7	(15)
- With Dirty Filter Element - kPa (In. H ₂ O)	6.2	(25)
Minimum Allowable Intake Pipe Diameter - mm (In.)	127	(5.0)
Minimum Dirt Holding Capacity - g/L/s (g/CFM)	53	(25)

COOLING SYSTEM

Coolant Capacity - Engine Only - L (U.S. gal.)	20.8	(5.5)
- With Radiator - L (U.S. gal.)	60.6	(16.0)
- With Heat Exchanger - L (U.S. gal.)	49.2	(13)
Maximum Coolant Friction Head External to Engine - kPa (PSI)	48	(7)
Maximum Static Head of Coolant (exclusive of Pressure Cap) - kPa (PSI)	103	(15)
Maximum Static Head of Coolant Above Engine Crank Centerline - m (ft.)	14	(46)
Standard Thermostat (Modulating) Range - °C (°F)	82-94	(180-202)
Minimum Allowable Pressure Cap - kPa (PSI)	48.2	(7)
Maximum Coolant Temperature - °C (°F)	96	(205)
Maximum Allowable Top Tank Temperature - °C (°F)	100	(212)
Recommended Minimum Top Tank Temperature - °C (°F)	71	(160)
Minimum Coolant Expansion Space - % of System Capacity	5	
Minimum Coolant Makeup Capacity - L (U.S. gal.)	4.2	(1.1)

LUBRICATION SYSTEM

Oil Pressure @ Idle Speed - kPa (PSI)	103 Min	(15) Min
@ Governed Speed - kPa (PSI)	241-345	(35-50)
Maximum Allowable Oil Temperature - °C (°F)	121	(250)
Oil Pan Capacity - Low / High - L (U.S. gal.)	28.4/36.0	(7.5/9.5)
Total System Capacity		
- With Combo Filter - L (U.S. gal.)	38.6	(10.2)
- With Full-Flow and By-Pass Filter - L (U.S. gal.)	40.9	(10.8)
Angularity of Oil Pan - Front Down/Front Up/Side to Side	38°/38°/38°	

FUEL SYSTEM

Type Injection System	Direct Injection Cummins PT	
Maximum Allowable Restriction to Fuel Pump		
- With Clean Fuel Filter - kPa (In. Hg)	13.5	(4.0)
- With Dirty Fuel Filter - kPa (In. Hg)	27.1	(8.0)

CONTROLLED DISCLOSURE

Maximum Allowable Head on Injector Return Line		
– With Check Valve - kPa (in.Hg).....	22.0	(6.5)
– Without Check Valve - kPa (in.Hg).....	8.5	(2.5)
Minimum Fuel Supply Line Size - mm (in.).....	16	(0.625)
Minimum Fuel Return Line Size - mm (in.).....	13	(0.5)
Maximum Fuel Pump Supply - L/h (U.S.gal/h).....	356	(94)
Recommended Fuel Temperature Range - °C (°F).....	32-43	(90-110)
Maximum Allowable Fuel Temperature - °C (°F).....	71	(160)

ELECTRICAL SYSTEM

Minimum Recommended Battery Capacity (24V)	
– Cold Soak (No Load) - CCA.....	900
– Minimum Reserved Capacity - CCA.....	320
– Cold Soak (With Load) - CCA.....	900
– Minimum Reserved Capacity - CCA.....	320
Maximum Allowable Resistance of Cranking Circuit - ohm.....	0.002
Standard Cranking Motor (Heavy Duty , Positive Engagement) - volt.....	24

COLD START CAPABILITY

Minimum Crankshaft Rotation for unaided Cold Start - r/min.....	150	
Minimum Torque for unaided Cold Start - N.m(lb.-ft.).....	509	(375)

PERFORMANCE DATA

All data is based on :

–Engine Operating with fuel system, water pump, lubricating oil pump, air cleaner and exhaust silencer, fan, and optional driven components.

–Engine operating with fuel corresponding to grade 0 per GB 252.

–ISO3046 Standard Reference Conditions of : Barometric Pressure:100kPa(29.6in.Hg); Altitude: 110m (361ft.); Air Temperature: 25°C (77°F) ; Relative Humidity: 30% .

All data are subject to change without notice.

	MAXIMUM POWER			
	1800			
Governed Engine Speed - r/min.....				
Gross Engine Power Output - kW (HP)	373	(500)		
Torque - N·m (lb·ft.).....	1979	(1459)		
Brake Mean Effective Pressure - kPa (PSI)	1776	(257)		
Piston Speed - m/s (ft./min).....	9.1	(1800)		
Friction Horsepower - kW (HP).....	35	(47)		
Intake Air Flow - L/s (CFM)	528	(1118)		
Engine Water Flow - L/min(GPM)	427	(113)		
Exhaust Gas Temperature (After Turbine) - °C (°F).....	450	(842)		
Exhaust Gas Flow - L/s (CFM).....	1370	(2907)		
Heat Radiation - kW (BTU).....	45	(2550)		
Heat Rejection to Coolant - kW (BTU).....	224	(12770)		
Heat Rejection to Ambient - kW (BTU).....	269	(15320)		

Engine Model: NTA855-P500

Data Sheet: FR11032

Date: 2019/10/24

Figure 1,2,3: NEW DIESEL FIRE PUMP ENGINE DATA

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

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 under electrical plant and electrical works in this document according to the applicable codes and standards and taking account of:

- Required design life of 25 years

The electrical Contractor must take note of the steel works requirements listed under 3.2.3.3 Additional Requirements and Prerequisites. Steel works shall be corrosion protected or painted to prevent corrosion.

3.2.3 Mechanical Plant Information

3.2.3.1 Existing Diesel fire Pump

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

- **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

CONTROLLED DISCLOSURE

- 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 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 Additional Requirements and Prerequisites

3.2.3.2.1 Steelwork

- All work is required to be of good quality.
- The *Contractor* is responsible for the stability of all structural elements during all the construction, erection stages.
- All dimensions are required to be verified on site by the *Contractor* before any fabrication of steelwork, distribution boards, supports, steel brackets, cable racks commences.
- The *Contractor* is required to supply all bolts, washers, nuts etc. for the structural steelwork.

3.2.3.3 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].

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

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 SANS10142-1 and a COC shall be issued by an installation or master installation electrician.

Contractor 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 existing lighting, plugs and dc charger ac supply distribution board shall be changed and equipped to cater for the new electrical supply required for the new diesel fire pumps' dc battery charger and controls and the lighting of the fire pumphouse.

The cable, switchgear and lighting 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

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 batteries shall be housed in separate battery cabinet.
- 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.
- The battery bank shall have a fused isolator/disconnector.

3.2.4.2 Distribution Box/Board

The distribution box and associated MCBs shall be changed, updated and 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 installed in the fire pump house shall be changed, updated in order to supply the existing and new electrical equipment.

- The distribution box shall contain a two-pole rated at 32A isolator; 40 A Earth leakage residual current detector (RCD). The RCD shall have a residual current of not more than 30 mA leakage

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

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 2x two pole MCB for the diesel engine heaters.
- 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.

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

Surge protection devices shall be fitted.

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

The contractor 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 liveing 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.

CONTROLLED DISCLOSURE

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.
- b. Cables schedules of the cable types, sizes, source, destination earthing requirements and unique identification alpha numeric number shall be provided by the contractor to the employer.
- c. Cables schedules detailing the cable types, sizes, source, destination earthing requirements and unique identification alpha numeric number shall be provided by the employer.
- d. 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 by the Contractor 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.

The Contractor to determine cable size and number of cores as per Contractor design required for the interface, electrical supply and operation of the entire electrical AC and DC plant.

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.
- Red for single phase.
- 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. Bosal steel conduit shall be used.

3.2.4.4 Lighting

The existing lighting system shall be removed and replaced with energy efficient LED lights. The lighting design done by the Contractor shall comply with the requirements of the Occupational Health and Safety Act (OSHA) of South Africa. The purpose is to reduce the load on the main AC supply.

The lights and light fittings shall be the battery backup versions in order to function during emergency/loss of power conditions. The batteries and its OEM required auxiliaries to function shall be included with the lights.

CONTROLLED DISCLOSURE

Inside the Pumphouse:

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*.

The old HID light fitting shall be removed and replaced with LED high bay lights. The Contractor shall perform the lighting design and the design shall be reviewed and approved by the Employer.

The quality requirements for the LED high bay lights are:

Recommended installation height (m)	4 - 12
Compliance	SABS Approved ROHS compliant SANS 60598-2-3 SANS 62262
Luminaire output flux (lm)	18350 - 38990
Power consumption (W)	132 - 321
Luminaire efficacy - up to (lm/W)	149
Housing	Marine grade high-pressure die-cast aluminium (EN 1706 AC-44300)
Optic	Acrylic PMMA
Protector	High-impact polycarbonate
Tightness level	IP 66
Impact resistance	IK 07 IK 10
Access for maintenance	Easy access to the gear compartment by means of a hinging mechanism
Operating temperature range	-30°C up to +35°C
Electrical class	Class I EU
Nominal voltage	198-264V - 50Hz
Surge protection (kV)	10kV
LED colour temperature	Neutral White 840
Colour rendering index (CRI)	≥70
Lifetime	100,000h
Battery Backup	Yes, battery backup, to be used in emergency situations.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

Outside entrance, above the main entrance door, of the Fire Pump House:

- The lights shall be fitted with a day/night control switch
- The old light fittings to be removed and replaced.

The quality requirements for the LED outside lights:

Recommended installation height (m)	3 - 8
Compliance	SABS Approved ROHS compliant SANS 60598 SANS 62262 IEC 60068-2-6
Luminaire output flux (lm)	2715 - 9389
Power consumption (W)	24 - 77
Luminaire efficacy - up to (lm/W)	124
Housing	Marine grade high-pressure die-cast aluminium (EN 1706 AC-44300)
Optic	Acrylic PMMA
Protector	High-impact polycarbonate
Tightness level	IP 66
Impact resistance	IK 07 IK 10
Operating temperature range	-35°C up to +45°C
Electrical class	Class I EU Class II EU
Nominal voltage	198-264V - 50Hz
Surge protection (kV)	10kV 20kV
LED colour temperature	Neutral White 740 Warm White 730 Cool White 757
Colour rendering index (CRI)	≥70
Lifetime	100,000h
Battery Backup	Yes, battery backup, to be used in emergency situations.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

3.2.4.5 Battery chargers in the fire pump controller

Battery charge shall be in accordance with NFPA 20 -12.5

- Chargers shall be specifically listed for fire pump service and be part of the diesel fire pump controller.
- A switch mode type charger shall be utilised. The rectifier shall be a semiconductor type.
- The battery charger at its rated voltage shall be capable of delivering energy into a fully discharged battery in such a manner that it will not damage the battery.
- The battery charger shall restore to the battery 100 percent of the battery's reserve capacity or ampere hour rating within 24 hours.
- The charger shall be marked with the reserve capacity or ampere-hour rating of the largest capacity battery that it can recharge in compliance with.
- An ammeter with an accuracy of ± 5 percent of the normal charging rate shall be furnished to indicate the operation of the charger.
- The input AC supply to the battery charger shall be 220V AC.
- Each battery charger shall have selectable DC (24V).
- The battery charger shall allow selection of the battery type.
- 24V DC Battery charger (industrial type) with programmable settings function for output voltage and current, charging time, float/bulk/charge settings. Overcharge and short circuit protection.
- The charger shall be designed such that it will not be damaged or blow fuses during the cranking cycle of the engine when operated by an automatic or manual controller.
- The charger shall automatically charge at the maximum rate whenever required by the state of charge of the battery.
- The battery charger shall be arranged to indicate loss of current output on the load side of the direct current (dc) overcurrent protective device where not connected through a control panel.
- The charger(s) shall remain in float mode or switch from equalize to float mode while the batteries are under the loads in 12.5.2. as listed in NFPA 20 -12.5
- The chargers and its required auxiliaries shall be fitted inside the diesel pump engine control panel. If not possible, and additional pedestal mounted DB shall be mounted.

3.2.5 Earthing and Lightning Protection

The Contractor adheres to Eskom 240-56356396 Earthing and Lightning Protection Standard and Eskom 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.

Compliant earthing shall be done to the diesel engine and base, control panels, lighting, roof and steel structure.

Earth spikes shall be used to ensure the roof and structure is properly earthed. The appropriate positions shall be identified as close to the structure as possible and cable scanning shall be done by the contractor to identify safe locations to drive the earth spike/s into, in order not to do damage existing infrastructure.

Earthing conductors shall be the appropriate size carry the expected fault current.

Test the earthing system to ensure that it is functioning properly by performing ground resistance testing.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

Ensure earth continuity and resistance compliance to SANS 10142-1.

3.2.6 Electrical Control and Power Cabling

The Contractor adheres to Eskom 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.

SANS10142-1 applies.

3.2.7 Alarm requirements

Fit two 24V DC Red Sounder Beacons, IP66 Base Mount, 95dB above the pumphouse entrance.

- It shall be supplied from the 24V DC battery supply and fuse protected in order to have uninterruptable power supply.
- It shall have a test button fitted on a panel mounted inside the fire pumphouse.
- It shall activate whenever there is an alarm standing on the battery charger or when main AC supply voltage is lost to the battery charger.
- Two voltage monitoring relays shall be used to monitor the main AC income voltage and shall be utilised to activate the Sounder Beacon.
- It shall also be incorporated to activate when there is an alarm activated or standing on the new Fire Diesel Pump controller.
- Auxiliaries (voltage monitoring relays, dry contact relays, fuses, mounting kits, screws, terminal blocks, panels, contactors, circuit breakers) that are required to ensure success of the integration shall be made provision for by the contractor.

3.2.8 Maintenance and Operating

The Contractor shall 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:

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

- Quality Management documentation, QCP's, ITP's.
- Safety clearances (to be granted prior commissioning).
- COC as per SANS10142-1
- Construction, layout and component approvals
- Routine test certificates
- Construction and as-built drawings and approvals on Eskom drawing templates
- Schematic drawings
- 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*
- COC as per SANS 10142-1 – hold point for *Contractor* and *Engineer*
- Data Book review – hold point for *Contractor* and *Engineer*
- Punch list – hold point for *Contractor* and *Engineer*
- Spares list – hold point for *Contractor* and *Engineer*
- Final inspection – hold point for *Contractor* and *Engineer*
- Hand-over – hold point for *Contractor* and *Engineer*

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

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 with the latest revision of Engineering Drawing Standard [56]. 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 with the latest revision of the Eskom Project Engineering Change Management Procedure [57] 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:

CONTROLLED DISCLOSURE

- Datasheets of all new equipment
- Piping and Instrumentation drawings of as is plant
- Design calculations
- Isometric drawings
- Schematic diagrams and 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 Contractor.

All equipment, cables, switches, panels, contactors, relays, circuit breakers, indicators and lights shall be labelled in order to assist with future fault finding, it includes AC and DC cables and control cables.

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

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

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
2023/02/17	02	Riaan Grobler	Specification update

6. DEVELOPMENT TEAM

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

- R Grobler

7. ACKNOWLEDGEMENTS

Not Applicable

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.