Eskom	Technical Specification	Generation

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1 INTRODUCTION

1.1 HYDROGEN PLANT

Hydrogen gas is used as a cooling medium in the turbine generators. This gas is used because of its thermal conductivity and very low-density properties. To meet the hydrogen requirements at Medupi Power Station, hydrogen shall be produced and stored on site. The gas produced shall be of high purity to ensure safety and generator long term plant health.

Safe plant operation must be ensured by on-line monitoring of all critical parameters, gas analysing and automatic control of the hydrogen system. The hydrogen generating plant, bulk storage, metering and reticulation are controlled as an integrated system in order to ensure safety. The design of the hydrogen generating system must prevent unnecessary stopping of the plant to optimise cell stack life expectancy and limit venting to atmosphere. The entire hydrogen system must comply with the Eskom's Hydrogen systems standard (240-56227413). OEM contractor will be executing this scope.

1.2 NITROGEN PLANT

Medupi Power Station requires Nitrogen gas for the blanketing of the five tanks containing demineralised water (Demineralised Water Storage Tanks (DWST), Polishing of the Demin Feed Tanks (PDFT) and the Condensate reserve tanks (CRT). The entire Nitrogen Plant design, construction and commissioning must comply with the Eskom's Nitrogen systems standard (240-110414644).

There were previous Contractors that were unable to complete these works. This document focuses on the Scope of Works that still need to be done to complete and commission the Nitrogen plant. From the terminated contracts there is free issue material and equipment that the Contractor is to incorporate into his designs, then construct and commission the Nitrogen generating Plant and its distribution piping.

1.3 INTEGRATED WORKS

The Hydrogen and Nitrogen Plants are in a shared space (site) as indicated on 084/65535. These plants share common infrastructure in terms of road access, paving, fencing, drainage, piping servitudes and electrical servitudes. The arrangement design of the Hydrogen and Nitrogen plant is to be integrated to avoid clashes, duplication of equipment and optimise the use of available space to improve the maintainability of the plant.

2 SUPPORTING CLAUSES

2.1 SCOPE

2.1.1 Purpose

The document covers the scope of work for the design and construction of civil and services for the Hydrogen plant Contractor, the Integrated works including roads, Equipment room, civils and services and for the design, construction and commissioning of the complete nitrogen plant.

2.1.2 Applicability

This document applies to Medupi Power Station.

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] Act No. 85 of 1993: The Occupational Health and Safety, 1993 (as amended).

[2] Act No. 103 of 1977: National Building Regulations and Building Standards Act No. 103 of 1977 (as amended)

[3] Act No. 73 of 1989: Environmental Conservation Act, 1989 (as amended))

[4] Act No. 36 of 1998: National Water Act, 1998 (as amended)

[5] Act No. 44 of 2000: Architectural Profession Act, 2000 (as amended)

[6] Act No. 46 of 2000: Engineering Profession Act, 2000 (as amended)

[7] 240-56227413: Hydrogen Systems Standard

[8] 240-110414644: Nitrogen System Standard

[9] 240-123801640: Standard for Low Pressure Pipelines

[10] SANS 1700: Fasteners

[11] 240-105020315: Standard for Low Pressure Valves

[12] 240-106628253: Standards for Welding Requirements on Eskom Plants

[13] 240-83539994: Standard for Non-Destructive Testing (NDT) on Eskom Plant

[14] 240-53114026: Project Engineering Change Management Procedure

[15] 240-56536505: Hazardous Location Standard

[16] 240-56356396: Earthing and lightning protection standard

[17] 240-49230046: Failure Mode and Effect Analysis (FMEA) Guideline

[18] 240-52844017: System Reliability, Availability and Maintainability Analysis Guideline

[19] 240-49230111: Hazard and Operability Analysis (HAZOP) Guideline

[20] 200-53810 (348-621432): Documentation Handover List

[21] 240-86973501: Engineering drawing standard - Common Requirements

[22] 200-3340 (348-630398): Medupi KKS Coding and Labelling Standard

[23] 240-60782552: Process Flow Diagram Standard

[24] 240-56355815: Control & Instrumentation Field Enclosures and Cable Termination Standard

[25] 200-1689 (348-389557): Medupi / Matimba Contractor Quality Specification

[26] 200-129834 (348-860843): Storage and Preservation Work Instruction

[27] 240-54937450: Fire Protection & Life Safety Design Standard

[28] 240-56356376: Site commissioning for low pressure services

[29] 200-18202 (348-694071): Medupi KKS Key Part Standard (NPSZ 45-45)

[30] 200-11303: Medupi Occupational Health, Safety and Management Policy

[31] 200-5343 (348-885912): Medupi Power Station Project - List of Abbreviations

[32] 200-4190 (348-882024): The application of KKS plant coding (NMP 45-7)

[33] VGB–B 106 E Part A– KKS Application Commentaries Part A – General

[34] VGB–B 106 E Parts B1 – KKS Application Commentaries Part B1_ Mechanical Engineering

[35] VGB–B 106 E Part B2 – KKS Application Commentaries Part B2 - Civil Engineering

[36] VGB–B 106 E Part B3 - KKS Application Commentaries Part B3_Electrical and C&I Engineering

[37] VGB–B 106 E Part B4 - KKS Application Commentaries Part B4 Identification of C&I and Control Tasks

[38] 348-883860: Documentation Format and Layout Specification

[39] 240-56364545: Structural Design and Engineering Standard

[40] 200-6166 (348-355152): Medupi Power Station Backfill Specification

[41] 84CIVL053 (348-880042): Medupi Concrete specification for structural concrete

[42] 240-107981296: Standard for Eskom Power Stations Concrete Remedial Work

[43] SSZ_45-17 (348-133183): Medupi Power Station Corrosion Protection Specification

[44] 84CIVL052 (348-9974683): Medupi Civil Specification – Low Pressure Services (Civil and Building Works)

[45] 200-26680 (348-361813): Medupi Power Station Architectural Technical Specification for Structures & Other Buildings

[46] 84CIVL007 (348-884646): Conceptual Architectural Design Specifications for Structures and Other Buildings (84CIVL007)

[47] SANS 3001-CO3-1: Concrete durability index testing — Part CO3-1: Preparation of test specimens

[48] SANS 3001-CO3-2: Concrete durability index testing — Part CO3-2: Oxygen permeability test

[49] SANS 3001-CO3-3: Concrete durability index testing — Part CO3-3: Chloride conductivity test

[50] 240-84418186: Road Specification Manual

[51] 240-85549846: Standard for Design of Drainage and Sewerage Infrastructure

[52] 240-57127955: Geotechnical and Foundation Engineering Standard

[53] 240-57127951: Standard for the Execution of Site Investigations

[54] 240-57127953: Execution of Site Preparation and Earthworks Standard

[55] 240-107981296: Constructability Assessment Guideline

[56] SANS 10400: The application of the National Building Regulations

[57] 200-3583 (348-912995): Specification for the Identification of the Contents of Pipelines and Vessels (ESKSCAAC6)

[58] 240-54937439: Fire Protection/Detection Assessment Standard

[59] 240-50056004 Constructability Analysis Guideline

[60] 0.84/3 Sheet 1 and 2: Station Layout

[61] 0.84/86 Sheet 1: Low Pressure Services H2 Plant PFD

[62] 0.84/195: Terrace and Contractor's Yards Road Layout

[63] 0.84/198 Sheet 5: Stormwater Layout

[64] 0.84/199 Sheet 1 to 19: Stormwater Drainage Longitudinal Sections

[65] 0.84/65535 Sheet 1: General Arrangement Nitrogen and Hydrogen Plant

[66] 0.84/65536 Sheet 1 and 2: General Arrangement Nitrogen and Hydrogen Pipe Routing

[67] 0.84/46781 Sheet 1 to 10: P&ID Nitrogen Plant Process and Instrumentation Diagram

[68] 200-1680 (348-883808): Medupi Document and Records Management Work Instruction

[69] 200-13735 (348-597764): Commissioning and Completion of Power Station Projects as Per 'NEC'

[70] 200-94660 (348-80410): KKS Plant Codification Standard

[71] 348-942820: Contractor’s Document Transmittal Form

[72] 01/A1042/ABCEFGI/5213 (348-31313): Medupi water use licence

[73] 240-53114186: Eskom Project/Plant Specific Technical Document and Records Management Procedure

[74] 240-53114248: Thyristor and switch mode chargers, AC/DC to DC/AC converter and inverter/uninterruptible power supplies standard

[75] 240-55410927: Cyber Security Standard for Operational Technology

[76] 240-55714363: Eskom Generation Power Station Lighting and Small Power Installation Standard

[77] 240-56176097: Electrical Cable Schedule Template

[78] 240-56227443: Requirements for Control and Power Cables for Power Stations Standard

[79] 240-56227516: LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltage up to and Including 1000V AC and 1500V DC Standard

[80] 240-56227927: Electrical Load List Template

[81] 240-56355466: Alarm Management System Guideline

[82] 240-56355541: Control system Computer Equipment Habitat Requirement Guideline

[83] 240-56355728: Human Machine Interface Design Requirements Standard

[84] 240-56355729: Plant Control Modes Guideline

[85] 240-56355731: Environmental Conditions for process control equipment

[86] 240-56355888: Temperature Measurement Systems Installation Standard

[87] 240-56355910: Management of Plant Software

[88] 240-56357424: MV and LV Switchgear Protection Standard

[89] 240-56737448: Fire Detection and Life Safety Design Standard

[90] 240-57617975: New Low Voltage Motors Procurement Standard

[91] 240-58552870: Smart Plant for Owner Operators (SPO) Documentation Metadata Standard

[92] 240-61379718: Instrument Schedule Template

[93] 240-61379755: Drive and Actuator Schedule Template

[94] 240-72344339: Virtual Signal List Template

[95] 240-72344727: Control System Architecture

[96] 240-76394151: Cold Commissioning Report Template

[97] 240-77302094: Electrical Termination Schedule Template

[98] 240-83561037: Reporting and Data Requirements Specification for Contractors

[99] 240-89147446: Instrument Piping for Coal Fired Power Plants Standard

[100] 240-93576498: KKS Coding Standard

[101] 240-100183119: Standard for fences in Eskom transmission substations

[102] 240-114967625: Operating Regulations for High Voltage Systems

[103] 240-129014618: Cyber Security Guidelines

[104] 240-150642762: Generation Plant Safety Regulations

[105] 204-110414644: Nitrogen System Standard

[106] 348-1024121: Hydrogen Plant and Nitrogen Plant (H2N2) Safety, Health and Environmental (SHE) Specification

[107] ASTM A446: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

[108] AWS D1.1: Structural Welding Code – Steel

[109] IEC 60584: Thermocouples

[110] IEC 60751: Industrial platinum resistance thermometers and platinum temperature sensors

[111] IEC 60751: Industrial platinum resistance thermometers and platinum temperature sensors

[112] IEC 62381: Automation systems in the process industry - Factory acceptance test (FAT), site acceptance test (SAT), and site integration test (SIT)

[113] IPC/WHMA-A-620: Requirements and Acceptance for Cable and Wire Harness Assemblies

[114] ISO 3834-3: Quality requirements for fusion welding of metallic materials - Part 3: Standard quality requirements

[115] ISO 10007: Quality management - Guidelines for configuration management

[116] NFPA 15: Standard for Water Spray Fixed Systems for Fire Protection

[117] PD 5500: Specification for unfired fusion welded pressure vessels

[118] SANS 62: Steel pipes

[119] SANS 121: Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods

[120] SANS 227: Burnt clay masonry units

[121] SANS 428: Fire performance classification of thermal insulated building envelope systems

[122] SANS 719: Electric welded low carbon steel pipes for aqueous fluids (large bore)

[123] SANS 966-2: Components of pressure pipe systems Part 2: Modified poly(vinyl chloride)(PVC-M) pressure pipe systems.

[124] SANS 986: Precast reinforced concrete culverts

[125] SANS 1128: Firefighting equipment (All parts)

[126] SANS 1200 DK: Standardized specification for civil engineering construction Section DK: Gabions and pitching

[127] SANS 1200 M: Standardized specification for civil engineering construction Section M: Roads (general)

[128] SANS 1910: Portable refillable fire extinguishers

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

[130] SANS 2001-DP5: Construction works Part DP5: Stormwater drainage

[131] SANS 10083: The measurement and assessment of occupational noise for hearing conservation purposes

[132] SANS 10100-1: The structural use of concrete Part 1: Design

[133] SANS 10102-1: The selection of pipes for buried pipelines Part 1: General provisions

[134] SANS 10102-2: Selection of pipes for buried pipelines Part 2: Rigid pipes

[135] SANS 10108: The classification of hazardous locations and the selection of electrical apparatus for use in such locations

[136] SANS 10139: Fire Detection and Alarm Systems for Buildings – System Design, Installation and Servicing

[137] SANS 10140-2: Identification colour marking Part 2: Identification of hazards and equipment in work situations

[138] SANS 60947-7-1: Low-voltage switchgear and control gear Part 1: General rules

[139] SANS 60947-7-2: Low-voltage switchgear and control gear Part 2: Circuit-breakers

[140] VGB-R 170C: Function-related Documentation of Power Plant Instrumentation and Control in Line with Operating Requirements

[141] VGB-R 171e: Guidelines for the supply of technical documentation for fossil-fired and regenerative power stations.

[142] VGB-S-811-01-2018-01-EN: VGB Standard KKS Identification System for Power Stations

2.2.2 Informative

[143] 348–965775: Medupi Power Station: Nitrogen Plant Scope of Works

[144] 348-26633: Medupi Hydrogen plant technical specification

[145] ISO 9001: Quality Management Systems.

[146] 200-1679 Medupi Project Quality Plan Rev 07

[147] 200-1682 Quality Management System Audits Rev 09

[148] 200-1684 Corrective Action Request (CAR) Rev 05

[149] 200-1687 Management Review Work Instruction Rev 04

[150] 200-90604 NOD Quality Clearing House (ToR) Rev 03

2.3 DEFINITIONS

Definition	Description
Absorption drying	a chemical process in which water vapour is bound to absorption material. The absorption material can either be a solid or liquid
Compressor	a mechanical flowing device designed to increase the pressure of a gas by reducing its volume, e.g Air or refrigerant.
Inline device	Any measurement and/or control element that is either welded, screwed or flanged into any mechanical plant.
Control elements/devices	This includes all inline devices associated with the plant process, e.g. valves, dampers, primary elements etc.
Control System/Controller	The control system is a complete control system for remote and automatic control.

Definition	Description
Drives	Drives are all mechanical or electrical prime movers, e.g. actuators, pumps, etc.

2.3.1 Disclosure Classification

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

2.4 ABBREVIATIONS

Abbreviation	Description
AIA	Approved Inspection Authority
BOM	Bill of Materials
C&I	Control and Instrumentation
COC	Certificate of Compliance
CP	Common Plant
DCS	Distributed Control System
ECSA	Engineering Council of South Africa
FAT	Factory Assessment Test
FMECA	Failure Modes Effects and Criticality Analysis
H2	Hydrogen
HAZLOC	Hazardous Location
HAZOP	Hazard and Operability
HMI	Human Machine Interface
I/O	Input/Output
KKS	Kraftwerk-Kennzeichen System
LOSS	Limits Of Supply and Services
MCP	Multi Cylinder Packs
MDL	Master Document List
N2	Nitrogen
OEM	Original Equipment Manufacturer
PEC	Professional Engineering Certificate
PLC	Programmable Logic Controller
UPS	Uninterruptible Power Supply
VDSS	Vendor document submittal schedule
RAM	Reliability, Availability and Maintainability
SHEQ	Safety, Health & Environmental and Quality

3 GENERAL REQUIREMENTS

3.1 KEY PEOPLE

The Contractor's registered professionals shall provide services in accordance with ECSA Code of Conduct (Act No. 46 of 2000) and guidelines for registered professionals as well as the Construction Regulations (Act No. 85 of 1993) for the respective engineering disciplines.

The Contractor's appointed ECSA registered professional shall conduct a final inspection and issue a Professional Engineering Certificate certifying the containerized unit thus confirming structural integrity, design life and it is safe for use. The Contractor shall as a minimum, comply with relevant SANS, other codes (applicable to containerized units) and all the Employer's Handover procedures when submitting the final certificate/s.

3.2 STORAGE AND PRESERVATION

The *Contractor* shall implement storage and preservation requirements in accordance with the Storage and Preservation Work Instruction (200-129834).

The *Contractor* shall provide a storage and preservation procedure as per OEM for all Plant and Material including the free issued Plant and Material in section **Error! Reference source not found.**.

3.3 DRAWING REQUIREMENTS

The creation and control of all Engineering Drawings shall be in accordance with the latest revision of 240-86973501 (Engineering Drawing Standards – Common Requirements). The *Contractor* shall provide detailed "As Required" arrangement/dimensional drawings for each part of work to be done.

After the *works* have been completed, the *Contractor* to submit detailed "As-built" drawings to the *Project Manager* for acceptance. The "As-built" drawings are subject to the *Employer*'s Engineering representative comments and approval. All drawings shall indicate all the new installation/modified parts as well as enough of the existing pipework to which the items are connected. This shall be done in sufficient detail to easily identify the location of the installation. All drawings shall be issued as a final black line version with "As-built" status clearly indicated on the drawing. All final "As-built" drawings shall be signed off by the Designer indicating the Designer's name and ECSA registration details.

All drawings shall contain the following as a minimum:

- Description of component with KKS number.
- Layout of the pipework with dimensions and angles.
- Bill of materials for all components traceable to the layout. BOM should include size, schedule, pressure rating or class, material, quantity etc.
- Design and operating pressures and temperatures.
- Proof Pressure Test requirements and pressures.
- Design Code.

- All drawing revisions must be provided as paper copies in original (in all cases at least A3) size, otherwise provide larger size in case of legibility limitations. Electronic copies of the drawings must be provided in both pdf and dgn format.

3.4 MASTER DOCUMENTATION LIST

The *Contractor* is required to compile and maintain a Master Document List (MDL) of all required project documentation, which details when the documentation shall be submitted to the Project Manager. The *Contractor* submits a template of the MDL to the Project Manager for review and approval.

The *Contractor* submits a preliminary MDL within 30 calendar days of contract award.

The *Contractor* submits the updated MDL to the Project Manager at least once a month for review.

3.5 DOCUMENTATION FORMAT AND LAYOUT

Documentation has the following attributes:

a. Documentation Unique identification number

b. Eskom Drawings must have the Eskom Drawing number before the Vendor submits to Eskom. The Vendor may request pre-allocation of Eskom Drawing numbers, if required.

c. Documentation Revision

d. Documentation Title or Description

e. KKS code

3.6 DOCUMENTATION MANAGEMENT GOVERNANCE

The *Contractor* manages the documentation in line with the Eskom Documentation Management governance listed below.

a. 348-883860: Medupi Documentation Format and Layout Specification

b. 348–883808: Medupi Document and Records Management Procedure

c. 240-86973501: Engineering Drawing Standard - Common Requirements

d. 240-53114186: Eskom Project/Plant Specific Technical Document and Records Management Procedure

e. 240-83561037: Reporting and Data Requirements Specification for Contractors.

f. 348-942820: Contractor’s Document Transmittal Form

g. 200-1689 (348-389557): Medupi / Matimba Contractor Quality Specification

3.7 CONFIGURATION MANAGEMENT REQUIREMENTS

3.7.1 Configuration Management Plan

The *Contractor* prepares a configuration management (CM) plan utilizing ISO 10007 as a reference guide for the scope of work. The CM plan includes the following:

The process of managing documentation for the project works will be supported by the following

a. A complete and comprehensive description of the *Contractor*'s document numbering conventions and revision schema.

b. A description of the electronic data management system(s) that the *Contractor* will use for the management of documents and/or configuration items;

c. A description of the configuration management activities to be indicated in the programme;

d. A description of the baselines that will be established and the content of these baselines;

e. The release procedure for product configuration information;

f. The procedure for the control of changes prior to the establishment of baselines as well as after;

g. The method for processing changes, emanating both internally and from sub-suppliers;

h. The method for collecting, recording, processing and maintaining the data necessary for producing configuration status accounting records;

i. The definition of the content and format for all configuration status accounting reports;

j. A list of audits which will be conducted to ensure adherence to the CM plan.

3.7.2 Plant Designation

3.7.2.1 Plant Designation System

The *Contractor* applies the Kraftwerk-Kennzeichen system (KKS) codification system to uniquely identify the systems, sub-systems and components constituting the Plant.

The *Contractor* applies the following guidelines and standards when codifying plant:

a. The application of KKS plant coding (NMP 45-7) - 200-4190 (348-882024)

b. Medupi KKS Key Part Standard (NPSZ 45-45) - 200-18202 (348-694071)

c. Medupi Power Station Project - List of Abbreviations - 200-5343 (348-885912).

d. KKS Plant Codification Standard - 200-94660 (348-80410)

e. VGB-B 106 E Part A-KKS Application Commentaries Part A General

f. VGB-B 106 E Part B1-KKS Application Commentaries Part B1_Mechanical Engineering

g. VGB-B 106 E Part B2-KKS Application Commentaries Part B2_Civil Engineering

h. VGB-B 106E Part B3-KKS Application Commentaries Part B3_Electrical and C&I Engineering.

i. VGB-B 106E Part B4-KKS Application Commentaries Part B4 Identification of C&I and Control Tasks.

The *Contractor* identifies all plant indicated or referenced by documentation by the plant's unique KKS codes within the documentation itself.

The *Contractor* ensures that the codification assigned to plant is consistently maintained throughout the design cycle, e.g. the KKS codes indicated in the O&M manuals are consistent with the KKS codes indicated in the original process and instrumentation diagram.

The *Employer* shall supply the *Contractor* with a system-level plant breakdown structure (PBS) of the existing plant at the Site, as well as a preliminary system-level plant breakdown structure of the plant within the *Contractor*'s scope at contract initiation. The *Contractor* reviews the PBS to ensure alignment with the *Contractor*'s design philosophy and expands the PBS to the complete system level (Fn level of the KKS hierarchy). The *Contractor* provides a complete system-level PBS with the submission of the process flow diagrams (240-60782552)[23] of the plant within the *Contractor*'s scope.

KKS coding identification system shall be allocated according to their function, type, location in relation to the KKS Key Parts definitions and the VGB guideline. As a minimum, all plants shall be coded as follows:

a. According to process functions: All plant shall be coded to KKS Breakdown Level 3.

b. According to points of installations: Electrical and Instrumentation devices installation units (e.g. cabinets, panels, consoles) shall be coded to KKS Breakdown Level 3.

c. Location codes: Plant structures shall be coded to KKS Breakdown Level 2.

d. Cables coding: Cables shall be coded with either source or destination equipment KKS code followed by sequential four-digit number and optional four alpha numeric characters.

The *Contractor* shall indicate equipment and component codification in drawings and documents indicating or referencing such plant.

The *Contractor* shall submit all KKS codes designated by the *Contractor* in an Equipment List format with equipment descriptions, with the documents in which they were originally designated, to the *Employer* for review. Any description abbreviations shall be done according to the Medupi Power Station Project - List of Abbreviations (200-5343 / 348-885912). The *Contractor* will remain responsible for ensuring that the codes designated are unique, not duplicated and meet the requirements established by the various standards applicable to the project. Where any ambiguities or doubts with regards to KKS codification exist, the *Contractor* will engage the *Employer* for resolution.

3.7.2.2 Plant Labelling

The *Contractor* shall manufacture and install labels according to the Medupi KKS Coding and Labelling standard, 200-3340.

Any abbreviations to plant descriptions shall be prepared in accordance with the Medupi Power Station Project - List of Abbreviations, 200-5343 (348-885912).

Detailed name plate or label lists with the service legends and including the KKS Code shall be prepared by the *Contractor* and submitted to the *Employer* for review and comment before commencing the manufacture of the labels. On plant areas where labels do not make ergonomically sense please consult site configuration management for guidance.

3.7.2.3 Plant Designation within Documentation

The *Contractor* shall prepare a list of KKS designations allocated to components for each scope of delivery or system (this list will be referred to as equipment list in the rest of this document for simplicity's sake, but includes documents such as cable schedules, valve schedules, etc.). The equipment list shall be submitted with the original implementation documentation describing the design of the system (e.g. process and instrumentation diagram, single line diagram, etc.). The *Contractor* shall ensure that the equipment list

accurately represents the implementation documentation which it accompanies. The content of the lists will be agreed to per discipline with the *Employer*. As a minimum, the equipment list shall include:

a. The KKS designation of all components within the relevant scope of work or system.

b. The full verbal description of each component, compiled according to the standards referenced in this document.

c. The abbreviated description of each component, utilising abbreviations as listed in the referenced project abbreviation list and abbreviated to several characters as required by the project digital control system (DCS) and as per the label requirements in, 200-3340 (348-630398).

d. The approval status of each component, in alignment with the list of approval statuses specified for document.

Table 1: Configuration Management Codes and Standards

Code	Description
240-58552870	Smart Plant for Owner Operators (SPO) Documentation Metadata Standard
200-3340 (348-630398) 240-93576498 200-5343 (348-885912) 200-94660 (348-80410)	Medupi KKS Coding and Labelling Standard KKS Coding Standard Medupi Power Station Project-List of Abbreviations KKS Plant Codification Standard
240-53114186	Project/Plant Specific Technical Document and Records Management Procedure
VGB-S-811-01-2018-01-EN	VGB Standard KKS Identification System for Power Stations

3.8 ENGINEERING CHANGE MANAGEMENT

All Design change management shall be performed in accordance with the latest revision of the Eskom Project Engineering Change Management Procedure (240-53114026).

3.9 RELIABILITY, AVAILABILITY AND MAINTAINABILITY

Nitrogen Plant shall be designed and configured such that the availability of plant systems over its life in percentage of time is 99.99% or greater. This plant should be designed and constructed in any which way that allows for redundancy to improve maintenance of the plants as well as produce concentration levels of above 95 %. The *Contractor* shall perform RAM (Reliability, Availability and Maintainability) studies on all major areas of Plant forming part of the *works*. These studies shall be done in accordance with the requirements as laid down in the Eskom System Reliability, Availability and Maintainability Analysis Guideline: 240-52844017. The objectives of these studies are to achieve the following:

- Predicting the Availability, Reliability and Throughput of each subsystem
- Predicting the Availability, Reliability and Throughput of the complete System
- Performing redundancy studies on the systems
- Using the above studies to optimise the system spares holding

- Essential to the above process is the construction of an ABD (Availability Block Diagram) of the system and shall form part of the RAM study. The ABD shall show the interconnections between equipment for each of the subsystems making up the plant. All redundancies must also be shown.

The *Contractor* shall supply the following:

- RAM Report as per the objectives listed above. The report must include all the models, model results, programming logic flow-charts, plant design down to equipment level.
- A presentation of the results.
- All RAM documentation including all assumptions, as well as the operating and maintenance philosophy for the complete system in the *works*.
- The *Contractor* shall provide the definition of what constitute plant availability in the software models.
- The *Contractor* shall present the RAM models and documentation, in draft format for comment, to the *Employer* two weeks prior to compiling the final RAM assessment and package.
- Detailed RAM models and programming logic flow-charts.
- Process description of the system and subsystems.
- Availability, Reliability and Throughput and Sensitivity analysis of the system and the subsystems derived from the model output.
- ABD's (Availability Block Diagrams) of the complete system and subsystems in the *works*, in order to achieve the objectives described above. Each ABD shall show the interconnections between the equipment of the systems and subsystems concerned.
- Derive an Optimised Maintenance philosophy for the systems and equipment. Ageing of equipment must be considered. The "probabilistic ageing" feature of the *Contractor*'s simulation model will be used and the process taken to arrive at the optimised maintenance philosophy must also be shown

  - The complete ABD model's software logic (All the simulation software Input files, Bubble logic files and Output files) – i.e. the actual ABD simulation latest version software models. The ABD models and software logic provided by the *Contractor*, as part of the *works*, must be supplied in their entirety and is sufficient in it for the *Employer* to replicate or re-create all the ABD calculations and models using the *Employer*'s latest version software of choice.
  - MTTF (Mean Time to Failure) for each type of equipment provided as part of the *works* and the type of failure distribution i.e. Exponential or Weibull.
  - MTTR (Mean Time to Repair) or MDT (Mean Down Time) for each type of equipment provided as part of the *works*.
  - Optimised spares holding for the complete system using the *Contractor*'s simulation software Optimizer tool to optimise the system spares holding.

3.9.1 Maintainability Analysis

The maintainability of the *works* shall conform to the following requirements:

- The maintenance of the systems is possible within the existing maintenance structures.
- The *works* are designed with due regard to the need for safe and easy access, monitoring, inspection, frequent cleaning and repair.
- All inspection and maintenance access in the form of ladders / platforms are provided with due regard to safety of personnel, and in accordance with applicable safety standards (OHS Act No. 85 of 1993).

Maintenance and access diagrams indicating primary maintenance activities and methodologies shall be submitted. Maintainability reviews shall be performed during the 3D model reviews stage.

3.10 TECHNICAL RISK ASSESSMENTS

3.10.1 HAZOP (hazard and operability) studies

The *Contractor* shall carry out formal Hazard and Operability (HAZOP) Studies. These studies shall be done in accordance with the requirements as laid down in the Eskom HAZOP Guideline: 240-49230111.

3.10.2 FMECA (failure mode effects and criticality analysis)

The *Contractor* shall carry out formal Failure Mode Effects and Criticality Analysis (FMECA). These studies shall be done in accordance with the requirements as laid down in the Eskom FMECA Guideline: 240-49230046.

3.10.3 HAZLOC

The *Contractor* shall carry out formal HAZLOC Study according to the following Standard: 240-56536505. It is the *Contractor*'s responsibility to ensure that all electrical and instrumentation equipment on the Hydrogen plant and Nitrogen plant comply with relevant hazardous locations South African National Standards referred to on 240-56536505.

The standard, SANS 10108, "The classification of hazardous locations and the selection of electrical apparatus for use in such locations" shall be used for classifying hazardous locations and selecting electrical equipment for use in such locations.

The *Contractor* shall supply and install any resulting signage identified necessary through the HAZLOC study.

4 ENGINEERING AND THE CONTRACTOR'S DESIGN

4.1 EXISTING DESIGN AND CONSTRUCTION DONE BY OTHERS

Nitrogen is processed from atmospheric air under pressure, which is produced by compressors, water removed by dryers and stored in a fixed volume tank (air receivers). Atmospheric air consists of 78% Nitrogen and 21% oxygen. Nitrogen gas production is purifying the nitrogen in the compressed air by passing the air through a nitrogen generating unit and the unit adsorbs the oxygen and hydrocarbons hence producing to the required purified nitrogen by the unit (240-110414644: Nitrogen Systems Standard).

The site-specific design has been determined in terms of what the site-specific requirements should be in terms of sizing nitrogen generating units and high pressure vessels (bulk storage nitrogen receivers) for storing the nitrogen to accommodate maximum demands for short durations.

The nitrogen plant has been designed and partly constructed by Others. The Contractor shall review the existing design and partially constructed works to verify and fully accepted design and take accountability.

4.1.1 Review of the existing design for the nitrogen plant and associated works

The *works* includes the verification of the existing design of the mechanical, electrical, C&I, civil and structural work for the Nitrogen Generating Plant. Employer is to share these documentations.

The *Contractor* shall be responsible for the review, evaluation, design, updating and acceptance of existing design documents. The *Contractor* shall confirm that its review, evaluation, design, update and acceptance of the existing design assures that the design is in full compliance with the Nitrogen System Standard (240-110414644). The existing design documentation are referenced in Appendix E. Any updates and changes to the design documents shall be submitted to *Project Manager* for acceptance.

The *Contractor* corrects the following deficiencies/defects in the existing design

- Incomplete Databooks for pressure vessels and
- Incorrect nameplates for the high-pressure vessels
- Lack of datasheet for some equipment
- Missing control valves for feeding the high-pressure vessels and main supply line to WTP and Units

The following deficiencies/defects in the existing design, identified by the Employer are acceptable:

- Proposed Process Flow and P&IDs by previous Contractor
- Missing control valves for feeding the high-pressure vessels and main supply line to WTP and Units

4.1.2 Assessment of the portion *works* already constructed by Others

The *Contractor* shall inspect the works already completed by others and associated Databooks to determine and notify Eskom of any additional design modifications, construction works, testing and any other additional work and documents that the *Contractor* deems reasonably required beyond those already specified in this scope of work to allow for professional certification of the civil, structural, mechanical, electrical and C&I works.

The *Contractor* shall do an inspection of as built piping and supports from road 40 to WTP and U6-U4 to confirm outstanding works in line with the existing design documents and existing data books.

The *Employer* shall free-issue the following Plant and Material to the *Contractor* to be used as part of the engineering and design works, and the contractor is to service this equipment:

a. 3 off Atlas Copco ZT160 Compressors
b. 3 off Atlas Copco DDP850 air filters
c. 3 off Atlas Copco FD870 air dryers
d. 3 off Atlas Copco NGP 250 nitrogen generating plants
e. 3 off Hycomp AN44F booster compressors
f. 3 off ILVA 3 m3 air receivers
g. 3 off ILVA 3 m3 nitrogen receivers
h. 2 off ILVA 118 m3 bulk storage nitrogen receiver (Contractor to supply and install pressure equipment markings(tags) as per OHSA 85 of 1993)
i. Sheeting
j. Piping

The free-issued Plant and Material has not been preserved. The use of free issue Plant and Material for the scope is subject to fit for purpose assessment by the *Contractor* and acceptance by the *Employer* before the design freeze milestone.

Review, evaluation, update and acceptance of existing mechanical data books as compliant to all applicable Eskom requirements, engineering standards and regulations (all the equipment on site are to be test and refurbished, to make the necessary required documentation. Any required testing necessary for acceptance of data books shall be communicated to Eskom for acceptance. All tests shall be conducted in line with applicable Medupi specifications.

4.2 HYDROGEN PLANT

4.2.1 System description and parameters

The Hydrogen generating plant is designed to produce 15 Nm 3/hr at a minimum pressure of 2.7MPa with no additional compression, connecting the plant with four hydrogen storage vessels (supplied by Others) with each having a storage capacity of 24 m3 with the minimum design pressure of 2.7MPa shall be provided to store Hydrogen. The works must comply with the Eskom's Hydrogen Systems Standard (240-56227413). The hydrogen plant is designed and constructed by Others.

4.2.2 Scope of work

The Contractor design and constructs the following for the sections of the hydrogen plant:

- Fire detection and protection system for the bulk storage vessels – designed, constructed, certified, supplied, installed and Commissioned by the Contractor. TP-04-03-03.
- Explosion proof/blast proof walls around the Hydrogen Bulk Storage Tanks–designed supplied, installed by the Contractor
- Concrete works and support infrastructure (including but not limited to plinths and trenches) for the H2 Bulk Storage vessels (with suitable bulk storage loading area, covered sheltered/canopy infrastructure at point of bulk tank loading, drainage and other supportive services)– designed, constructed and certified by the Contractor
- Reinforced concrete foundation slab and supportive concrete pipe plinths and trenches works for the Hydrogen Generating Container and interconnecting pipework to the Bulk Storage vessels) – designed, constructed and certified by the Contractor
- General concrete and steel supporting infrastructure (supports, plinths, apron slab) – design, construction, and construct for Hydrogen piping and cable racking (Design of location by others)
- Steel structure (sheltered/canopy) over the Hydrogen Generating Container – designed, constructed, and certified by the Contractor.
- All other needed civil, structural, architectural, geotechnical. civil services and surveying works - designed and constructed, certified commissioned/tested from the use of other interfacing Contractor designs as well as from the Hydrogen Generating Container to other areas of plant.
- Earth Mat connection point - tie in and connection point for (others – At Hydrogen generating container and Bulk storage vessels, bulk offloading and metering panels)
- 400 Volt design, supply and provide tie in point and commission/test from switchgear to Load (Container)
- Small Power and Lighting design, supply and provide tie in point and commission/test from DB to Load (Container)
- Demin or Raw Water design, supply and provide tie in point commission/test from TP-04-20-120 to (Container)
- Safety Shower and associated civil services and finishes - designed, constructed, supplied, installed and provide tie in point with relevant existing Medupi civil services line based on effluent

being washed off as well as_commission/test from Contractors designed connection point with existing relevant Medupi site drainage line (TP to be confirmed)-to (Container).

- Potable Water design, supply and provide tie in point commission/test from TP-04-20-210 to (Container)
- Instrument air design, supply and provide tie in point commission/test from TP-04-20-001 to (Container)
- CBMS design and supply, install, commission and integrate into plant CBMS.

4.3 NITROGEN PLANT

4.3.1 System description

The system consists of three identical Nitrogen generating units (compressor, dryer, receiver, compressor and booster in a train format), all relevant valves and a pipeline connecting the supply manifold to the plant as indicated in P&ID 0.84/46781. The normal supply of Nitrogen gas is from one or two Nitrogen generating units while the other unit serves as a back-up should either unit/s fail. The Nitrogen generating units are located under a shelter to protect the units against rain. The Nitrogen generating plant is situated in a designated area of the Nitrogen complex as indicated on drawing 0.84/65535.

Safe plant operation shall be always ensured by the on-line monitoring of all critical parameters and automatic control of the nitrogen system. The nitrogen gas shall be supplied to the relevant tanks (High Pressure Vessels) through a piping system and then be routed from the plant into the 132kV trench to the Z-trench. It splits into two branches, one to the Demineralised Storage tanks and the other one to the CRT's in the Turbine hall of each unit as indicated on drawing 0.84/65536.

4.3.2 Design Parameters

The three Nitrogen generating units have been designed to produce a flow of 240 Nm^3/hr with a purity 95%. The *Contractor* analyses the system for the following two scenarios and optimises the period for which these scenarios can be maintained.

Scenario 1:

- DWST and PDFT maximum demand = 2091 Nm^3/h
- With Two nitrogen generating plants in operation.

Scenario 2:

- DWST and PDFT demand = 118.17 Nm^3/h;
- CRT maximum demand to Unit 1 and 2 = 772 Nm3/h (386 Nm^3/h per unit),
- CRT make-up for Units 3 to 6 = 80 Nm^3/h (20 Nm^3/h per unit);
- With two nitrogen generating plants in operation.

The two scenarios will not happen simultaneously. A supply pressure of 800 kPa shall be maintained at the terminal point to the Demineralised water storage tanks (DWS) while the terminal points to the

Condensate reserve tanks (CRT) shall be maintained at 350 kPa. There may be periods of no demands due to the fluctuating demand patterns. It is crucial consider the following be considered when designing system:

- Fail-safe — ability to sustain a failure without causing loss of equipment, injury to personnel, or loss of operating time.
- Maximum allowable working pressure (MAWP) — maximum gauge pressure permissible in a storage vessel (at its top) or piping system for a designated temperature
- The MAWP is the basis for the pressure setting of the pressure-relief devices protecting the vessel or piping system.

Normal temperature and pressure (NTP) (For calibration purposes)

The *Contractor* will comply with the *Employer*'s interfacing data sheets that are listed in Appendix D. The mechanical and electrical equipment of the plant to be designed and procured by the *Contractor* shall operate effectively for 35 years. All civil works should be designed for 50 years which is the expected operational life of Medupi Power station.

4.3.3 Operating concept

The nitrogen supply plant shall be automated with initial start/stop activated on the local control station which is connected to the *Contractor*'s PLC as per LOSS diagrams. There shall be a full *Contractor*'s PLC to *Employer*'s DCS interface providing complete feedback of plant status and monitoring as per IO function blocks. The plant to be equipped with monitoring devices to help maintain gas purity, vessel pressure, and valve operations which will be highlighted in the following format;

NITROGEN USER LIST

A nitrogen user list shall be developed to list all users of nitrogen in terms of the key nitrogen parameters;

- Pressure in kPa(g) (minimum, maximum, normal operating)
- Nitrogen purity
- PDP Temperature (minimum, maximum, normal operating)
- Flow in m3/min FAD (minimum, maximum, normal operating, continuous or cycle rates)
- Maximum flow condition in m3/min FAD describing when the user will require maximum nitrogen flow

4.3.4 Scope of Work

The *Contractor* is responsible for the evaluation, engineering, manufacture, supply, shipment to South Africa, transport from ship or local works to Site, unloading from road or rail, transport at site, erection, quality assurance, on and off-Site testing painting, finishing, complete in working order and commissioning of the Nitrogen Generating Plant, together with auxiliary and ancillary plant services and works.

The procurement and installation of the pressure reducing valve stations on as built piping to WTP and U6-U4 shall be in the *Contractor*'s scope.

The *Contractor* shall be responsible for procurement of material, delivery of material to Medupi Site, storage and Installation of piping, supports and associated valves and pressure reducing valve stations on U3-U1 and supports and piping installation under Road 40 crossing to the nitrogen receivers at H2 complex including interconnecting piping inside the shelter.

The *Contractor* shall be responsible for positioning and installation of equipment (Compressors, dryers, generating plant etc.) including interconnecting piping inside the shelter.

The installation, pressure testing and commissioning of vessels shall be the *Contractor'*s responsibility.

The *Contractor shall* install, pressure test and commission all vessels for the functionality of these plants.

On and off-site testing (including pressure testing) of all mechanical equipment and piping in compliance to PER shall be the *Contractor'*s responsibility.

The *Contractor* shall provide Professional Certification of the *works*, signed by ECSA registered competent engineer in line with the National Building Regulations (Act no. 103 of 1977), ECSA, OHS Act No. 85 of 1993 and Eskom requirements using Eskom approved templates before safety clearance. The *Contractor*'s registered professionals shall provide services in accordance with ECSA Code of Conduct (Act No. 46 of 2000) and guidelines for registered professionals as well as the Construction Regulations (Act no. 85 of 1993).

The reviewed, evaluated and updated design documents shall be signed by a competent ECSA registered engineer.

The *Contractor* shall compile integrated design reports for each of the mechanical, civil, electrical and C&I designs. These integrated design reports shall be signed by a competent ECSA registered engineer.

4.4 INTEGRATED WORKS

The *Contractor* to design and construct an integrated area with all required services around the Hydrogen and Nitrogen plants, complete with the following:

4.4.1 Road access, loading bay and internal roads

a. The roadways and access to plant shall be assessed and comply with the operating philosophy of the plant as well as be designed in a manner that integrates all new and existing works/other services. The *Contractor* is encouraged to consider the Eskom Arrangement design department's conceptual layout 084/65535 to assist in further developing the final design. Note: Civil and Structural design, construction and certification requirements are specified later in specific section of this document. The following shall be considered as a minimum:

   i. Road 40 shall be redesigned, reconstructed and integrated with the any newly designed and constructed internal plant road/s.

   ii. Internal road/s shall be designed for this plant to ensure optimal movement (preferably one way with sufficient turning radius) within the plant during operations and maintenance as well as loading and unloading of deliveries.

   iii. Road designs shall consider the use of legacy ash from Medupi; however, this can be discussed further with the Employer during the design phase of the project.

iv. Relevant detailed design calculations and swept analysis shall be included in the design reports, with all separate 3D models, surveys and drawings and topographical layouts provided at appropriate project phases.

4.4.2 Road crossings, supportive structures, plinths, trenches for pipes, sleeves and cable servitudes

a. The *Contractor* shall design, construct, and certify all supportive infrastructure for both plants. Considerations for these works include but is not limited to designing for effective operation and maintenance of both plants, spacing and routing within the new road crossings for all electrical and C&I cables and Hydrogen and Nitrogen piping and other required services. Refer to the 0.84/65535 for proposed road crossing locations to consider.

b. Additionally, all pipe plinth, trenches, cable racks and sleeves designed and constructed either below and above ground all of which must comply with all Electrical, C&I and Civil and structural sections of this document.

c. The *Contractor* ensures these works (including but not limited to road crossings, trenches, supportive structures) are designed to allow for access to perform routine maintenance. The works to be designed with sufficient space to enable replacement of any of the services and pipes being routed through the road crossing. Additionally, the *Contractor* shall consider practical construction measures when carrying out the design and their constructability assessment, this to ensure works can be constructed timeously and safely (i.e. adherence to all necessary clearances of the services being routed).

4.4.3 Surface drainage and interface to Medupi station drains (clean and dirty)

a. The *Contractor* shall design, construct and certify the trenches, manholes, civil services and associated finishes as well as drainage lines based on the effluent and discharge from the Hydrogen and Nitrogen plants, in accordance with civil and structural section of the document.

b. The Contractor shall survey, scan, locate and verify all existing stormwater lines, clean and dirty drainage networks surrounding and on this plant. The clean and dirty drain layout (0.84/198 sheet 5) may be used to assist the *Contractor'*s Designer to provide for the necessary design details, routing and connection into these existing civil services and drainage lines.

c. The *Contractor* shall ensure that the clean and dirty drainage lines are kept separate as per the Medupi safety and environmental specifications and a stormwater management plan is submitted.

d. New stormwater and drainage systems needed shall then be designed and integrated with new and existing roads as well as the other portions of plant. The Contractor also shall verity, test and comply with all specifications and procedures when distinguishing between clean, dirty, process and stormwater lines needed for the design of this plant. Contractor shall submit a stormwater management plan and relevant design assumptions and adherence to Medupi site EMP and relevant water use licence and regulations.

e. All coatings and epoxy products that are chosen by the *Contractor* shall be preferably locally available and applied as per the approved method statements and product specifications.

4.4.4 Safety Fencing

a. The safety fence with lockable gates around both the Hydrogen and Nitrogen plants shall be designed, constructed and certified.

   i. The Hydrogen/Nitrogen shall at minimum be fenced with 2.5mm diamond mesh fence with a height of 1.8m including the lockable gate/s for access control.

   ii. The *Contractor's* designs and details the safety fence to suit the requirements in this section as a minimum or motivate differently to *Project Manager* should there be a need to have a stricter access control for these plants considering their operations in line with HAZOP and constructability assessment performed by the Contractor.

b. The materials (concrete, wire, post and overhang) and other specifics aligned to the above fence selection can be found in 240-100183119.

   i. Section 3.3 contained in 240-100183119 entitled Standard for fences in Eskom transmission substation may be considered by the *Contractor*.

   ii. All entrance and exit points and fence gate/s for the plant shall be lockable to prevent unauthorized access to both plants.

   iii. Civil and Structural design and construction aspects for steel, concrete, geotechnical works and corrosion protection shall comply with the civil and structural section further on in this document.

4.4.5 Access control

a. The fence gates, hatches entrance and all building doors shall design accordingly and fitted with the suitable locking mechanisms and/or accessories that are preferably locally sourced and with full datasheets/specifications.

b. Moreover, the emergency and escape doors and their locking mechanisms shall meet all fire protection requirements as deemed necessary by all SANS standards and Eskom specifications as well as the HAZPO and constructability assessment conducted by the Contractor.

4.4.6 Landscaping

a. The final landscaping shall comply with the Civil section of this document and include time for reviews/collaboration with the Eskom Environmental department and Medupi Generation.

4.4.7 Power supply and Mini-substation

a. The location of the mini-substation for the Hydrogen and Nitrogen plant is provided for on the conceptual layout 084/65535.

b. The electrical cable routing has been indicated. Specific details of the Electrical and C&I installations/works are covered in the respectively. Additionally, the LOSS diagrams for civil, electrical and C&I scopes clarifies scope further.

4.4.8 Sheltered/Canopy structures

a. H2 plant area: The H2 container generating unit shall require the design, construction and certification of a sheltered covering structure
b. H2 plant area: A separate covered area for off-loading bulk Hydrogen into bulk storage vessels may require. All areas that will require sheltered coverings shall be designed, constructed and certified by the Contractor.
c. N2 plant area: The existing N2 works shall be completed and this requires completion of the existing roof and sheltered structure designs, construction and certification.

4.4.9 H2/N2 Plant substation building

a. A separate building/electrical room to house the main electrical distribution board, small power and lighting board, plant distribution board and C&I equipment.
b. This building shall be designed, constructed, certified and commissioned to provide controlled access to the distribution boards, preventing unauthorised access, PPE compliance on this plant, centralise electrical and instrumentation equipment and extend the service life span of the electrical and C&I equipment.
c. All operation and maintenance, routing, racking, corrosion protection and prevention of flooding shall be considered as well as allow for access, installation, removal and maintenance of equipment and components in the building.

4.5 PIPING SYSTEMS

The Nitrogen piping systems should comply with the requirements stated in the Nitrogen System Standard (240-110414644).

4.5.1 Piping

This topic covers the following:

All piping is in accordance with ASME B31.1.

The Contractor provides air release and drainage valves where necessary for filling and drainage of the pipeline as part of the design.

- All piping to be carbon steel, except for 25NB bore tubing which shall be stainless steel.
- It is important that all piping shall slope in the direction of air flow and provided with a drain point.
- Interface with users shall be positioned on the top of the air pipes in order to prevent moisture carry-over and provided with a condensate trap at the bottom (see Section 6.6)
- The piping and fittings for the nitrogen gas supply and distribution shall be designed according to the

- latest version of the OSH Act pressure equipment regulation [16], SANS 347 [25] and the approved
- international standard EN 13480 (All parts) Piping [19] or ASME B31.3 3 Code for pressure piping –Process piping.
- Fittings (elbows, bends, tees and reducers) between 15NB and 50NB are suited for socket welding as far as possible and are in accordance with ASME B16.11, “Forged Fittings, Socked-welded and threaded or BS EN equivalents.
- Fittings of 65NB and larger are suited for butt welding and are in accordance with ASME B16.9, “Factory
- Made Wrought Butt-welded Fittings” or BS EN equivalents.

All other piping system to comply with requirements of the Standard for Low Pressure Pipelines, 240-123801640. Corrosion protection shall be as per the requirements of the Medupi Power Station Corrosion Protection Specification (SSZ_45-17) [43].

Colour coding of piping shall be as per the requirements of the Specification for the Identification of the Contents of Pipelines and Vessels (200-3583, 348-912995) [57]. As well as piping to be refurbished.

The specifics of pipe systems, routing and their support structures at each of the Units (Turbine Hall area) shall also be catered for in the final design by the *Contractor*'s Designer, all of which shall be submitted as part of the integrated arrangement design.

Contractor must include the high-level summary of existing pipe works below:

1. The works N2 piping is in place from N2 plant terminal point up to WTP Demin water storage tanks terminal point and unit 4, is completed.
2. The Outstanding works on WTP interface is to be completed.
3. The works on existing N2 piping at unit 6 &5 have been completed.
4. The Outstanding works on existing N2 piping at unit 4 is to be completed eg painting.
5. The Outstanding works on N2 piping at unit 3 is to be completed.
6. The Outstanding works on N2 piping to unit 1 and 2 is to be completed.
7. The works on the Termination points for unit 3-1 are ready.
8. The Outstanding works on for N2 piping construction on units’ tie-in points to be completed.
9. The Outstanding works on the Pressure reducing valve stations on all units is to be completed.
10. All piping to be inspected, tested and commissioned for safe operation.

The following requirements are applicable to all piping systems included in this *works*:

4.5.2 Pipe Supports

Pipe support locations shall be shown on all general arrangement and elevation drawings, along with each support mark or reference number. The *Contractor* designs pipe supports with due regard of all applicable

loads and to piping of other systems. The pipe support steelwork shall not be welded or fixed to existing steel structures without prior approval from the *Employer*.

4.5.3 Holding down and Foundation bolts

Holding down and foundation bolts, where required shall be designed and be of materials to secure satisfactorily the plant item in its designed operating position under all operating and environmental conditions.

4.5.4 Bolts, Nuts, Washers, Studs and Threads

All bolts, nuts, washers and studs shall be sized and be of material satisfactory for the maximum and varying operating and environmental conditions. They shall comply with the requirements of SANS 1700, Grade 8.8 and the relevant standards specified therein, unless otherwise specified in these requirements or on approved drawings.

Flat washers shall be used under nuts and bolts. Where nuts or bolt heads are in contact with a rubber or similar surface, a large plate washer shall be placed under the nut and bolt head. Such plate washer shall have sufficient area and be suitable to prevent any damage to the covering. Washers sheared from plate shall be flat, with all edges ground smooth and free of burrs and other protrusions.

4.5.5 Valves

The design, supply and installation of the valves are required to be as per 240-105020315: Standard for Low Pressure Valves.

4.5.6 Welding Requirements

The *Contractor* is responsible for the welding and personnel performing weld related work to be according to 240-106628253 Standards for Welding Requirements on Eskom Plants. Welding *Contractor* should be as a minimum ISO 3834-3 certified as per the Eskom Welding Standard requirement.

All welding documentation will be subject to approval by an Eskom welding engineer, according to current Eskom specification 240-106628253: Standards for Welding Requirements on Eskom Plants.

4.5.7 Non-Destructive Testing (NDT) Requirements

The following requirements are applicable for all testing, where required, (site and workshop):

- NDT is only to be done by an Eskom approved NDT company and program to be provided for the piping works.
- NDT is to be done on all welds and consists of 100% surface testing and 100% volumetric testing and must be indicated as such on the quality control plan (QCP).
- All NDT is in line with requirements as stipulated in 240-83539994 Standard for Non-Destructive Testing (NDT) on Eskom Plant.

4.5.8 Pressure Test Requirements:

The following applies:

1. All pressure tests to be done with water i.e. hydraulic pressure tests.
2. Pressure test procedure must be submitted to and approved by the *Employer* before the pressure test can commence. The pressure test procedure must also be included in the data book.
3. Two pressure gauges are used for the pressure test.
4. All Pressure gauges must have valid calibration certificates done by a South African National Accreditation System (SANAS) approved laboratory. The maximum validity of the calibration certificates is 6 months.
5. After the test has been completed a pressure test certificate must be issued which is included in the data book.
6. All pressure tests on site after installation to be witnessed by the *Employer* and the Inspection Authority.
7. All pressure tests shall comply with PER.

4.5.9 Flushing

All system piping shall be flushed prior to commissioning to ensure that there are no blockages or debris in the piping unless an alternative clean erection procedure has been submitted by the *Contractor* and has been approved by the *Employer*.

4.5.10 Pipe Routing

The *Contractor* carries out on-site inspections and walk downs to determine the most efficient pipe routing servitudes. The *Contractor* must submit all pipe routing to the *Employer* for approval before commencing with the detailed design. The *Contractor* must take into consideration any restrictions from the site Environmental Impact Assessment (EIA) when selecting the pipe routing.

4.5.11 Road 40 and all road crossings

a. The *Contractor* designs and constructs suitable road crossings to allow for both the Hydrogen and Nitrogen plant services and piping to cross the redesigned Road 40 and may consider the conceptual layout (084/65535).

4.6 CONTROL AND INSTRUMENTATION REQUIREMENTS

The C&I for the Nitrogen Plant and integrated works must interface with the entire C&I system requirements as detailed below:

1) The *Contractor* shall be responsible for overall design, integration, procurement, delivery to Medupi Site, storage and installation and commissioning of the C&I material and equipment including but not limited to redundant PLCs and rack controllers, HMI/SCADA, Cabling to PLCs, racking and cabling to equipment and field instrumentation (flowmeters and PIT's).

2) The *Contractor* shall supply, install and commission all field instrumentation, e.g. flow measuring devices, etc., as required in the LOSS diagrams. The control and automation functionality, alarm indication, human machine interface, information system, information archive etc. will be engineered and provided in the HMI/SCADA by the *Contractor*.

3) With respect to the Nitrogen plant the *Contractor* shall be responsible for the review, evaluation, update and acceptance of existing C&I design documents in Appendix E as compliant to applicable engineering standards and regulations. Any updates and changes to the design documents shall be submitted to Eskom for review and acceptance.

4) The *Contractor* shall provide control, operation, protection, interlocking and alarm philosophies together with a rationalised alarm list as per the Alarm Management System Guideline (240-56355466). The C&I signals shall be passed from the *Contractor*'s PLCs to the main power station's Distribution and control system (DCS)for monitoring and alarming purposes.

5) The *Contractor* will standardise the PLC model and supplier for the standardization of the control and instrumentation equipment as per currently installed items across the power station. The *Contractor* will also standardise the supplier for the instrumentation, gauges, limit switches and solenoids in order to ensure standardisation as per currently installed items across the power station.

6) It is the responsibility of the *Contractor* to ensure that the plant meets the dynamic and static operation, reliability, availability and safety requirements. The *Contractor* will implement the HMI in the *Employer's* HMI system located in the Outside Plant Control Room.

7) The Contractor shall ensure that all equipment provided is suitable for the environment where it is to be located, all instrumentation and C&I equipment shall have a minimum IP rating as stipulated in the standards listed in section 4.4.2. The Contractor's Junction Box location shall be outside the hazardous zone location. The Contractor will interface to the Employer's DCS in the Substation South (SSB) C&I equipment room. A Local Control Station shall be provided at the N2 plant, connected to the Employer's existing BOP DCS.

8) The design of the control and instrumentation systems shall ensure standardisation for simplified operation and maintenance and reduce lifecycle management costs. The system shall employ a uniform approach across all plant areas with respect to control system platform, equipment selection design philosophy, basic functional characteristics, system interfaces, documentation, standard function blocks and engineering tools.

9) It is the *Employer*'s philosophy not to utilise binary transmitters and switches, but analogue transmitters with software levels unless where binary transmitters and/or level switches are required for statutory requirements or for protection and hardwired interlocking. The *Contractor* shall take this into consideration when developing the operating and control philosophies and motivate the use of binary transmitters and switches in the Instrument Schedule's "Remarks/Motivations" column.

10) The *Contractor* shall supply all the relevant flow sheets, measuring point schedules, logic diagrams, logic descriptions and location drawings as per the VDSS and the VGB-R 170c requirements. The flow sheets should provide a schematic layout of either a portion or the whole of a section of the plant showing all measuring points and in-line control elements and should also state what section of the plant is represented and give all the measuring point numbers. Each flow sheet shall be accompanied by a schedule giving the measuring point numbers together with details of the measuring points and the process parameters.

11) The C&I Designers as appointed/designated by the Contractor shall liaise with the Employer during detail clarification to reach the design freeze for the detail design and procurement of the Contractor's control equipment. The Contractor shall ensure that the performance of the Plant is optimised by providing all necessary assistance, test equipment and plant materials. The Contractor shall ensure that all primary devices supplied have the necessary quality and reliability to meet the safety, availability and reliability requirements of the plant and indicate the quality and safety rating and standards required in the Instrument Schedule". The Contractor shall also submit the Alarm List and setting parameters.

12) All inline flow elements required for flow measurements, gauges, indicators and test points for the plant are part of the *works*. All tapping points for measurements, switches, gauges, indicators and test points for the plant are part of the *works*.

13) level measurement and/or switch where differential pressure transducers are used, all low-pressure instrument tapping points and isolation valve connections shall be as stipulated in the standard 240-56355843 - Pressure Measurement Systems Installation Standard.

14) All temperature pockets/wells shall be fitted with a cap and chain and shall comply with the standard 240-56355888 - Temperature Measurement Systems Installation Standard

15) All field equipment shall operate over an ambient temperature range of -10°C to 70°C. Protection hoods and enclosures shall protect those transmitters situated outdoors or in adverse environments. All field instruments shall comply with 240-56355754 - Field Instrument Installation Standard.

16) All transmitters provided by the *Contractor* shall be HART devices.

17) All analogue transmitters shall be provided with built in local indicators. Transmitters with high turn-down ratios, while still conforming to the accuracy/repeatability specification shall be provided. Calibration of all transmitters shall be the responsibility of the *Contractor*. Each transmitter shall have its own tapping point.

18) The *Contractor* shall provide all impulse piping as per the Instrument Piping for Coal Fired Power Plants Standard (240-89147446). Quality assurance documentation for all non-destructive testing conducted shall be submitted to the *Employer* for approval.

19) All pipe work supplied by the *Contractor* shall be inclusive of supports, valves, fittings, condensing chambers for closed vessel level transmitters, transition pieces to primary isolating valves and drains to provide complete impulse and blow-down lines for all instruments. All pipe work designs shall be submitted to the *Employer* for approval prior to installation.

20) The *Contractor* shall provide all temperature transmitters in accordance with the Nitrogen System Standard 240-110414644. The thermocouple compensating cables supplied shall be suitable for the environment.

21) The Contractor shall provide all cable racking, cable trays, and conduits required for the installation of his equipment. All cables provided as part of the Works must be secured with suitable cable glands, straps or clamps on racks, in cubicles and equipment rooms. All cabling shall be in line with 240-56227443 - Requirements for Control and Power Cables for Power Stations.

22) Temperature transmitters shall either use 4 wire Pt 100 RTDs, or 6 mm type K thermocouples, with calibration characteristics that comply with IEC 60751 and IEC 60584 standards. All transmitters provided shall be mounted in suitable transmitter racks, equipment cabinets or field panels.

23) Where transmitters cannot be mounted in transmitter racks, equipment cabinets or field panels, these shall be mounted firmly on stands or brackets as close as possible to tapping point. The location shall allow safe and easy access for maintenance and calibration.

24) Stands and brackets shall be robust. Transmitters shall be located and installed such that vibration, heat, and any other harmful environmental conditions do not affect them. Where necessary transmitter racks shall be fitted with anti-vibration mountings. A circular type or sandwich type of anti-vibration mounting shall be used.

25) All transmitter racks, equipment cabinets and field panels shall be supplied and erected by the *Contractor*. These racks, equipment cabinets and field panels shall be supplied complete with all necessary holding down bolts and equipment to make a complete assembly. The transmitter racks, equipment cabinets and field panels shall be erected on concrete foundations or steel structures and shall include the levelling, lining-up, bolting or welding together, bolting or welding down, and earthing of the racks. Provision shall be made for cable trunking or cable trays where required.

26) The *Contractor* shall submit the final number, location, design, equipment content and layout of the transmitter racks, field panels and equipment cabinets to the *Employer* for approval. All analysers shall have a local display. All analysers shall be configured either through local push buttons on the analysers or remotely. All the engineering tools required for programming and configuring the analysers shall be supplied as part of the works.

27) All analysers shall have the following parameters available for configuration:

- High and low measuring range
- High and low display range
- Engineering units
- Temperature at measurement cell (where applicable)
- Offset adjustment on temperature measurement (where applicable)
- Offset adjustment on measured value

- Indication of measurement device health

28) All analysers shall provide measurements that are repeatable and have no drift for a minimum of 10 years. The output signal of all the analysers shall be load independent direct current 4 to 20 mA signal or by bus interface. The output signal is also a rising linear and falling linear signal.

29) All analysers shall be recalibrated as part of commissioning on site and the calibration gases shall be supplied by the *Contractor*.

30) The enclosures shall provide clear visibility of the local displays of the enclosed analysers. The *Contractor* shall provide junction boxes to meet the *Contractor*'s design requirements. The *Contractor* shall provide stainless steel junction boxes rated as per the Control & Instrumentation Field Enclosures and Cable Termination Standard (240-56355815).

31) All controller cubicles forming part of the *works* shall be of size (0.9m x 1m x 2.2m) and same appearance further they shall conform to the following:

- floor mounted with suitable dust and vermin proofing
- bottom cabling access
- earthing
- front and rear access
- temperature monitoring per cubicle
- Powder coated RAL 7035

32) The *Contractor* shall submit the final location and design details of the junction boxes and controller cubicle to the *Employer* for approval.

33) The scope of field/instrument cabling is defined as being all cabling between the field equipment and first junction box. The scope of trunk cabling is defined as being all cabling between the junction boxes and the control system, and between the switchgear and the control system.

34) The scope of power supply cabling is defined as being all cabling required to power field equipment. The *Contractor* shall provide the design, supply, installation, termination, labelling, testing and commissioning of:

- Bus cabling
- Field/instrument cabling
- The *Contractor* shall provide, the design, testing and commissioning of:
- Power supply cabling
- Trunk cabling

35) All cabling shall be of blue-stripe type i.e. consist of flame-retardant, low-halogen PVC outer sheath. The *Contractor* shall provide management and design expertise for all cabling.

36) The *Contractor* shall take final responsibility for all cabling and associated requirements in accordance with the Contract. The routes for field cabling, trunk cabling, power supply cabling and the racking shall be of a consistent and integrated design. The *Contractor* shall provide the cabling

as per the Standard for the Requirements for Control and Power Cables for Power Stations (240-56227443).

37) The terminal block for the marshalling cabinet and junction box terminations shall comply with the SANS 60947-7-1 and 60947-7-2 standards. The *Contractor* shall use the IPC/WHMA-A-620 standard as a guide in determining the acceptability of cable and wire preparation including lacing and restraining criteria. All cables provided shall be secured with suitable cable glands, straps or clamps on racks, in cubicles switchgear rooms, and equipment rooms. Accurate records shall be kept in Cable Schedules by the *Contractor* for all cabling forming part of the *works*.

38) The *Contractor* shall provide the cable schedules inclusive of origin, target, and size and type specification. The *Contractor* shall provide the termination schedules for all cables forming part of the *works*. The *Employer* requires all actuated valves to be electrical.

39) The *Contractor* shall populate the Drive and Actuator Schedule as per the template 240-61379755 Control & Instrumentation Drive & Actuator Schedule Template provided by the Employer.
If mechanical actuators are supplied, the *Contractor* shall include the provision of the actuation power. The *Employer* may during clarification optimise the non-electrical actuation power sources. The *Contractor* shall provide position transmitters of the two-wire type for the actuators.

40) The design and sizing of actuators shall take into account the duty cycle for the plant operation. Actuators shall be designed and selected such that no overheating occurs under worst-case conditions.

41) All electrically driven modulating actuators provided by the *Contractor* shall have integrated local switchgear and thermal overload protection. For analogue controlled electric actuators, step controllers are preferred.

4.6.1 SUMMARY DESCRIPTION OF C&I WORKS

i. The *Contractor* shall perform engineering, design, procurement, manufacturing, factory acceptance testing, delivery, off-loading at site, storage, installation, testing, commissioning, optimization and as-built documentation for the complete C&I plant and material. The Limit of Supply and Services (LOSS) Diagrams shall be tabulated for all Engineering disciplines.

ii. The *Contractor* shall supply documentation and information as per the C&I VDSS – clarification of the referenced documents in the C&I VDSS can be found in the VDSS.

iii. The *Contractor* shall implement the operating and control of the plant in the *Employer*'s Distributed Control System (DCS).

iv. The Plant shall be operated from the *Employer*'s Outside Plant Control Room with HMI supplied by the *Employer*.

v. The Plant shall also be operated and controlled by C&I equipment supplied by the *Contractor*.

vi. The C&I system forming part of the *works* shall provide all information, alarms, protections, process interlocks, control and local control facilities to enable the operator (located in the Outside Plant Control Room) to execute operating tasks safely, reliably and consistently.

vii. The *Contractor* shall integrate the C&I plant forming part of the *works* to the *Employer*'s C&I plant.

viii. The *Contractor* shall ensure that the C&I plant forming part of the *works* is standardized.

ix. The *Contractor* shall ensure that the C&I plant forming part of the *works* meets the dynamic and static operation, reliability, availability and safety requirements and does not affect adversely the *Employer*'s C&I plant performance.

x. All C&I, protection system and control components supplied as part of the *works*, shall be supported and maintainable for a minimum of 25 years.

xi. The *Contractor* is fully responsible for integrating the operation, monitoring, control and process management of the C&I Works with existing installed C&I plant and material.

xii. The *Contractor* shall be responsible for obtaining all relevant information of plant and material outside their supply where it affects design or plant and material within the *Contractor*'s scope of supply.

xiii. The *Contractor* shall use only proven technology with references accepted by the *Employer* prior to the commencement of the design phase.

xiv. The buildings supplied by the *Contractor* shall have Fire Detection System (FDS), Access Control System (ACS), HVAC and Closed-Circuit Television (CCTV) which all shall be integrated to *Employer's* CBMS by the *Contractor*. The fire protection supplied shall also be interfaced to the CBMS. New buildings shall have an EPPA system that shall be integrated to the existing PA system infrastructure and shall be in accordance with 240-64720986 - Emergency Preparedness Public Address System standard.

4.6.2 STANDARDS

i. The additional standards applicable to the C&I Works are listed in **Error! Reference source not found.**, List of Additional Standards Applicable to C&I Works.

ii. The *Contractor* shall notify the *Employer* of any conflict within this Specification with any referenced standards, specifications or technical guideline.

iii. Substitutions of any standards in Standards shall be approved by the *Employer*.

iv. Additional standards proposed by the *Contractor* shall be submitted for approval by the *Employer*.

Table 2: List of Additional Standards Applicable to C&I Works

Number	Title
559-577223024	Generation Cyber Security Standard for Operational Technology
240-56227443	Requirements for control and power cables for power stations
240-56355466	Alarm Management System Guideline
240-56355535	Process Calibration Equipment Standard
240-56355541	Control system Computer Equipment Habitat Requirement Guideline
240-56355728	Human Machine Interface Design Requirements Standard

Number	Title
240-56355729	Plant Control Modes Guideline
240-56355731	Environmental Conditions for process control equipment
240-56355754	Field Instrument Installation Standard
240-56355815	Junction Boxes and Cable Termination Standard
240-56355843	Pressure Measurement Systems Installation Standard
240-56355888	Temperature Measurement Systems Installation Standard
240-56355910	Management of Plant Software
240-72344727	Control System Architecture
240-129014618	Cyber Security Guidelines
IEC 62381	Automation systems in the process industry - Factory acceptance test (FAT), site acceptance test (SAT), and site integration test (SIT)
240-56355815	Control and Instrumentation Field Enclosures and Cable Termination Standard
240-56355789	Flow Measurement Systems Installation Standard
240-161708025	Generic Public Address System Technical Specification Standard
240-102220945	Specification for Integrated Access Control System (IACS) for Eskom Sites
240-91190304	Specification for CCTV Surveillance With Intruder Detection
240-56737448	Fire Detection and Life Safety Design Standard
240-119638133	Control Systems Design for Redundancy and Diversity Standard
240-89147446	Instrument Piping for Coal Fired Power Plants Standard
559-577223024	Generation Cyber Security Standard for Operational Technology
240-91479924_	Cyber_Security_Configuration_Guide_OT
240-61379718	Control & Instrumentation Instrument Schedule Template
240-61379755	Control & Instrumentation Drive & Actuator Schedule Template
240-72344339	C&I Virtual Signal List for External Signal Exchange Template
240-72350241	C&I Hardwired Signal List for External Signal Exchange Template
240-72350241	Panel Interface List Template
N/A	Alarm Schedule Template

4.6.3 BACKGROUND ON *EMPLOYER*'S CURRENT C&I SYSTEM DESIGN

i. The *Employer*'s control system is based on the Alspa Series 6 Distributed Control System (DCS) supplied by Alstom

ii. The DCS Input-Output Functional Blocks as implemented by the *Employer* are as per IO Function Blocks.

iii. MFC3000 Controllers are used throughout the outside plant

iv. The *Employer*'s DCS cubicles are distributed throughout the outside plant in C&I equipment rooms adjacent to electrical substations.

v. All field equipment is HART-enabled to allow for interfacing with *Employer*'s Asset Management System.

4.6.4 C&I Minimum assessment and Testing Requirement

1. The responsibility of the Factory Acceptance Test (FAT) lies solely with the Contractor to demonstrate compliance with the specification, approved design documentation and product documentation. Factory acceptance testing will be required as per IEC62381 and Nitrogen Systems Standard 240-110414644.

2. The seven days continuously uninterrupted operation FAT test shall be done after installation at site. This topic covers the following in addition to IEC62381:

- Documentation checks
- Design Philosophy Tests
- Application logic checks
- Inventory checks
- Mechanical checks
- System related checks
- HMI related checks

3. The responsibility of the Site Integration Test (SIT) lies solely with the Contractor to demonstrate compliance with the specification. This topic covers the following:

- Verification of FAT with Engineers
- UPS available and stand-by
- 24V battery supply, standby and charges
- High pressure Vessels and metering panel HMI local and at DCS.
- Receiver filling philosophy
- Nitrogen generating plant indication at DCS.

4. The responsibility of the commissioning loops checks as defined by IEC 62382 lie with

- the Contractor. This topic covers the following:
- Take measurement values and compare with the Contractor's own procedures

5. Operational Acceptance Testing (OAT) takes place at the Employer's site after hot commissioning has concluded and the control system is connected to the plant process. During this test the Employer gets the opportunity to witness the functionality

- of the system and ensure that the system is ready for operation in terms of reliability
- and suitability for plant and personnel safety. This topic covers the following:
- Basic Nitrogen generating plant and auxiliaries' operation.
- Receivers, High pressure vessels and metering operation.
- Receivers, High pressure vessels and metering safety operations.
- Plant Alarms
- Verification of Plant redundancy bulk storage and metering panel control.

4.6.5 STANDARDIZATION REQUIREMENTS

i. The *Contractor* shall standardize similar plant components with the rest of the power plant to ensure simplified operation and maintenance, and reduced lifecycle management costs.

ii. The system shall employ a uniform approach across all plant areas as per the rest of the power plant with respect to design philosophy, basic functional characteristics, system interfaces, documentation, standard function blocks and engineering tools.

iii. The requirements of standardization shall be applicable to all C&I plant and material including the PLCs. The *Contractor* shall supply a standardization strategy document for the *Employer*'s approval during concept engineering design phase.

4.6.6 C&I SYSTEM PERFORMANCE REQUIREMENTS

i. The availability of the complete C&I system (including interfaces to DCS) consisting of the individual sub-systems over its life in percentage of time shall be 99,99% or greater. The availability shall include for all software updates and upgrades, and planned and unplanned maintenance, but exclude hardware upgrades. This would require an emphasis on on-line maintenance of all C&I system components.

ii. The availability of the complete protection systems over its life in percentage of time shall be 99,999% or greater. The availability shall include for all software updates and upgrades, and planned and unplanned maintenance, but exclude hardware upgrades. This would require an emphasis on on-line maintenance of all protection system components, without putting the plant at risk.

iii. Field devices availability shall as a minimum match that of the C&I system forming part of the *works* so that it does not constitute a weak link. This will require an emphasis on matching the MTTF and MTTR of the field device with that of the overall C&I system forming part of the *works*, on-line maintenance of field device, functional distribution of equipment, and matching of redundancy philosophies with mechanical and electrical systems.

iv. All field instrumentation shall have a minimum MTTF of 100 years.

v. All transmitters shall have a minimum long-term stability of 0.15% drift in 6 years.

4.6.7 ENVIRONMENTAL CONSIDERATIONS

The *Contractor* shall guarantee the maximum sound power level (in watts) of each item of plant shall not exceed a noise level (sound pressure level) of 85 dB (A) according to SANS 10083, at a distance of 3m from any such item in its permanent location site. This guarantee applies to normal site operating conditions with the item fitted with standard silencing equipment. For items of the *works* that operate periodically, the guarantee applies to the time when they are operating.

4.6.8 C&I PLANT AND MATERIAL ENVIRONMENTAL AND HAZARDOUS LOCATION PROTECTION REQUIREMENTS

i. The *Contractor* shall provide equipment protection ratings and certificates for the *Employer*'s approval.

ii. Field equipment and devices shall comply with the standard 240-56355754 - Field Instrument Installation Standard

iii. The equipment supplied by the *Contractor* shall be immune to electromagnetic interference according to internationally accepted EMC standards for power plant.

4.6.9 DOCUMENTS AND INFORMATION EXCHANGE

i. The *Contractor* shall supply all necessary documents or information to ensure proper design, operation and maintenance of the plant.

ii. The *Contractor* shall supply documentation and information as per the C&I VDSS (Appendix I) and templates provided. Also, a C&I documentation description document (Appendix I) that clarifies the C&I documentation requirements is provided.

- 240-61379718: Instrument Schedule Template
- 240-61379755: Drive and Actuator Schedule Template
- 240-72344339: Virtual Signal List Template
- 240-76394151: Cold Commissioning Report Template
- IO Block Template

4.6.10 DCS ENGINEERING REQUIREMENTS

i. The *Contractor* shall be responsible for the DCS software development phase through to commissioning phase to assure proper interfacing and implementation of the control and operating philosophy of the plant forming part of the *works* in the DCS.

ii. The *Contractor* shall verify and approve the DCS interfacing and implementation of the *works*' operating and control philosophy as detailed in documents provided by the *Contractor* as per C&I VDSS.

4.6.11 CONTROL SYSTEM DETAILED REQUIREMENTS

i. The *Contractor*'s control system shall be incorporated in the Balance of Plant control system. It is the *Contractor*'s responsibility to develop a system architecture for the C&I Works.

ii. The control system should be structured such that the whole system forming part of the *works* can be operated and controlled independent from the DCS.

iii. The Contractor shall design, supply and install new equipment rooms or enclosures for all the control equipment and cubicles which meet the requirements and the conditions of the environment it is located in to ensure that the system meets the operating life expectancy of the plant.

iv. Where integrated field localized equipment is required, the equipment and its enclosures shall meet the requirements and the conditions of the environment it is located in to ensure that the system meets the operating life expectancy of the plant. The minimum requirements shall be as per enclosures prescribed but not limited by Eskom Standard – 240-56355815.

v. All cubicles forming part of the *works* shall be provided as follows:

- floor mounted with suitable dust and vermin proofing
- bottom cabling access
- earthing (as per applicable Eskom Standards)
- front and rear access
- remote temperature monitoring per cubicle
- Powder coated RAL 7035

vi. The PLC shall be protected against lightning and power surges.

vii. The *Contractor* shall provide all the operator data, alarms, event related signals and measurements to DCS from the PLC for operating, monitoring, trending and archiving purposes.

viii. This data described above shall be sent to the DCS via the fibre optic link using a suitable open communication protocol – standardization of interfaces (protocol) shall be as per the standardization requirements.

ix. The various plant areas of the *works* shall be controlled from a number of independent PLCs functionally distributed and connected to the master PLC interfaced to the DCS. The functional distribution of the PLCs shall need to be approved by the *Employer* before detail design phase.

x. The master PLC shall have a panel mounted HMI with all the necessary mimics.

xi. Where power supplies are required to a PLC or cubicle, they shall be redundant and hot exchangeable.

xii. All control signals shall be hardwired from the field to the controller.

xiii. The PLC and DCS interface is as per IO Function Block Diagrams and LOSS Diagrams.

xiv. All PLC inputs and outputs shall be made available to the *Employer*'s DCS via the provided interface with time delays as approved by the *Employer*.

xv. Master copies of all final PLC programs (which include all relevant comments and symbols) are supplied to the *Employer* as per C&I VDSS.

xvi. The *Contractor* shall supply redundant CPU and redundant communication cards per PLC control system to allow for hot swap-over in the event that the primary CPU or Comms module fail.

xvii. The control system communication network shall be dual redundant in all instances. The transfer to the back-up communications channel shall be bump-less, seamless and without operator intervention and without disrupting the system operation.

xviii. Fibre optic technology shall be provided for the inter-connection between all systems not located in the same room.

xix. Redundant buses shall be run in different physical routes.

xx. I/O shall be functionally distributed to IO racks such that the failure impact of rack failure on plant availability is minimized.

xxi. The I/O modules shall be hot swappable.

xxii. The integrity of all Binary input signals from field devices shall be checked and system shall have capability to detect wire break. All field contacts shall be interrogated using 24 V DC.

xxiii. All analogue and digital signals shall be continuously monitored for validity, whether used for operator information, control, protection, interlocking, calculations or plant history. Data validation shall include:

- signals monitored for wire break (change over contacts),
- out-of-range values,
- same measurement discrepancies
- abnormal rate-of-change,
- contact bounce,
- invalid process operating ranges
- power supply failure,
- card removal,
- out-of-scan,
- simulated inputs,
- short circuit,
- pole disagreement (changeover binary contacts).

xxiv. The *Contractor* shall provide galvanic isolation between the source of the signal and the controller or at interfaces to other C&I systems.

xxv. Time synchronization shall be achieved via GPS. The GPS signal is supplied by plant DCS via the following protocol: NTP. The PLC control system supplied shall support these protocols and shall be interfaced to the plant DCS for GPS time sync.

xxvi. The *Contractor* shall supply 1 portable programming unit for engineering and configuration purposes installed with all the necessary software and tools for the PLC control system and HMI engineering.

xxvii. The *Contractor* shall supply the *Employer* with software and hardware licenses and original software packages with provision for upgrades. The licensing shall be unlimited licenses and shall not require installation codes after initial installation.

xxviii. A user shall be requested to enter a username and password, before being able to access the configuration and diagnostic software. Recording of users logging into the system shall be incorporated.

xxix. Full security of data, safety and integrity of all control functions and data shall be guaranteed. The system shall be fully protected from the possibility of data corruption, external changes and computer viruses and software corruption.

xxx. The *Contractor*'s design shall provide for later expansion of the PLC control and instrumentation system such that future changes and enhancements can be readily incorporated. The spare capacity shall be demonstrated to the *Employer* at design freeze. At design freeze, the *Contractor* shall provide for the following without the necessity for reconfiguring the design:

- 10% spare installed I/O of each type in the control and instrumentation system cubicles spatially distributed throughout the cubicle throughout the I/O modules.
- 20% reserve physical space in all cubicle racks (I/O, signal conditioning etc.), field panels, marshalling racks and cable racks.
- 10% spare installed terminals per cubicle.
- 20% spare installed capacity in all multi-core cables (rounded up)
- 20% reserve power availability at full load use per area.

xxxi. The *Contractor* shall provide for the following at Completion without reconfiguring the design:

- The utilisation of all CPUs shall not exceed 45% loading during normal operation
- The *Contractor* must cater for full expandability range for bus loading
- 30% spare memory capacity for software expansions

xxxii. The *Contractor* shall provide a report on the control and instrumentation system expandability confirming each of the above parameters as tested by the *Contractor* before Completion in the form of an Expandability Report document.

4.6.12 FIELD DEVICES DETAILED REQUIREMENTS

i. The minimum requirements for enclosures shall be as per enclosures prescribed but not limited by Eskom Standard – 240-56355815.

4.6.13 ERECTION AND COMMISSIONING REQUIREMENTS

i. The *Contractor* shall ensure that the performance of the control and instrumentation equipment is optimised and shall provide all necessary assistance and test equipment to the *Employer*.

4.6.14 Fire Detection, Access Control, Closed Circuit Television and CBMS

The fire detection complies to the *Employer's* Fire Detection and Life Safety Design Standard (240-56737448) with reference to SANS 10139 and 10400– T (specifically Table 10).

The current fire detection system is based on the Honeywell XLS series.

For standardization purposes, the CCTV, Fire detection and Access control system shall be in line with the currently installed systems and shall be integrated to the existing CBMS.

Refer to Appendix J for the interfacing systems documentation.

4.6.15 Cyber Security

All components and interfaces to and from the system shall be in accordance with Eskom's Cyber security standards. (559-577223024 Generation Cyber Security Standard for Operational Technology and 240-91479924 Cyber_Security_Configuration_Guide_OT). Full security of data, safety and integrity of all control functions and data shall be guaranteed. The system shall be fully protected from the possibility of data corruption, external changes and computer viruses and software corruption. A user shall be requested to enter a username and password, before being able to access the configuration and diagnostic software. Logging of users using the system shall be incorporated.
Backup and restore of the system shall be possible. The Contractor shall provide detailed backup and disaster recovery procedures of the system. The backups shall be provided by the Contractor via removable external hard drives.

4.7 ELECTRICAL REQUIREMENTS

The *Contractor* is responsible for the following:

- With respect to the Nitrogen plant the *Contractor* shall be responsible for the review, evaluation, update and acceptance of existing Electrical design documents in Appendix E and Appendix G ,as compliant to applicable Eskom specifications and standards, engineering standards and regulations. This scope includes all the electrical design works for the plant; this being the small power and lighting, earth mat for the plant, earthing of equipment and lightning protection for all the equipment including vessels. Any updates and changes to the design documents shall be submitted to Eskom for review and acceptance.
- Cabling requirements: Power cabling includes incoming power cable from the Mini substation supplying the Switchgear and further includes power cables from Electrical Distribution Panels feeding respective Nitrogen and Hydrogen plants. The incoming power Cable from the 11kV/400 Mini sub-LV switchgear will be the responsibility of the Contractor. The Contractor is also

responsible for designs, supplying, pulling and termination of any secondary cabling, therefore all interfacing cabling to all the equipment's including PLC loads.

- The 1MVA MV/LV mini sub has outgoing circuits rated between 250A and 400A, it is the contractor's responsibility to upgrade the outgoing Circuit breaker to meet the switchgear s demands.
- The Plant as a whole shall be designed using a system approach to ensure satisfactory matching and performance of all its systems, sub-systems and components. Unless otherwise specified, all electrical equipment necessary for the safe and efficient working of this plant shall be provided by the *Contractor* in terms of this Specification and the requirements as specified in relevant standards. This includes all electrical and auxiliary equipment as is necessary for the proper operation of the plant.
- Site installation, interfacing and commissioning activities.
- Submission of the Electrical Plant Operating Philosophy to enable integration of the plant forming part of the *works* into the overall plant operating system.
- The Supply and installation of all cables, cable racks, transformers, switchgear, motors, valve actuators, lightning and small power etc. for a complete operating plant.
- Pulling and termination of power cables from mini substation to the electrical switchgear to power the nitrogen plant and provide bulk supply to the Hydrogen plant. The mini-substation is installed by the *Employer* near the site location. The *Contractor*'s scope will include trenching, breaker update and installation on the mini substation, and installation of cable sleeves where such is required.
- Design, supply, install and commission power distribution boards for each plant or loads necessary to supply each plant.
- Emergency Power Supply during plant shutdown period – This will provide the minimum power required for operation of equipment, controls and instrumentation to ensure safe plant shutdown.
- The *Contractor* to request the *Employer* power supply matching the requirements for the equipment that the Contractor will be installing to ensure that the Plant can be operated with the power supply conditions and parameters as supplied by the *Employer*.
- Ensure that all outdoor electrical equipment is compliant to IP65 and all in door electrical equipment is compliant to IP55.
- The contractor shall provide earthing designs, earthing layout for clean and dirty earth, connection details to the earth mat. Upon installation, testing shall be conducted and results issued to the employer.
- The scope of work includes the provision for the design, manufacture, factory testing, supply, delivery, off-loading, move to position, erection, installation, site testing, commissioning, and handover of LV Switchgear and control gear.
- The designs and installation of the switchgear shall be in accordance with the requirements of 240-56227516 - LV Switchgear and Control gear Assemblies and Associated Equipment for

voltage 1000V AC and 1500V Standard and 240-56357424 MV and LV switchgear protection standard.

- The switchgear and associated equipment shall be house in the H2/N2 Substation Building.

- Technical schedule A&B to be submitted in line with 240-56227516 - LV Switchgear and Control gear Assemblies and Associated Equipment for voltage 1000V AC and 1500V Standard prior to design start of the electrical switchgear.

- The LV Switchgear must be of a type tested design as per SANS 61439-1 as a minimum. Panel design and construction of the switchgear is as per 240-56227516. The switchgear is for indoor use, air insulated, metal-enclosed and internal arc classified in accordance with SANS 61439-1.

- The Contractor submits the following data in neat files for acceptance by the Employer before the Design Freeze status can be declared as a minimum:

  - Technical Schedules A and B.
  - Compliance Schedules.
  - Engineering Change Register.
  - Single Line Diagrams for Switchboards.
  - General Arrangement Drawings.
  - HVAC plant switchgear locations
  - Switchgear Schedules.
  - Protection Functional and Interface Block Diagrams.
  - Schematic Diagrams for Protection and Control Systems.
  - Component Schedules.
  - Technical Manuals

- The main incomer circuits must be controlled either locally or remotely from the operating room (EOD – Electrical Operating Desk).
- The Contractor performs the detailed design of the protection and control circuits as well as interfacing.

- The Contractor provides the As-built drawings, operating manuals, and maintenance schedules as per the following requirements:

- Language: All documentation, including reports, manuals, etc is in the English language.

- Type Test Reports

  - Type test documentation represents the design of the functional unit with respect to the configuration, type and rating. The information to be included in type test reports is in accordance with 240-56227516. The report of the type tested functional unit and associated components reflects the equipment under consideration. The type test report is provided in full, containing all records of the tests conducted as well as the drawings.

- Installation and Operating Manuals

- The technical, training, maintenance and operating manuals are provided for the board. Where generic manuals are provided, an addendum is provided indicating the applicable project specific components.

- Manuals are of a good quality and cover the following as a minimum:

- Technical descriptions of the equipment and component parts

- General arrangement drawings

- Installation instructions with drawings or pictures

- Operating and maintenance instructions for all components

- Detailed parts lists (accompanied by exploded view type drawings clearly detailing the part and uniquely identifying it)

- Spare part ordering instructions

- Any special instructions pertaining to storage of spare parts, or their shelf life is included in the maintenance manual. All drawings requested for component location, dismantling and re-assembly for maintenance are included in the maintenance manual. All special tools required for operating and maintenance of the equipment are presented in a form of a schedule in the operating and maintenance manual, respectively. The content of the training manual is based on the content of the technical, operating and maintenance manuals.

- For small power and lighting, the contractor performs the scope of Design, manufacture, FAT, supply, installation, SAT, commissioning, and handover of 400-230 V AC small power and lighting to cover Hydrogen, Integrated area, Civil building and Nitrogen plant.

- The earthing of mechanical Plant for example vessels, support structures and ducts shall be provided and installed by the *Contractor* in accordance with the earthing and lightning protection standard 240-56356396 and the Hydrogen System Standard 240-56227413.

- Further where the contractor pulls and terminates cables, they shall conduct earth test on all equipment- this includes distribution boards, Motors etc and provide earthing results to the Employer.

- Templates to be utilised for Load List, Cable and Terminations schedules 240-56227927, 240-56176097 and 240-77302094 respectively (Appendix F).

- Ensure compliance to grid code requirements that may be applicable.

- A detailed list of spares shall be provided for all electrical components to be supplied.
- All special tools and test equipment required to maintain the systems shall be provided.
- The equipment of the same rating should be fully interchangeable to allow for low inventory and reduced down-times.
- Assembly design and construction and component selection shall be such that maintenance intervals shall be kept to a minimum.
- All maintenance required until the *Employer* takes over the *works*, will stay the responsibility of the *Contractor*
- The *Contractor* shall supply the plant that complies to the electrical standards as listed in Table 4 below:

Table 3 Electrical Standards

Item number	Standard description	Standard number
1	LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltage up to and Including 1000V AC and 1500V DC Standard	240-56227516
2	MV and LV Switchgear Protection Standard	240-56357424
3	Requirements for Control and Power Cables for Power Stations Standard	240-56227443
4	Procurement of Power Station Low Voltage Motors Specification	240-57617975
5	Earthing and Lightning Protection Standard	240-56356396
6	Coal Fired Power Stations Lighting and Small Power Installation Standard	240-55714363
7	Thyristor and switch mode chargers, AC/DC to DC/AC converter and inverter/uninterruptible power supplies standard	240-53114248

4.8 CIVIL AND STRUCTURAL REQUIREMENTS

4.8.1 General Structural Design and Construction Criteria

4.8.1.1 Design Criteria

4.8.1.1.1 Structural Steel

a. The *Contractor* shall include but not be limited to the considering the below mentioned design criteria for the *works* and compliance with 240-56364545, *Employer*'s Corrosion specification.

4.8.1.1.2 Reinforcement

a. All concrete cover shall comply with Medupi Power Station Specification for Structural Concrete (84CIVL053).

4.8.1.1.3 Concrete

a. The *Contractor* shall as a minimum develop all the concrete design/s that complies with 240-56364545 and Medupi Power Station Specification for Structural Concrete (84CIVL053).

4.8.1.1.4 Brickwork

a. All brick walls to be cavity walls shall comply with SANS 227 requirements.

b. Brick walls shall be built in two stretcher bonds.

c. Mortar shall be Class II as per SANS 2001-CM1.

d. All brick force shall comply with SANS 2001CM1

e. Selected wall ties shall comply with the requirements of SANS 2001CM1

f. The *Contractor* shall as a minimum develop all the design/s that complies with 240-56364545, 84CIVL053, "Conceptual Architectural Design Specification for Structures and Other Buildings" (84CIVL007 / 348-884646), "Power Station Architectural Technical Specifications for Structures and other Buildings" (200-26680 / 348-361813).

4.8.1.2 Construction Criteria

g. The *Contractor* shall construct the *works* in accordance with this SoW and in compliance with all relevant normative listed documents and applicable SANS specifications.

4.8.1.2.1 Structural Steelwork

a. The *Contractor* shall ensure that all conceptual, detailed and final construction drawings are approved as per Eskom's review processes prior to beginning construction and that compliance is maintained to all specifications for material grades that are fabricated and erected. This includes fabrication and erection tolerances, testing parameters and corrosion protection required for steel structures and their supporting elements. The *Contractor* is also required to submit to the *Employer*, steel grade certificates, fabrication drawings, welder's certificates and quality and test plans for review prior to fabrication.

b. All structural steel work must be manufactured and erected in accordance with relevant national standards and specifications.

c. All structural steel elements, metal grating, stair treads and fasteners are required to be hot dipped galvanized to SANS 121.

d. Only coded welders are to perform all welding works. Supporting welding documentation must be submitted to the *Employer* for review and acceptance prior to construction. Note: All welding is required to comply with AWS D1.1.

e. All welding joints are required to be inspected using visual aids and/or non-destructive tests as indicated below:

   i. Butt welds 100% ultrasonic NDT

   ii. Fillet welds 20% MPI.

   iii. Or as directed by the Contractor.

f. The *Contractor* shall also submit construction method statements for acceptance by the *Employer* for all works, inclusive of risk assessments per area of construction.

4.8.1.2.2 Concrete

g. The *Contractor* shall submit to the *Employer* concrete and grouting mix designs including but not limited to trial test cube results and all other required test results as indicated in the Medupi Power Station Specification for Structural Concrete (84CIVL053) prior to the placement of any concrete. The *Contractor* shall also submit detailed construction method statements and a quality and test plan to the *Employer* for review prior to the casting of concrete which may include but not be limited to waste disposal that is compliant to *Employer* procedures and applicable legislation.

a. The *Contractor* shall submit to the *Employer* its inspection and test plans (ITP's) for acceptance. The *Employer* will indicate his\her hold and witness points on the ITP. All specified tests and required interventions to be itemized on the ITPs and should be easily linked/referenced to relevant technical documents and the Program.

b. All of the above-mentioned documents, concrete and grouting mix design, material and aggregate test results and reports shall be submitted to the *Employer* for acceptance. Where test results are not within limits specified by Eskom and national specification the *Contractor* shall discuss with the *Employer*'s engineering team and make recommendations for acceptance.

4.8.1.2.3 Temporary Works

The Contractor shall ensure his designs, calculations and associated drawings for all temporary works, as a minimum, complies with the Employer's requirements, relevant and applicable design codes, codes of practice, best practice guidelines, Medupi requirements, latest legislative and applicable regulatory requirements including but not limited to Engineering Professions Act (Act 46 of 2000), Engineering Council of South Africa code of conduct and code of practice requirements, Occupational health and Safety Act, Construction Regulations 2014 and applicable SANS codes.

4.8.1.2.4 Adverse weather conditions

a. For clarity on the Medupi Power Station specification for structural concrete, rev 3, the *Contractor* shall note the following:

   i. When ambient temperature is above 36 ºC, the temperature of the concrete when deposited shall not be allowed to exceed 32 ºC and when ambient temperature is below 36 ºC, the temperature of the concrete when deposited shall not be allowed to exceed 35 ºC.

   ii. The *Contractor* should note that concrete works placed during hot weather conditions, exposed to direct sun and wind is especially subject to plastic-shrinkage and the *Contractor* shall adapt construction processes and methods to prevent the occurrence of plastic-shrinkage cracks.

4.8.1.2.5 Exposure of concrete to aggressive environment conditions

a. Due to the aggressive environment that the reinforced concrete works are exposed to durability of the concrete works is of utmost importance. The construction of concrete works shall be done to ensure resistance to the aggressive environment the *works* are exposed to.

b. The *Contractor* shall ensure that concrete placed is of good quality, dense and well-compacted. As specified in *Employer* specifications and SANS codes, including but not limited to SANS 10100-1 structural concrete, exposed to aggressive environment, shall be designed and detailed to ensure concrete crack widths, under serviceability conditions, are limited to 0,004 times the nominal cover to the reinforcement.

c. The *Contractor's* construction methods should ensure plastic-shrinkage cracks are limited, that special precautions are taken to ensure crack widths are within acceptable limits and that placed concrete is of good quality.

4.8.1.2.6 Materials and concrete testing

a. The *Contactor* to fully comply with the testing stipulated in Medupi Specification for Concrete Structures (84CIVL053 / 348-880042) and relevant SANS standards. The following additional notes on testing shall be complied with by the Contractor.

   i. Eskom Medupi Specification for Structural Concrete 84CIVL053 Sub-clause VA-G 3.4.6 a.)

The *Contractor* shall discuss during the design phase and agree with the *Employer* regarding the frequency and stages of project at which all testing shall be conducted. All test results to be submitted to the *Employer* for review in accordance with the specification. The *Contractor* shall submit a Quality Assurance and Quality Control plan and a concrete mix design with trial mix test results for acceptance by the *Employer*.

In addition to the tests specified in the specification (84CIVL053), durability index tests shall be performed (SANS 3001-CO3-1, SANS 3001-CO3-2, SANS 3001-CO3-3), if required by the *Employer*, on already constructed concrete works to confirm the durability of concrete placed. The durability index tests are developed to assess the transport properties of the concrete cover zone. There are three durability tests, namely Oxygen Permeability Index, Chloride Conductivity test and the Water Sorptivity test. Table 4 below provides the acceptance criteria for the three different test results as defined below:

Table 4: Acceptance criteria for durability index test results

	Oxygen Permeability Index	Sorptivity Index	Chloride Conductivity Index
Excellent	> 10	< 6	< 0.75
Good	9,5 - 10	6 – 10	0.75 - 1,5
Poor	9,0 -9,5	10 – 15	1,5 - 2,5
Very Poor	<9,0	>15	> 2,5

4.8.2 General Architectural Design and Construction Criteria

a. The Architectural design of the building shall be in accordance to the "Conceptual Architectural Design Specification for Structures and Other Buildings" (84CIVL007 / 348-884646), "Power Station Architectural Technical Specifications for Structures and other Buildings" (200-26680 / 348-361813) as well as the H2 (240-56227413) and N2 (240-110414644) standards.

b. The *Contractor*'s architectural designer shall be responsible to ensure the design meets the requirements of SANS 10400 and follow the Architectural Profession Act No. 44 of 2000.

4.8.2.1.1 Standard architectural requirements and finishes for all buildings

a. All color codes referred to here are from the NCS standard color range obtained from the internet, this is only to be used as a guide.

b. Concrete aprons to be least 1000mm wide and fall at least 20mm away from the building for quick and effective drainage.

c. Concrete foundation slab to be mass reinforced concrete that must be even and free of bumps and cracks as well as avoid ponding.

d. All exterior walls to be cavity walls with satin face brick in stretcher bond, mortar is required to be Class II as per SANS 2001-CM1, plastered and painted inside, paint color code: P602 linen (15),

e. All windows to be charcoal anodized aluminum window frames.

f. Ceiling to be crisp white in color and have a 2-hour fire rating or be a non-combustible material

g. There is no Medupi Landscaping specification for the Hydrogen or Nitrogen plants that prescribes to the *Contractor* what is required post construction for landscaping and/or land rehabilitation. Therefore, the following should be considered by the *Contractor* for the design and construction of these plants.

h. The *Contractor* to provide landscaping that shall have the least amount of required maintenance within the lifespan of both plants due to the access control requirements and in particular the nature of the operations within these plants.

i. Be compliant with the Medupi Environmental procedures and relevant legislation.

j. Refer to Hydrogen (240-56227413) and Nitrogen (240-110414644) standards for signage requirements.

4.8.2.1.2 H2 and N2 Passive fire protection

a. All emergency exit doors shall open in the same direction as the emergency exit route and shall be lockable.

b. All emergency exit door handles shall be fitted on the inside of the doors.

c. Fire ratings for wall, fire dampers and fire door shall be designed by the *Contractor* in accordance with Fire Protection/Detection Assessment Standard (240-54937439)

d. All walls, flooring and ceiling shall have a fire rating of at least 2 hours.

e. Emergency exit lights and signage on the emergency exit route.

4.8.2.1.3 Painting and Corrosion Protection

a. The painting and corrosion protection requirements are to be included in the relevant design drawings and drawing notes to be produced by the *Contractor*. All of which should comply with the corrosion requirements stipulated in the Medupi Power Station Corrosion Protection Specification, SSZ_45-17 Revision 2 and Identification of the Contents of Pipelines and Vessels, 200-3583 (348-912995). The *Contractor* shall refer to the Designer's drawings and well-defined drawing notes for all specifications including but not limited to corrosion protection of the structural steel.

4.8.2.1.4 Roof Sheeting and Cladding

a. The sheets shall be laid down, fastened and sealed in accordance with the manufacturer's specifications.

b. Roofing to be a hip roof with min. slope of 3 degrees or a curved roof only, minimum radius of the curved to be 15m. All roof sheeting to be Klip-Lok 700 profile 0.58mm thick high yield stress ASTM A446 grade E (3T), the sheets must be laid down, fastened and sealed in accordance with the manufacturer's specifications.

c. Heavy industrial Z275 galvanised with bullnose eaves of 450mm radius with 750mm min. eaves to outer face of external wall, eaves to be closed with metal sheeting or rhino board.

d. The *Contractor* shall indicate the colour of sheeting to be used in the architectural drawings which is subject to acceptance by the *Employer*.

e. Contractor to refer to the Medupi Architectural specification for further description on all sheeting and cladding requirements.

f. Contractor to complete the design, construction, certification and supply of all materials including but not limited to performing a redesign of the existing N2 plant roof and sheltered structure and trusses that all elements that are the missing (i.e. Sag bars, crawl beam for maintenance, other bracing members) .All design, construction, certification , supply activates shall be reflected on the Contractor's program/project schedule that is submitted to the Employer).

4.8.3 General Storm-Water Drainage Design and Construction Criteria

4.8.3.1 Design Criteria

The storm water design shall interface with all existing infrastructure and new designs for the roads and structures. Levels and positioning shall be considered to ensure that no flooding occurs in any existing and new buildings. The natural ground levels shall be assessed, and terracing or localised reshaping may be required to ensure that no ponding occurs in any of the affected areas. The *Contractor* shall include but be limited to considering the 240-85549846 and 240-84418186 standards.

4.8.3.1.1 Considerations for Initial Assessment

The initial assessment by the *Contractor* for the storm-water drainage design may include but not be limited to initiating following:

a. Familiarising oneself with the location of all existing drainage infrastructure within the area contributing to the storm-water network and/or independent drainage infrastructure. *Contractor* can make use of the drainage layouts 0.84/328, clean and dirty drain layout 0.84/198 sheet 5 and 0.84/199.

b. Performing necessary topographical survey of surrounding areas to determine contributing catchment areas to the storm-water network and the H2 and N2 plants.

c. Survey verification of all existing drainage infrastructure and possible integration thereof with new infrastructure.

d. Calculations of pre-development storm water flows and any other additional process flows which currently contribute to the existing storm water network.

e. Calculations of post-development flows to determine the additional flow that will be entering the existing storm water network.

f. Water balance model to be created for additional flow entering the storm water network from both the H2 and N2 plants.

g. Submission of a stormwater management plan

h. Assessment of any treatment and storage facilities integrated within the storm water network to accommodate the additional flow requirements for the H2 and N2 plants.

4.8.3.1.2 Alternative Studies

a. Should the existing storm water network be insufficient in accommodating the additional flow, the *Contractor* shall investigate alternative options to cater for the additional flows resulting from the new developments. These options may include but not be limited to any combination of providing new drainage infrastructure, upgrading the relevant sections of the existing storm water network, or attenuating this flow prior to its release into a system. Any possible alternative options considered by the Designer shall be discussed as early as possible in the design phase with the *Employer*, (i.e. prior to including it in the final design and calculation report). This shall also be supplemented by a water balance assessment and high-level cost benefit analysis, Flood Calculations

b. The method used to determine design flood peaks shall be referenced in all the design calculations. It is also required that all the design calculations should be submitted in detail in the design report. Outputs from any software used shall be submitted in the appendices of the design report.

4.8.3.1.3 Storm water pipes

a. A minimum pipe diameter of 450 mm shall be used for any new designs.

b. Calculations for the loads on the pipelines and selection of the appropriate pipe class shall be done in accordance with SANS 10102-1 and SANS 10102-2. A minimum of Class 100D is required for all concrete storm water pipes.

c. All storm water pipes shall be designed with a minimum slope of 0.5%. Changes in slope, especially a reduction in slope, shall be avoided as far as is possible.

d. Design flow velocities shall be between 0.5 m/s and 3.0 m/s with a desirable minimum range of between 0.9 and 1.5 m/s. The absolute minimum of the half-full velocity shall be less than 0.6 m/s.

e. The design flow in pipes shall not exceed a ratio of 80% of the capacity of the pipe.

f. The designed drainage system shall meet the discharge quality and quantity requirements specified by the institution responsible for receiving the storm water (i.e. Department of Water Affairs and Forestry) and the Record of Decision (ROD) for the H2 plant and N2 plant, as indicated in the 84CIVL052.

4.8.3.1.4 Erosion Protection

a. As discussed in the previous sections and particularly with regards to the dissipation of energy in channels, the discharge from pipes or weirs shall be considered where downstream erosion or scouring is possible.

b. The above mentioned may be achieved by increasing the size or roughness of the drainage way; or the use of structural elements. SANS 1200 DK shall be adhered to for the use of gabions and stone pitching.

4.8.3.1.5 Legislation

The *Contractor* to consider but not be limited to adhering to the following legislative documents/standards during the designs of all water related infrastructure, namely The National Water Act (Act No. 36 of 1998), The Environmental Conservation Act (Act No. 73 of 1989), Government Notice 704, National Water Act 1998, the latest Medupi and Eskom procedures outlined in this document and Medupi Water Use licence (01/A1042/ABCEFGI/5213).

4.8.3.2 Construction Criteria

In general, the technical details listed below, and their latest versions shall be considered by the *Contractor* during construction and manufacturing of the *works*.

4.8.3.2.1 Drainage Specifications

a. SANS 2001-DP5: to be used for: Storm water drainage.

b. SANS 986 to be used for Precast concrete reinforced culverts

c. The gutters shall be made of 2.0 mm thick MS plate (strengthened with suitable stiffeners 1m apart), galvanised or metal sprayed as specified by the *Contractor*. Additionally, the 240-85549846- specification shall be considered in this regard.

d. Down pipes shall be provided at suitable intervals and attached to the main columns. The water from the down pipes shall be collected in sloping launders and discharged vertically through down pipes connected to the existing Medupi plant drainage system that is indicated in drawings 0.84/328, 0.84/198 sheet 5 and 0.84/199.

e. Down-pipes and launders shall be of ample capacity to carry away rainwater from heavy storms.

f. Down-pipes, launders, spreaders and fittings shall be made of 1.5 mm minimum thickness steel plate. Launders shall be designed with the longitudinal seam at the top.

g. Down-pipes and heads shall be of ample size and shall run vertically (with the least possible number of off-sets) Bends shall nowhere have an angle of less than 60 degrees with the horizontal. No down pipe shall be less than 100 mm in diameter.

h. The lower ends of down-pipes shall terminate in shoes which will deflect the water into the manholes to be provided about one meter below the basement floor (pending *Contractor*'s design).

i. If there is a bund wall envisaged for either the Hydrogen and Nitrogen design, it shall discharge water into correct drains within the drainage system/network indicated in drawings 0.84/328, 0.84/198 sheet 5 and 0.84/199. Make provision to sample, test classify, , confirm and locate all sources of effluent/water/discharge generated on both plants.

j. The drainage shall feed into the common station drains. Construction of storm water system and pipe links to the dirty water drains must commence at the start of the construction phase. Minimization of erosion and sedimentation (e.g. using drainage ditches and stabilization of steep slopes) during construction is important.

4.8.4 General Earthworks and Road Design and Construction Criteria

The *Contractor* shall ensure that all Works comply with 240-84418186, 240-57127955, 240-57127951, 240-57127953 and SANS 1200 M design standards, and all other applicable normative references within Section 2.2 of this document.

4.8.4.1 Design Criteria

4.8.4.1.1 Initial Assessment

The *Contractor*'s Designer to consider but not be limited to initiating the following listed items for the Earthworks and Road designs:

a. Geotechnical investigation of the ground to confirm if the location is suitable for road works.

b. Desktop review of site layout and availability of materials

c. The topographical survey of the proposed area(s).

d. Underground surveys in the proposed areas to locate any underground services.

e. Location of existing road(s) infrastructures within the area to tie in the proposed access.

f. Survey of all existing road infrastructures.

4.8.4.1.2 Geotechnical works and Layout design

The following aspects shall be taken into consideration by the *Contractor*:

a. The *Contractor* shall include but not be limited to considering the following geotechnical and constructability standards, 200-6166 (348-355152), 240-57127955, 240-57127951, 240-57127953, 240-107981296, 240-144332407 during the compilation and execution of all respective design and construction documentation and works for the H2 and N2 plants.

b. The *Contractor* shall carry out geotechnical assessments as deemed required by the Contractor, this may include but not be limited to conducting excavations, investigations, test pits, sampling, laboratory testing (at a South African National Accreditation System (SANAS) accredited laboratory) and backfilling within the proposed area of the H2 and N2 plants.

c. For the N2 plant in particular, the *Contractor* shall be given all existing and available design drawings, geotechnical Data Books, investigation records and reports that exist for existing works already completed on the N2 plant.

d. Where this document is not clear regarding the location of an item to be installed or work to be performed, it is the *Contractor*'s responsibility to determine the correct location. The *Contractor* will only act upon confirmation/by receipt of an Engineering Instruction from the *Project Manager* (as per the Eskom Change management procedures and Works information/contract). Incorrectly positioned items, or incorrect work done (where Engineering Instructions were not issued) will be moved / removed / replaced / changed / reinstalled by the *Contractor* at his/her cost

e. The *Contractor* is responsible as part of the design to provide swept path analysis of the roadway

f. The *Contractor* is to provide the estimated usage of the designed roads based on the information available and best engineering practice.

g. The *Contractor* shall account for any temporary construction access roads, final access roads and future maintenance access roads requirements. The required roads shall be designed using the existing road pavement layers (0.84/195 Rev 13). However, the *Contractor* shall be allowed to deviate from existing pavement layers if *Contractor* deems it necessary due to load, site conditions, final surface layers or any other motivation.

h. The roads shall interface with the drainage design, terrace design and existing as-built roads, services, road markings/signage, parking, structures where necessary.

4.8.4.2 Construction Criteria

In general, the technical details listed below, and their latest versions shall be considered by the *Contractor* during construction and manufacturing of the *works*. The *Contractor* also shall ensure that all construction Works complies with, but is not limited to Construction regulations (Act no. 85 of 1993), 240-84418186, 240-57127955, 240-57127951, 240-57127953, legislative and applicable environmental standards as well

as all relevant SANS standards including but limited to SANS 1200 M design standards, and all other applicable normative references

4.8.5 Documentation, Construction Monitoring and Professional Engineering Certification

a. The *Contractor* shall take full professional accountability/responsibility for all the Works in their scope and shall submit the necessary proof of professional registration and experience, as well as submit a completed Competency Declaration form, for the professionally registered, accountable, and certifying Designer.

b. The *Contractor* shall produce and submit all information including a Master Document List (MDL), 3D model (in a format/software file that the *Employer* can open and review), layouts, calculations, detailed drawings, method statements, product specifications, risk assessment, constructability assessment, KKS Equipment lists, register and verification record templates for the various works (including QC/QA documentation) as well as a bill of quantities, all of which are required for the timely planning, design and construction of all outstanding and new civil and structural works for the N2 and H2 plants.

c. Detailed drawings for construction shall be submitted timeously by the *Contractor* for *Employer* review prior to commencement of works. *Contractor* to note that all drawings shall also be submitted in the correct templates. CAD and PDF formats, all of which shall follow the *Employer*s quality specifications and document control procedures

d. All review durations shall be agreed with *Project Manager* over and above the general contractual periods due to the nature and intricacy of this project.

e. Submission of consolidated detailed design and calculation reports signed by a Professional ECSA Registered Civil Engineer which includes all survey results, outcomes of geotechnical investigations, testing and sampling deemed necessary by Designer. Reports shall also include but not be limited to listing/detailing all Designer selected design criteria/parameters, specifications and standards used, loadings, assumptions, calculations results including detailed design calculations, design models, credible sources of information and any record of other information associated with the completed *works*.

f. The *Contractor* shall submit As-built data (inclusive of QC and QA data books) for the entire scope. All As-built drawings produced for the completed works shall be submitted upon handover, this includes but is not limited to provision of all relevant certificates (inclusive of a PEC, COC's and project completion certificate). All data and records for the QC and QA data books shall however be submitted progressively as works are carried out and in accordance with the *Employer's* Quality procedures.

g. All submitted design calculations and drawings shall be signed by an accountable Professional Civil Engineer with both ECSA registration number and signature.

h. Review and acceptance of all construction documentation (includes but is not limited to method statements, ITP's, material approvals and approval of all other quality verification records), as well as fabrication records shall be the responsibility of the Designer, prior to being submitted to the *Employer* for review per the relevant quality procedures.

i. The *Contractor*'s designer shall perform the necessary construction monitoring, as required by the Construction Regulations (Act No. 85 of 1993), to ensure design intend is achieved

j. The *Contractor* shall issue the Professional Engineering Certificates for completed structures/buildings in line with National Building Regulations (Act No. 103 of 1977), SANS 10400 and Construction Regulations (Act No. 85 of 1993).

k. In the event where the *Contractor*'s designer is not in a position to confirm that design intent, of works already constructed, was achieved during construction due to lack of information, test results, inspection records and\or professional declaration certificates; the designer shall submit a risk assessment and make recommendations to the *Employer*.

l. In cases where the *Contractor* is uncertain of which specifications are applicable to the execution of particular works defined in this scope of work, the *Contractor* is required to follow due processes to request clarification from Eskom prior to executing such works.

m. All investigations and required testing of existing and new works shall comply with the civil and structural specifications outlined this document. Additionally, the *Contractor* is expected to keep records of tests conducted and submit to *Employer* for review in line with *Employer's* quality procedures.

n. The *Contractor*'s Designer shall provide all the necessary design integration, while ensuring that all works are inspected, constructed, and monitored in accordance with latest approved design drawings and as per the requirements outlined in this civil and structural section.

o. The *Contractor*'s civil designer shall be responsible to ensure design intent is achieved during construction. Construction monitoring shall be done in accordance with the Construction Regulations (Act No. 85 of 1993), SANS 10400, ECSA Code of Conduct (Act No. 46 of 2000), environmental and legislative standards.

p. Once construction work is complete, the *Contractor*'s ECSA registered professional shall conduct a final inspection and issue a Professional Engineering Certificate certifying the works are safe for use. The *Contractor* and Designer shall comply with all the *Employer's* Handover procedures.

4.8.6 Specific Considerations for the Nitrogen and Hydrogen Generating plants

4.8.6.1 Nitrogen Generating Plant

a. *Contractor* shall review all available documentation, existing incomplete and completed constructed works, As-built works as well as data books (348-9936991 and 348-9936992) as per Appendices E and H (i.e. steel structure, concrete surface bed slab and foundations, current drainage and all pipe supports). Once reviewed, the *Contractor* shall provide acceptance of existing civil and structural fabrication and construction data books as compliant to all applicable Eskom requirements, engineering standards and necessary regulations.

b. The Contractor shall take note that any design or redesign and/or remedial work and corrective work across all Engineering disciplines to the existing and free issue items is the Contractor's scope of work for the purpose of commissioning.

c. The *Contractor* shall ensure that a complete N2 design is provided and can be constructed, commissioned, certified and handed over as a fully functional Nitrogen generating plant that is compliant with all relevant regulations and standards.

d. The *Contractor* shall submit all proposed final updates/changes to the existing design documents for Eskom review and acceptance per the Change management procedure. The *Contractor* shall also consider updates/changes that include but are not limited to the following:

   i. Road 40 re-design to which the *Contractor* shall take into consideration the suggested conceptual layout (084/65535) and the actual operating philosophy required within this N2 plant,

   ii. Possibility of having two or three road crossings linked/across Road 40 to encompass site access for maintenance/general operations,

   iii. Assessment and completion of the existing works. The *Contractor* shall assess the existing constructed works indicating whether design intent was achieved. Any required testing deemed necessary for acceptance of data books and existing works shall be communicated to *Employer* for acceptance in the form of a risk assessment and constructability assessment. All tests shall be conducted in line with applicable Medupi specifications and applicable normative references of this document.

   iv. Assessment of all Civil and Structural parts of the vessel and pipe support/s as required by all mechanical, electrical and C&I systems,

   v. Provision of an adequate storm water design and management (includes integrated assessment/constructability assessment and tie in with existing and new drainage of both N2 and H2 plants/areas).

   vi. Consideration of suitable landscaping and applicable safety fence (inclusive of plant signage) and finishes (protective coatings, door specifications, corrosion protection) in line with design intent and operations of the plant/area.

   vii. Inspection, correction and repair of any defects on all existing building and or structures.

e. Compilation of Data book records shall be created for all works carried out (outstanding scope on existing works and new works) on the Nitrogen plant. Data books shall also be submitted to *Employer* for review and acceptance and shall comply to the Medupi QC and QA procedures/processes described in this document.

f. Construction activities such as excavations, movements of construction vehicles and any other activities that can damage existing works, shall be executed through methods that minimize damage/repairs. *Contractor* shall submit relevant method statements, risk and constructability assessments indicating how all works and associated activities will be carried out on site.

4.8.6.2 Hydrogen Generating Plant

a. The *Contractor* shall carry out the civil and structural designs in line with available information and approved concepts. The civil and structural designs shall be completed to provide the following;

   - Structures and services that shall adequately house and support all systems, equipment and accessories that constitute the H2 plant and Hydrogen Bulk storage tanks.
   - Sheltered structures for multicylinder packs -, Nitrogen & Hydrogen and their bulk off-loading panels;
   - Multicylinder packs -, Nitrogen & Hydrogen and their bulk off-loading panel foundation/ slab;

b. The design for the H2 plant shall ensure optimum usage of allocated space/location and all surrounding existing infrastructure. All *Contractor* designs including but not limited to drainage, earthworks, foundations, all other civil and structural structures/elements, fire safety, architectural, equipment and building finish levels, and any other items relevant for a complete and functional H2 Plant shall be compliance with relevant specifications and legislative requirements.

c. The H2 Plant shall have a containerised generating Unit (supplied by others) with a shelter/covered structure (supplied by the Contractor) and shall be placed on top of a newly designed and constructed foundation slab/raised concrete floor slab and apron slabs that is adequately designed by the Contractor to support and protect the containerised unit.

d. The *Contractor* shall submit a complete design pack with full civil and structural design of a H2 plant as well as any additional design considerations/elements that may be deemed required by the *Contractor*. The *Contractor*'s Designer shall indicate all considerations/assumptions and risks considered for all civil and structural design elements, which should include but not be limited to incorporating the requirements from the Hydrogen Systems Standard (240-56227413) and justifying the necessary protective measures to handle the expected hazards linked to operating a H2 plant.

e. The overall civil and structural H2 plant designs and associated construction works shall be well integrated with other designs including but not limited to chemical, electrical, mechanical, C&I and all other relevant designs set out in this document. Additionally, the following shall also be considered by the *Contractor*:

    i. Blast proof/explosion proof walls/fire walls shall be designed to withstand/minimize a failure/ explosion event on the H2 plant. The Designer shall design all buildings/infrastructure to adequately withstand and protect surrounding area from impact of a potential explosion or multiple explosions of the H2 plant. The necessary assumptions, design safety factors and loading/forces (including but not limited to explosive pressure/s) shall be designed in line with the design codes, HAZOP and other safety assessments performed for this plant as well as in line with the product suppliers/specific OEM specifications/datasheets of all equipment, systems, vessels and plant installed on the H2 plant. Designer shall ensure all parameters as taken into consideration including but not limited to using reinforced concrete with suitably specified reinforcement, suitable wall height and thickness, sufficient space/distances between walls and potential blast/explosive sources. Where technical information is needed from other stakeholders a request can be sent to the Employer or with the interfacing Others (Contractors and other Designer/s).

4.8.6.3 Integrated works

The following overview includes but is not limited to the various functional requirements that the *Contractor* shall consider enabling integration of both the H2 and N2 plants with each other and with the surrounding/existing infrastructure:

a. The *Contractor* shall integrate the plant and provide the appropriately designed safety fence, final landscaping, protective shelter/canopy structures, supportive infrastructure, new drainage systems with associated connection to existing works, road crossings, trenches, pipe plinths and

new Road 40 with any other needed road extensions and loading area around the entire H2 and N2 plant, all essential supportive plinths, plumbing, civil services and associated finishes. The coordination and integration of common systems between N2 and H2 plants shall be the *Contractor's* responsibility. Such coordination and integration shall be addressed at each project phase/stage through necessary design and documentation reviews and approvals as well as during the construction monitoring, commissioning, and certification phases.

b. The Contractor shall also provide a dedicated building for containing and protecting all N2 and H2 Electrical and C&I components, plant cabling, equipment and switchgear cabinets and N2 C&I cabinets.

   i. The Location, building/structure footprint and overall floor plan size shall consider the available space on entire N2 H2 plant and the required distances for routing of cables, cable racking/supports and shall be integrated into overall plant designs (existing works, stormwater and drainage services, trenches, roads, N2 plant, H2 plant, other contractor designs).

   ii. As a minimum consideration, the Contractor shall consider designing an above ground building with apron slabs, curved/hipped roof with crawl beam and additionally address the other discipline requirements for this building/structure as captured in this document.

   iii. All building elements, foundations, floor slab and their capacities to be designed to withstand all relevant loading combinations per SANS standards and Eskom specifications including but not limited considering the Contractor's own designs as stipulated in this document as well as the other Contractor designs).

   iv. Ceiling height to be designed with sufficient clearance above the Electrical and C&I switchgear equipment (minimum consideration for equipment size - 5m (length) x 0.8m (width) x 2.4m (height)) and shall also account for a suitably sized crawl beam.

c. Necessary designs/modifications to be incorporated into the existing and new designs to enable routine maintenance within containerized unit/buildings/ sheltered or covered structures /infrastructure/ supportive structures and shall also account for maintenance, movement, lifting drainage, slopage of supportive infrastructure and replacement of equipment/systems.

d. Typical maintenance vehicle sizes, loading bay/s, sheltered/covered off-loading areas and operating and maintenance philosophies shall be considered and allowed for in the design and construction of civil, structural, roads, access gates and other affected infrastructure on both plants.

e. The operational considerations shall be such that operations and maintenance activities of both plants do not disrupt one another as a consequence of design of the plant and systems (i.e. integration of designs to consider the HAZOP, constructability assessment, commissioning, operation and maintenance activities of both plants and the O&M's compiled by the *Contractor*).

4.9 FIRE SYSTEMS (ACTIVE, PASSIVE AND MANUAL)

4.9.1 General

Hydrogen fires normally are not extinguished until the supply of hydrogen is shut off because of the danger of re-ignition or explosion. The construction materials used in the hydrogen plant shall meet the definition of non-combustible according to SANS 428. Plant arrangement shall utilise passive protection in terms of containment, spatial separation and fire barriers (2 hour rated) to provide an inherently safe design.

The hydrogen generating plant, receivers, cylinders and all associated plant shall comply with the requirements of the Eskom Fire Protection and Life Safety Design Standard (240-54937450) [27] as well as the Hydrogen Systems Standard (240-56227413) [7].

Fire water to the Hydrogen and Nitrogen plant area shall be supplied from the ring main valve pit AA1. The *Contractor* shall be responsible to connect to the fire water ring main directly downstream of valve pit AA1. Fire water shall be supplied from valve pit AA1 at a pressure of approximately 9 bar. Refer to Appendix J for the interfacing systems drawings.

4.9.2 Works to be performed by the *Contractor*

The *Contractor* shall design, in accordance with the relevant standards, in detail, to cover all the fire system requirements for the areas identified in the 'Description of the *works*', including the following:

- As built Pipe and Instrumentation Diagrams of the complete fire protection system to be supplied to the *Employer*. The *Contractor* shall supply a Design Basis document which will describe on high level the proposed design, stating if it will be 100% code compliant or if it will be a Rational Design. Reference to be made of all relevant codes and standards, design is based on as well as any deviations from said codes and standards.
- Pipeline layout to achieve the optimum routing to the end user.
- The isometric drawings for all pipework.
- Hydraulic calculations for the fire suppression system.
- Pipe hangers and hanger supports.
- The integration between the main fire water supply system and all sub systems.
- Fire hydrants, hose reel and fire extinguisher layout and positioning.

. In addition to all relevant design documentation the *Contractor* shall submit the hydrostatic testing procedures, flushing procedures and functional testing procedures, drafted in accordance with the relevant design standards.

4.9.3 Fire Risk and Hazard Analysis

The *Contractor* shall develop emergency plans to cover predictable types of emergencies which shall cover situations ranging from a small incident to one of disaster proportions. The emergency plans shall be submitted to the *Employer* for approval. The risk assessment and emergency plans shall be in accordance with the Fire Protection/Detection Assessment Standard (240-54937439), Occupational Health and Safety Act and Regulations (Act No. 85 of 1993) and Major Hazard Installation Regulations including all codes and standards that are relevant to the design.

4.9.4 Materials

All above ground pipework shall be galvanised steel according to SANS 121. Pipes shall conform to SANS 62 and SANS 719. All steel piping up to 50NB shall be screwed and anything above 50NB shall be flanged.

All buried fire water piping shall be PVC-M as per SANS 966-2. PVC-M piping shall be installed as per the Manufacturer's instructions. Backfilling shall be as per the Medupi Backfilling Specification (200-6166) [40] (refer to section 4.7 for more details).

Corrosion protection shall be as per the requirements of the Medupi Power Station Corrosion Protection Specification (SSZ_45-17) [43]. Painting of fire system piping shall be as per the requirements of the Specification for the Identification of the Contents of Pipelines and Vessels (200-3583) [57]. All fire system piping shall be fully painted signal red as per the requirements of SANS 10140-2.

All hangers and hanging material will be hot dipped galvanised to SANS 121.

The *Contractor* shall design the fire protection system with pipe supports capable of supporting the loads of the system and without exceeding the maximum permissible deflection. Pipes shall be positioned to maintain a clearance to any other fixed structure, except the members to which such pipes are clamped to. All load bearing structures will need to be signed off by a professional engineer before any loads are subjected to the structures.

The design of the fire detection and suppression systems will be done by an engineer qualified as stipulated in SANS 10400, the said engineer will need to sign off on the design, installation and commissioning of all relevant systems.

All valves and equipment shall be as per the requirements of the Eskom Fire Protection and Life Safety Design Standard (240-54937450) [27].

4.9.5 Fire Hydrants

The *Contractor* shall install fire hydrants in the Nitrogen and Hydrogen plant area at a rate of not less than 1 hydrant per 500 m^2 as a minimum and installations shall be as per the requirements of the Eskom Fire Protection and Life Safety Design Standard (240-54937450) [27].

Fire hydrants shall comply with the following specification:

- Inlet: 80mm, Male BSP Thread
- Fire Hydrant Outlet: 65mm Female Instantaneous Outlet with double opposing "lugs".
- Body Material: Cat Iron or Bronze
- Spindle material: Stainless Steel
- Spindle Square Size: 16mm (to SANS 1128 Specification)
- Working Pressure: Seat tested to 16 bar

4.9.6 Fire Hose Reels

Fire hose reels shall be as per the requirements of SANS 10400.

4.9.7 Portable fire extinguishers

Fire extinguishers shall be as per SANS 1910 and as per the requirements of the Eskom Fire Protection and Life Safety Design Standard (240-54937450) [27].

4.9.8 Safety Signage & Escape Routes

Safety signage and escape routes shall be as per the requirements of the Eskom Fire Protection and Life Safety Design Standard (240-54937450) [27] and SANS 1186, SANS 23601.

4.9.9 Fixed Fire Protection System Requirements

Active fixed fire protection must be supplied for Hydrogen Bulk storage tanks and Hydrogen Multi Pack Cylinders. The system should be a deluge water spray system with medium velocity spray nozzles. The system should be designed to provide a minimum water flow rate of 10.2 L/min/m2. In addition, all pipes and valves within 2 meters of the storage vessel should also be protected.

System should be designed in accordance with NFPA 15.

Fixed fire protection systems shall be automatically activated via pilot sprinkler detection.

The area around the hydrogen receivers should have drainage to accommodate the fire system flow.

4.10 LIMITS OF SCOPE AND SUPPLY

The Limits of Supply and Services (LOSS) and the termination points are specified in Appendix D. The *Contractor* shall comply with the connection details of the lead discipline.

4.11 DELIVERABLES

4.11.1 Contractor's Design

At the end of the design phase, the *Contractor* shall (as a minimum) deliver the following updated documentation specific to the *works* for this project. Additionally, the Contractor shall also refer to the individual discipline sections in this document for other specific returnables:

- Equipment list
- Piping General Arrangements
- P&IDs
- Equipment drawings
- Maintenance manual
- Operating manual
- Original Equipment Manufacturer (OEM) manuals and part catalogues

- Spares list
- Design reports with design calculations. The design report shall clearly indicate value engineering has been considered in the selection of the design solution.
- Arrangement designs
- Set point and parameter lists.
- Three-dimensional (3-D) model in DGN format
- Integrated arrangement design for the *works.*
- The *Contractor* shall submit design reports for piping supports for approval by the *Employer*.

4.11.2 C&I TRAINING AND SUPPORT REQUIREMENTS

i. The *Contractor* provides engineering training for at least 3 X Power Station Control and Instrumentation Engineers, and 3 maintenance technicians and at 6 operating personnel on the control system (i.e. PLC & HMI hardware and software). The *Contractor* will declare the trainees competent to operate and maintain these systems.

ii. Engineering training includes, as a minimum:

- A system design philosophy which includes lessons and improvements from previous products and operating and maintenance concepts.
- The system structure showing the hierarchy from the HMI, the Automation System and field devices. The structure must also show the hierarchy from subsystems, to modules, down to components (frequently used and critical ones) for both HMI and the Automation System. The aim is to be aware of the risks subjected by external changes in electronic technologies
- System Configuration and Documentation Control, including all necessary activities for system expansion/modification, and software storage.
- Power requirement calculation
- Development, debugging and testing of all software
- Software configuration and low-level programming
- Compilation, cross referencing and module binding the configuration drawings
- Installation, configuration and maintenance of all software packages forming part of the *works*
- Graphic display design, development and configuration
- Data base generation, configuration and storage
- Network design, communication, configuration, security and expansion
- Process control loop tuning
- A system of monitoring system failure modes, effects and criticality to the business, for more proactive maintenance and lifecycle strategies

- Plant Information System engineering
- Alarm Management System engineering
- Third Party Interface system engineering where the third-party system is supplied by Others
- *Contractor* supplied expert/third party systems

4.11.3 3D Model Submission and Review

The Contractor is to submit a detail programme indicating when the 3D Models phases will be submitted in pdf and dgn format for reviewing.

3D Models shall be submitted, in phases, at the end of each month as well as end of each design phase.

The following 3D Model Reviews shall be performed by the *Contractor* in collaboration with the *Employer*:

- **30% Model Review**

  Mainly, but not limited to, review equipment layout, routing of large bore piping, accessibility to equipment, safety, human factors Engineering and constructability.

- **60% Model Review**

  To review actions from the 30% Model Review, and aims to review at a minimum the detailed plant design such as piping systems, underground facilities, cable trays, platforms and ladders, instrumentation, control panels, packaged equipment, etc.

  The result of this review is recommendations for the final design of the plant and that the 3D model represents the completed design.

- **90% Model Review – Final 3D CAD Model Review**

  The Final Model Review is aimed at reviewing the actions from the 60% review to confirm and finalize a detailed plant design.

- **100% Model Review – Confirmation Review**

  The confirmation review shall be performed to review the actions from the 90% review and to confirm that Client's comments are properly reflected in the final design.

4.11.4 Prior to manufacturing

- Manufacturing method statements together with the associated QCP's/ITP's

4.11.5 Prior to site delivery

- Manufacturing data books

4.11.6 Prior to Construction

- Constructability analysis report in accordance with 240-50056004, "Constructability Analysis Guideline". The analysis is performed as part of the 3D model.
- Rigging study.

- Manufacturing data books
- Construction method statements together with the associated QCP's/ITP's

4.11.7 Prior to Commissioning

The *Contractor* submits the following to the Project Manager for acceptance prior to commissioning:

- Construction data books
- Commissioning procedures
- As-built documentation
- Verification and Validation Report
- Preliminary Operating and Maintenance manuals. The maintenance manuals include a list of all equipment with serial numbers and OEM details as well as spares for critical components that their lifespan is estimated to be short. Preservation procedures of such components must be submitted by Contractor and reviewed by OEM.

4.11.8 Prior to Completion

- Commissioning/Acceptance Test Reports
- Verification and Validation Report
- Technical handover package.

4.11.9 After Completion

- Technical handover package.

  The Contractor shall before Completion handover the following documentation as per Eskom document handover list (200-53810 / 348-621432):

  - All design documentation (refer section 3.8), drawings and 3D model in as built status
  - Operating and Maintenance procedures, spares list
  - Manufacturing data book
  - Construction data book
  - Commissioning data books
  - Statutory documentation and register

- Statutory safety certificates issued by registered professionals as outlined in the Construction Regulations (Act No. 85 of 1993)

5 AUTHORISATION

This document has been seen and accepted by:

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6 REVISIONS

Date	Rev.	Compiler	Remarks
May 2025	0.1	H Mathebula	New Scope to align with procurement strategy and Risk Assessment after Contract Termination
August 2025	1	M Molabe	New integrated SOW

7 DEVELOPMENT TEAM

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

- Jan Strydom
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8 ACKNOWLEDGEMENTS

Also noting contributions from

- Mandla Patric Nkosi
- Thabang Kgobe

APPENDIX A: H2 PLANT PFD

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
Process flow diagram	348-602641	7		0.84/86 Rev 7	MEDUPI POWER STATION H2 PLANT PROCESS FLOW DIAGRAM-P&ID

APPENDIX B: PIPE ROUTE LAYOUT

Document Description	UID (ESKOM)	Rev	Alternate Identifier	Common Reference	Title
Pipe Route Layout	348-9982889	0		0.84/65536 Sheet 1 Rev 1	MEDUPI POWER STATION GENERAL ARRANGEMENT NITROGEN AND HYDROGEN PIPE ROUTING SHEET 1 OF 2 - ARRANGEMENT
Pipe Route Layout	348-9982890	0		0.84/65536 Sheet 2 Rev 1	MEDUPI POWER STATION GENERAL ARRANGEMENT NITROGEN AND HYDROGEN PIPE ROUTING SHEET 2 OF 2 - ARRANGEMENT

APPENDIX C: NITROGEN, HYDROGEN GENERATING PLANT LAYOUT

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
General arrangement drawing	348-9982888	0		0.84/65535 Sheet 1 Rev 1	MEDUPI POWER STATION GENERAL ARRANGEMENT AND HYDROGEN PLANT - ARRANGEMENT

APPENDIX D: LOSS DIAGRAMS AND TERMINAL POINT DATA SHEETS

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
LOSS diagram	348-9976938	0			MEDUPI POWER STATION N2H2 PLANT LIMIT OF SUPPLY SERVICES LOSS - STRATEGY
TP Data sheet	348-883387	5		200-42652 Rev 5	MEDUPI POWER STATION PROJECT TERMINAL POINT DATA SHEET TP-04-10-022
TP Data sheet	348-304307	3		200-42672 Rev 3	MEDUPI POWER STATION PROJECT DOWNSTREAM TERMONAL POINT DATA SHEET TP 04 20 001 - TERMINAL POINT LIST
TP Data sheet	348-884978	4		200-42674 Rev 4	MEDUPI POWER STATION PROJECT DOWNSTREAM TERMINAL POINT DATA SHEET TP 04 20 120 - TERMINAL POINT LIST
TP Data sheet	348-222521	3		200-42921 Rev 3	MEDUPI POWER STATION PROJECT DOWNSTREAM TERMINAL POINT DATA SHEET TP 03 20 001 - TERMINAL POINT LIST
TP Data sheet	348-885762	3		200-42922 Rev 3	MEDUPI POWER STATION PROJECT UPSTREAM TERMINAL POINT DATA SHEET TP 03 20 002 - DATA SHEET
TP Data sheet	348-883265	5		200-42958 Rev 5	MEDUPI POWER STATION PROJECT UPSTREAM TERMINAL POINT DATA SHEET TP-06-20-001
TP List	348-10124242	1			N2H2 Project Terminal Points

APPENDIX E: EXISTING DESIGNS DOCUMENT LIST

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
C&I drawing	348-603541	2	100.10.301 Rev 2	0.84/50626 Sheet 1 Rev 2	NUGENMEDUPI N2 CABLE BLOCK DIAGRAM N2 PLANT - DIAGRAM
C&I drawing	348-325283	2	100.10.302 Rev 2	0.84/50630 Sheet 1 Rev 2	NUGEN MEDUPI N2 N2 CARD CONNECTION 0 0QJE10 GH002-U02-CPU - DIAGRAM
C&I drawing	348-325252	1	100.10.302 Rev 1,348-24767	0.84/50630 Sheet 2 Rev 1	NUGEN MEDUPI N2 N2 CARD CONNECTION 0 0QJE10 GH002-U02-AI4 - DIAGRAM
C&I drawing	348-326252	1	348-24771	0.84/50630 Sheet 3 Rev 1	NUGEN MEDUPI N2 N2 CARD CONNECTION 0 0QJE10 GH002-U02-AI5 - DIAGRAM
C&I drawing	348-325476	1	100.10.302 Rev 1,348-24774	0.84/50630 Sheet 4 Rev 1	NUGEN MEDUPI N2 N2 CARD CONNECTION 0 0QJE10 GH002-U02-AI6 - DIAGRAM
C&I drawing	348-326149	1	100.10.302 Rev 1,348-24778	0.84/50630 Sheet 5 Rev 1	NUGEN MEDUPI N2 N2 CARD CONNECTION 0 0QJE10 GH002-U02-AI7 - DIAGRAM
C&I drawing	348-325961	1	100.10.302 Rev 00	0.84/50630 Sheet 6 Rev 1	NUGEN MEDUPI N2 N2 CARD CONNECTION 0 0QJE10 GH002-U02-AI8 - DIAGRAM
C&I drawing	348-325150	2	100.10.303 Rev 2	0.84/50633 Sheet 1 Rev 2	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-CP1 - DIAGRAM
C&I drawing	348-324901	1	100.10.303 Rev 00,348-24887	0.84/50633 Sheet 10 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-OLM - DIAGRAM
C&I drawing	348-324945	1	100.10.303 Rev 00,348-24888	0.84/50633 Sheet 11 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-24V - DIAGRAM
C&I drawing	348-325624	1	100.10.303 Rev 00,348-24889	0.84/50633 Sheet 12 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-0V - DIAGRAM
C&I drawing	348-324982	1	100.10.303 Rev 00,348-24859	0.84/50633 Sheet 2 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-CP3 - DIAGRAM

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
C&I drawing	348-325296	1	100.10.303 Rev 00,348-24862	0.84/50633 Sheet 3 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-CP3 - DIAGRAM
C&I drawing	348-325161	1	100.10.303 Rev 00,348-24873	0.84/50633 Sheet 4 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-AT4 - DIAGRAM
C&I drawing	348-326260	1	100.10.303 Rev 00,348-24874	0.84/50633 Sheet 5 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-AT5 - DIAGRAM
C&I drawing	348-325158	1	100.10.303 Rev 00,348-24875	0.84/50633 Sheet 6 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-AT6 - DIAGRAM
C&I drawing	348-326516	1	100.10.303 Rev 00,348-24877	0.84/50633 Sheet 7 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-AT7 - DIAGRAM
C&I drawing	348-326687	1	100.10.303 Rev 00,348-24881	0.84/50633 Sheet 8 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-AT8 - DIAGRAM
C&I drawing	348-326514	1	100.10.303 Rev 00,348-24883	0.84/50633 Sheet 9 Rev 1	NUGEN MEDUPI N2 N2 PANEL MARSHALLING 0 0QJE10 GH002-U02-ETH - DIAGRAM
C&I drawing	348-326147	0	100.10.304 Rev D	0.84/50631-SHEET 1 Rev 0	NUGEN MEDUPI N2 N2 FIELD MARSHALLING 0 0QJE10 GH002-U02-TR1 - DIAGRAM
C&I drawing	348-326682	1	100.10.304 Rev 00,348-24945	0.84/50631 Sheet 2 Rev 1	NUGEN-MEDUPI N2 N2 FIELD MARSHALLING 0 0QJE10 GH002 –U02-TR2 - DIAGRAM
C&I drawing	348-325846	1	100.10.304 Rev 00,348-24954	0.84/50631 Sheet 3 Rev 1	NUGEN-MEDUPI N2 N2 FIELD MARSHALLING 0 0QJE10 GH002 –U02-TR3 - DIAGRAM
C&I drawing	348-325758	1	100.10.304 Rev 00,348-24948	0.84/50631 Sheet 4 Rev 1	NUGEN-MEDUPI N2 N2 FIELD MARSHALLING 0 0QJE10 GH002 –U02-SV1 - DIAGRAM

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C&I drawing	348-326119	1	100.10.304 Rev 00,348-24961	0.84/50631 Sheet 5 Rev 1	NUGEN-MEDUPI N2 N2 FIELD MARSHALLING 0 0QJE10 GH002 –U02-SV2 - DIAGRAM
C&I drawing	348-326474	1	100.10.304 Rev 00,348-24980	0.84/50631 Sheet 6 Rev 1	NUGEN-MEDUPI N2 N2 FIELD MARSHALLING 0 0QJE10 GH002 –U02-SV3 - DIAGRAM
C&I drawing	348-325625	2	100.10.304 Rev 2	0.84/50631 Sheet 7 Rev 2	NUGEN-MEDUPI N2 N2 FIELD MARSHALLING 0 0QJE10 GH002 –U02-STR - DIAGRAM
C&I drawing	348-325478	2	100.10.305 Rev 2	0.84/50679 Sheet 1 Rev 2	NUGEN MEDUPI N2 SSB CARD CONNECTION 0 0QJE10 GH002-U01-CPU - DIAGRAM
C&I drawing	348-326728	1	100.10.305 Rev 00,348-24897	0.84/50679 Sheet 2 Rev 1	NUGEN MEDUPI N2 SSB CARD CONNECTION 0 0QJE10 GH002-U01-AI4 - DIAGRAM
C&I drawing	348-325157	2	100.10.306 Rev 2	0.84/50684 Sheet 1 Rev 2	NUGEN-MEDUPI N2 SSB PANEL MARSHALLING 0 0QJE10 GH002 –U01-CP1 - DIAGRAM
C&I drawing	348-325160	1	100.10.306 Rev 00,348-24997	0.84/50684 Sheet 2 Rev 1	NUGEN-MEDUPI N2 SSB PANEL MARSHALLING 0 0QJE10 GH002 –U01-CP2 - DIAGRAM
C&I drawing	348-326683	1	100.10.306 Rev 00,348-24998	0.84/50684 Sheet 3 Rev 1	NUGEN-MEDUPI N2 SSB PANEL MARSHALLING 0 0QJE10 GH002 –U01-CP3 - DIAGRAM
C&I drawing	348-325634	1	100.10.306 Rev 00,348-25000	0.84/50684 Sheet 4 Rev 1	NUGEN-MEDUPI N2 SSB PANEL MARSHALLING 0 0QJE10 GH002 –U01-AT4 - DIAGRAM
C&I drawing	348-325965	1	100.10.306 Rev 00,348-25002	0.84/50684 Sheet 5 Rev 1	NUGEN-MEDUPI N2 SSB PANEL MARSHALLING 0 0QJE10 GH002 –U01-24V - DIAGRAM
C&I drawing	348-325964	1	100.10.306 Rev 00,348-25004	0.84/50684 Sheet 6 Rev 1	NUGEN-MEDUPI N2 SSB PANEL MARSHALLING 0 0QJE10 GH002 –U01-0V - DIAGRAM
C&I drawing	348-326253	1	100.10.306 Rev	0.84/50684 Sheet 7 Rev 1	NUGEN-MEDUPI N2 SSB PANEL MARSHALLING 0 0QJE10 CMS –U01-CMS - DIAGRAM

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			00,348-25005		
C&I drawing	348-325297	1	100.10.306 Rev 00,348-25006	0.84/50684 Sheet 8 Rev 1	NUGEN-MEDUPI N2 SSB PANEL MARSHALLING 0 0QJE10 GH002 –U01-OLM - DIAGRAM
C&I drawing	348-325045	1	100.10.306 Rev 00,348-25008	0.84/50684 Sheet 9 Rev 1	NUGEN-MEDUPI N2 SSB PANEL MARSHALLING 0 0QJE10 GH002 –U01-ETH - DIAGRAM
C&I drawing	348-326107	2	100.10.307 Rev 2	0.84/50680 Sheet 1 Rev 2	NUGEN-MEDUPI N2 SSB FIELD MARSHALLING 0 0QJE10 GH002 –U01-CRT - DIAGRAM
C&I drawing	348-325469	1	100.10.307 Rev 00,348-25102	0.84/50680 Sheet 2 Rev 1	NUGEN-MEDUPI N2 SSB FIELD MARSHALLING 0 0QJE10 GH002 –U01-DWS - DIAGRAM
C&I drawing	348-324898	2	100.10.310 Rev 2	0.84/50629 Sheet 1 Rev 2	LOOP DRAWING NITROGEN PLAN_N2 TRAIN 1 EXTERNAL FEED BACK TAG_NO.:0 1QJE10 TR001 - DIAGRAM
C&I drawing	348-25181	2	100.10.311 Rev 2	0.84/50634 Sheet 2 Rev 2	LOOP DRAWING NITROGEN PLAN_N2 TRAIN 2 EXTERNAL FEED BACK TAG_NO.:0 2QJE10 TR002 - DIAGRAM
C&I drawing	348-25185	2	100.10.312 Rev 2	0.84/50635 Sheet 3 Rev 2	LOOP DRAWING NITROGEN PLAN_N2 TRAIN 3 EXTERNAL FEED BACK TAG_NO.:0 3QJE10 TR003 - DIAGRAM
C&I drawing	348-25239	2	100.10.313 Rev 2	0.84/50636 Sheet 4 Rev 2	LOOP DRAWING NITROGEN PLAN_N2 TRAIN 1 SOLENOIDS TAG_NO.:0 3QJE10 AA211 - DIAGRAM
C&I drawing	348-25263	2	100.0.314 Rev 2	0.84/50637 Sheet 5 Rev 2	LOOP DRAWING NITROGEN PLAN_N2 TRAIN 2 SOLENOIDS TAG_NO.:0 2QJE10 AA211-2 - DIAGRAM
C&I drawing	348-25296	2	100.10.315 Rev 2	0.84/50638 Sheet 6 Rev 2	LOOP DRAWING NITROGEN PLANT_N2 TRAIN 3 SOLENOIDS TAG_NO.:0 3QJE10 AA211-2 - DIAGRAM
C&I drawing	348-25304	2	100.10.316 Rev 2	0.84/50639 Sheet 7 Rev 2	LOOP DRAWING NITROGEN PLAN_N2 STORAGE PRESSURE TAG_NO.:0 0QJE10 CP001-2 - DIAGRAM
C&I drawing	348-324948	2	100.10.317 Rev 2	0.84/50681 Sheet 1 Rev 2	LOOP DRAWING NITROGEN PLANT SSB & SERVICE TAG_NO.:0 0QJD10 CF001 - DIAGRAM

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C&I drawing	348-326396	2	100.10.318 Rev 2	0.84/50682 Sheet 1 Rev 2	LOOP DRAWING NITROGEN PLANT SSB & SERVICE TAG_NO.:0 4QJD10 CF002 - DIAGRAM
C&I drawing	348-25324	2	100.10.319 Rev 2	0.84/50640 Sheet 8 Rev 2	LOOP DRAWING NITROGEN PLANT _N2 TRAIN 1 BOOSTER PUMP TAG_NO.:0 1QJE20 AN001 - DIAGRAM
C&I drawing	348-25328	2	100.10.320 Rev 2	0.84/50675 Sheet 9 Rev 2	LOOP DRAWING NITROGEN PLANT _N2 TRAIN 2 BOOSTER PUMP TAG_NO.:0 2QJE20 AN001 - DIAGRAM
C&I drawing	348-25331	2	100.10.321 Rev 2	0.84/50676 Sheet 10 Rev 2	LOOP DRAWING NITROGEN PLANT _N2 TRAIN 3 BOOSTER PUMP TAG_NO.:0 3QJE20 AN001 - DIAGRAM
C&I drawing	348-25340	2	100.10.322 Rev 2	0.84/50677 Sheet 11 Rev 2	LOOP DRAWING NITROGEN_PLANT_N2 TAG_NO.: 0 0QJE10-GH002-U2 - DIAGRAM
C&I drawing	348-325379	1	100.10.324 Rev 00,348-25346	0.84/50683 Sheet 1 Rev 1	GENERAL ARRANGEMENT NITROGEN PLANT_0QJE10 SSB_MASTER PANEL TAG.:_NO 0_0QJE10_GH002_U01- DIAGRAM
C&I drawing	348-325380	1	100.10.325 Rev 0,348-25375	0.84/50632 Sheet 1 Rev 1	GENERAL ARRANGEMENT NITROGEN PLANT_0QJE10 LCP_PANEL TAG.:_NO 0_0QJE10_GH002_U02- DIAGRAM
C&I drawing	348-325383	1	100.10.326 Rev 0,348-25392	0.84/50678 Sheet 1 Rev 1	POWER DISTRIBUTION NITROGEN_PLANT_LCP_PLANT 220V_/_24V_POWER_DISTRIBUTION_(SINGLE_LINE) TAG.:_NO 0_0QJE10_GH002_U02- DIAGRAM
C&I drawing	348-325630	1	100.10.327 Rev 0,348-25394	0.84/50685 Sheet 1 Rev 1	POWER DISTRIBUTION NITROGEN_PLANT_SSB 220V-/-24V_POWER_DISTRIBUTION_(SINGLE_LINE) TAG.:_NO 0_0QJE10_GH002_U01- DIAGRAM
C&I drawing	348-326152	1	100.10.328 Rev 0,348-25398	0.84/50686 Sheet 1 Rev 1	SYSTEM _ARCHITECTURE NITROGEN_PLANT NETWORK_LAYOUT TAG_NO.: N2-SSB-FIBRE - DIAGRAM
C&I report	348-325763	0	NGT-ME-N2-RPT-009 Rev 02	200-615419 Rev 0	NGT-ME-N2-RPT-009 NITROGEN PLANT FUNCTIONAL SPECIFICATION REPORT - SPECIFICATION
Civil drawing	348-325543	4		0.84/47220 Sheet 1 Rev 4	GENERAL ARRANGEMENT NITROGEN PLANT EARTHING GA KKS:0 1QJA10 - LAYOUT DRAWING

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Civil drawing	348-904986	4	100.10.062 Sheet 2 Rev 4	0.84/47220 Sheet 2 Rev 4	GENERAL ARRANGEMENT MITROGEN PLANT EARTHING GA KKS: 0 1QJA10 - LAYOUT DRAWING
Civil drawing	348-325510	2	100.10.082 Rev 4	0.84/51647-SHEET 1 Rev 2	NITROGEN PLANT CONCRETE LAYOUT - LAYOUT
Civil drawing	348-325509	1	100.10.083 Rev 1	0.84/50790-SHEET 1 Rev 1	NITROGEN PLANT SLAB A REINFORCEMENT - REINFORCEMENT
Civil drawing	348-325129	1	100.10.084 Rev 2	0.84/50791-SHEET 1 Rev 1	NITROGEN PLANT SLAB B REINFORCEMENT - REINFORCEMENT
Civil drawing	348-326012	1	100.10.085 Rev 1	0.84/50793-SHEET 1 Rev 1	NITROGEN PLANT SLAB C AND D REINFORCEMENT - REINFORCEMENT
Civil drawing	348-325213	1	100.10.089 Rev 0	0.84/51646-SHEET 1 Rev 1	NITROGEN PLANT CANOPY ASSEMBLY PLAN VIEW - DETAILS
Civil drawing	348-326158	1	100.10.090 Rev 0	0.84/51645-SHEET 1 Rev 1	NITROGEN PLANT CANOPY ASSEMBLY ELEVATIONS - DETAILS
Civil drawing	348-326823	2	100.10.091 Rev 01	0.84/51590 Rev 2	NITROGEN PLANT CANOPY FABRICATION DETAILS - DETAILS
Civil drawing	348-325905	1	100.10.092 Rev 0	0.84/51589-SHEET 1 Rev 1	NITROGEN PLANT CANOPY FABRICATION DETAILS 2 - DETAILS
Civil drawing	348-325219	1	100.10.110 Rev 1	0.84/51008 Rev 1	NITROGEN PLANT CONCRETE CAST IN ITEMS ASSEMBLY AND FABRICATION DETAILS -DETAILS
Civil drawing	348-325770	1	100.10.111 Rev 1	0.84/51009 Rev 1	NITROGEN PLANT STORMWATER DRAINAGE TRENCH AND SUMP REINFORCEMENT DETAILS - REINFORCEMENT
Civil drawing	348-326813	0	100.10.112 Rev 0	0.84/51010-SHEET 1 Rev 0	NITROGEN PLANT PIPE RACK PAD FOOTING REINFORCEMENT - REINFORCEMENT
Civil drawing	348-326402	1	100.10.114 Rev 1	0.84/51077 Sheet 1 Rev 1	NITROGEN PLANT NITROGEN STORAGE TANKS LINE ROAD CROSSING PIPE TRENCH CONCRETE DETAILS - DETAILS
Civil drawing	348-325644	0	100.10.115 Rev 0	0.84/51078-SHEET 1 Rev 0	NITROGEN PLANT NITROGEN STORAGE TANKS LINE ROAD CROSSING PIPE TRENCH REINFORCEMENT - REINFORCEMENT

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Civil drawing	348-326010	2	100.10.248 Rev 1	0.84/50689 Rev 1	NITROGEN PLANT PIPE SUPPORTS PS-001 CONCRETE REINFORCEMENT AND FABRICATION DETAILS - DETAIL DRAWING
Civil drawing	348-326833	2	100.10.262 Rev 1	0.84/51588 Sheet 1 Rev 2	NITROGEN PLANT CANOPY FABRICATION DETAILS 3 - DETAILS
Civil drawing	348-325648	2	0.84/51587 Sheet 1 Rev 2	100.10.263 Rev 1	NITROGEN PLANT CANOPY FABRICATION DETAILS 4 - DETAILS
Civil drawing	348-326575	2	100.10.264 Rev 1	0.84/51586 Sheet 1 Rev 2	NITROGEN PLANT CANOPY FABRICATION DETAILS 5 - DETAILS
Civil drawing	348-325204	2	100.10.265 Rev 1	0.84/51585 Sheet 1 Rev 2	NITROGEN PLANT CANOPY FABRICATION DETAILS 6 - DETAILS
Civil drawing	348-326165	2	100.10.266 Rev 1	0.84/51584 Sheet 1 Rev 2	NITROGEN PLANT CANOPY FABRICATION DETAILS 7 - DETAILS
Civil drawing	348-326282	0	100.10.269 Rev 0	0.84/51152-SHEET 1 Rev 0	NITROGEN PLANT CANOPY ROOF SHEETING DETAILS - DETAILS
Civil drawing	---	18	J26182/A/TER/SW/05	0.84/198	MEDUPI POWER STATION STORMWATER LAYOUT
Civil report	348-325730	0	NGT-ME-RPT-020 Rev 00	200-620207 Rev 0	NITROGEN PLANT STRUCTURAL STEEL CANOPY DESIGN REPORT - DESIGN REPORT
Civil report	348-325209	0		200-616136 Rev 0	NITROGEN PLANT SURFACE BED DESIGN REPORT - DESIGN REPORT
Component drawing	348-324773	2	100.10.009 Rev 1	0.84/46769-SHEET 1 Rev 2	GENERAL ARRANGEMENT NITROGEN PLANT FD870 AIR DRYER GENERAL ARRANGEMENT - GENERAL ARRANGEMENT
Component drawing	348-324789	2	100.10.012 Rev 1	0.84/46772-SHEET 1 Rev 2	GENERAL ARRANGEMENT NITROGEN PLANT NGP250 NITROGEN GENERATOR GENERAL ARRANGEMENT - GENERAL ARRANGEMENT
Component drawing	348-325259	1	100.10.027 Rev 1	0.84/46787-SHEET 1 Rev 1	GA NITROGEN PLANT AN44 BOOSTER GENERAL ARRANGEMENT - ARRANGEMENT
Component drawing	348-324975	1	100.10.038 Rev 1	0.84/46798-SHEET 1 Rev 1	GENERAL ARRANGEMENT NITROGEN PLANT BOP 3 0M3 VERTICAL NITROGEN RECEIVERS GA AND DETAILS - ARRANGEMENT
Component drawing	348-325506	1	100.10.039 Rev 1	0.84/46799-SHEET 1 Rev 1	GENERAL ARRANGEMENT NITROGEN PLANT BOP 3 0M3 VERTICAL AIR

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					RECEIVERS GA AND DETAILS - ARRANGEMENT
Component drawing	348-325886	1	100.10.040 Rev 1	0.84/46800-SHEET 1 Rev 1	GENERAL ARRANGEMENT NITROGEN PLANT BOP 118.0M3 HORIZONTAL NITROGEN RECEIVER - ARRANGEMENT
Component drawing	348-326110	0	100.10.064 Rev 0	0.84/50359-SHEET 1 Rev 0	GA NITROGEN PLANT TRAIN 1 ZT160 AIR COMPRESSOR GENERAL ARRANGEMENT - ARRANGEMENT
Component drawing	348-326781	0	100.10.093 Rev 0	0.84/50362-SHEET 1 Rev 0	GA NITROGEN PLANT TRAIN 1 DDP130 PLUS FILTER GENERAL ARRANGEMENT - ARRANGEMENT
Component drawing	348-326729	0	100.10.094 Rev 0	0.84/50357-SHEET 1 Rev 0	GA NITROGEN PLANT TRAIN 1 DD850 FILTER GENERAL ARRANGEMENT - ARRANGEMENT
Component drawing	348-325044	0	100.10.167 Rev 0	0.84/50345-SHEET 1 Rev 0	GA NITROGEN PLANT NITROGEN PLANT TRAIN 2 ZT160 AIR COMPRESSOR GENERAL ARRANGEMENT - DIAGRAM
Component drawing	348-326704	0	100.10.168 Rev 0	0.84/50346-SHEET 1 Rev 0	GA NITROGEN PLANT NITROGEN PLANT TRAIN 3 ZT160 AIR COMPRESSOR GENERAL ARRANGEMENT - DIAGRAM
Component drawing	348-326395	0	100.10.169 Rev 0	0.84/50347-SHEET 1 Rev 0	GA NITROGEN PLANT NITROGEN PLANT TRAIN 2 FD870 AIR DRYER GENERAL ARRANGEMENTT - DIAGRAM
Component drawing	348-325236	0	100.10.170 Rev 0	0.84/50348-SHEET 1 Rev 0	GA NITROGEN PLANT NITROGEN PLANT TRAIN 3 FD870 AIR DRYER GENERAL ARRANGEMENT - DIAGRAM
Component drawing	348-325732	0	100.10.171 Rev 0	0.84/50349-SHEET 1 Rev 0	GA NITROGEN PLANT NITROGEN PLANT TRAIN 2 NGP250 NITROGEN GENERATOR GENERAL ARRANGEMENT - ARRANGEMENT
Component drawing	348-326702	0	100.10.172 Rev 0	0.84/50350-SHEET 1 Rev 0	GA NITROGEN PLANT NITROGEN PLANT TRAIN 3 NGP250 NITROGEN GENERATOR GENERAL ARRANGEMENT - ARRANGEMENT - ARRANGEMENT
Component drawing	348-325466	0	100.10.173 Rev 0	0.84/50351-SHEET 1 Rev 0	GA NITROGEN AN44F BOOSTER TRAIN 2 GENERAL ARRANGEMENT - ARRANGEMENT
Component drawing	348-326105	0	100.10.174 Rev 0	0.84/50352-SHEET 1 Rev 0	GA NITROGEN PLANT AN44F BOOSTER TRAIN 3 GENERAL ARRANGEMENT - ARRANGEMENT
Component drawing	348-325608	0	100.10.175 Rev 0	0.84/50353-SHEET 1 Rev 0	GA NITROGEN PLANT TRAIN 2 DDP130 PLUS FILTER GENERAL ARRANGEMENT - ARRANGEMENT

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Component drawing	348-325847	0	100.10.176 Rev 0	0.84/50354-SHEET 1 Rev 0	GA NITROGEN PLANT TRAIN 3 DDP130 PLUS FILTER GENERAL ARRANGEMENT - ARRANGEMENT
Component drawing	348-325843	0	100.10.177 Rev 0	0.84/50355-SHEET 1 Rev 0	GA NITROGEN PLANT TRAIN 2 D0850 FILTER GENERAL ARRANGEMENT - ARRANGEMENT
Component drawing	348-325248	0	100.10.178 Rev 0	0.84/50356-SHEET 1 Rev 0	GA NITROGEN PLANT TRAIN 3 D0850 FILTER GENERAL ARRANGEMENT - ARRANGEMENT
Control philosophy	348-325834	1	NGT-EL-N2-DSG-041 Rev 01	200-213241 Rev 1	NITROGEN GENERATING PLANT CONTROLS PHILOSOPHY - DATA SHEET
Design calculations	348-326658	0	NGT-ME-N2-CAL-043	200-216388 Rev 0	NGT-ME-N2-CAL-043 DESIGN CALCS - COMPRESSOR, DRYER & NGP - CALCULATONS
Design calculations	348-325912	1	NGT-ME-N2-CAL-044 Rev 1	200-214623 Rev 1	DESIGN CALCS – BOOSTER - DATA SHEET
Design calculations	348-325495	0	NGT-ME-N2-CAL-045 Rev A	200-216588 Rev 0	DESIGN CALCS – BULK STORAGE - CALCULATIONS
Design calculations	348-325286	1	NGT-ME-N2-CAL-046 Rev 01	200-220221 Rev 1	NITROGEN GENERATING PLANT DESIGN CALCS – N2 VESSEL 3M/3 - CALCULATIONS
Design calculations	348-325013	1	NGT-ME-N2-CAL-047 Rev 01	200-216586 Rev 1	NITROGEN GENERATING PLANT DESIGN CALCS – AIR VESSEL 3M/3 - CALCULATION
Design calculations	348-326001	1	NGT-ME-N2-CAL-048 Rev 01	200-220223 Rev 1	NITROGEN GENERATING PLANT DESIGN CALCS – BULK N2 VESSEL 118M/3 - CALCULATIONS
Design calculations	348-324854	0	NGT-ME-N2-MOD-001 Rev 01	200-614823 Rev 0	NGT-ME-N2-MOD-001 NITROGEN PLANT NITROGEN PLANT GAS DISPERSION MODEL - REPORT
Electrical drawing	348-325862	2	100.10.010 Rev 1	0.84/46770-SHEET 1 Rev 2	AIR DRYER, FD870A WIRING DIAGRAM - ARRANGEMENT

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Electrical drawing	348-326393	2	100.10.013 Rev 1	0.84/46773-SHEET 1 Rev 2	ELECTRICAL SCHEMATIC NITROGEN PLANT TRAIN 1 NGP250 NITROGEN GENERATOR INTERNAL ELECTRICAL SCHEMATIC - ARRANGEMENT
Electrical drawing	348-325894	2	100.10.028 Rev 1	0.84/46788-SHEET 1 Rev 2	ELECTRICAL SCHEMATIC NITROGEN PLANT TRAIN 1 AN44F BOOSTER INTERNAL ELECTRICAL SCHEMATIC DIAGRAM - DIAGRAM
Electrical drawing	348-326727	0	100.10.153 Rev 0	0.84/50331-SHEET 1 Rev 0	ELECTRICAL SCHEMATIC NITROGEN PLANT TRAIN 2 FD870 AIR DRYER ELECTRICAL SCHEMATIC - DIAGRAM
Electrical drawing	348-326106	0	100.10.154 Rev 0	0.84/50332-SHEET 1 Rev 0	ELECTRICAL SCHEMATIC NITROGEN PLANT TRAIN 3 FD870 AIR DRYER ELECTRICAL SCHEMATIC - DIAGRAM
Electrical drawing	348-325724	0	100.10.155 Rev 0	0.84/50333-SHEET 1 Rev 0	ELECTRICAL SCHEMATIC NITROGEN PLANT TRAIN 2 NGP250 NITROGEN GENERATOR INTERNAL ELECTRICAL SCHEMATIC - DIAGRAM
Electrical drawing	348-325614	0	100.10.156 Rev 0	0.84/50334-SHEET 1 Rev 0	ELECTRICAL SCHEMATIC NITROGEN PLANT TRAIN 3 NGP250 NITROGEN GENERATOR INTERNAL ELECTRICAL SCHEMATIC- DIAGRAM
Electrical drawing	348-325723	0	100.10.157 Rev 0	0.84/50335-SHEET 1 Rev 0	ELECTRICAL SCHEMATIC NITROGEN PLANT TRAIN 2 AN44F BOOSTER INTERNAL ELECTRICAL SCHEMATIC- DIAGRAM
Electrical drawing	348-324900	0	100.10.158 Rev 0	0.84/50336-SHEET 1 Rev 0	ELECTRICAL SCHEMATIC NITROGEN PLANT TRAIN 3 AN44F BOOSTER INTERNAL ELECTRICAL SCHEMATIC- DIAGRAM
Electrical drawing	348-907285	0	100.10.383 Rev 1	0.84/53230 Sheet 1 Rev 0	NITROGEN PLANT SINGLE LINE DIAGRAM - DIAGRAM
Electrical drawing	348-907288	0	100.10.384 Rev 1	0.84/53231 Sheet 1 Rev 0	NITROGEN PLANT SCHEMATIC DIAGRAM LIGHTING CIRCUITS - DIAGRAM
Electrical drawing	348-907298	0	100.10.385 Rev 1	0.84/53232 Sheet 1 Rev 0	NITROGEN PLANT BLOCK DIAGRAM ELECTRICAL EQUIPMENT - DIAGRAM
Electrical drawing	348-907299	0	100.10.386 Rev 1	0.84/53233 Sheet 1 Rev 0	NITROGEN PLANT BLOCK DIAGRAM ELECTRICAL LAYOUT - DIAGRAM
Electrical drawing	348-907301	0	100.10.387 Rev 1	0.84/53234 Sheet 1 Rev 0	NITROGEN PLANT EQUIPMENT LOCATION DIAGRAM LIGHTING & CIRCUIT LAYOUT - DIAGRAM
Electrical drawing	348-907308	0	100.10.388 Rev 1	0.84/53235 Sheet 1 Rev 0	NITROGEN PLANT CABLE RACKING AND ROUTING ELECTRICAL RACKING - DIAGRAM

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Electrical drawing	348-907310	0	100.10.389 Rev 1	0.84/53236 Sheet 1 Rev 0	NITROGEN PLANT CABLE RACKING AND ROUTING ELECTRICAL RACKING - DIAGRAM
Electrical drawing	348-907312	0	100.10.390 Rev 1	0.84/53237 Sheet 1 Rev 1	NITROGEN PLANT CABLE RACKING AND ROUTING ELECTRICAL RACKING - DIAGRAM
Electrical drawing	348-907314	0	100.10.391 Rev 1	0.84/53238 Sheet 1 Rev 0	NITROGEN PLANT CABLE RACKING AND ROUTING ELECTRICAL RACKING - DIAGRAM
Electrical drawing	348-907407	0	100.10.397 Rev 1	0.84/53241 Sheet 1 Rev 0	NITROGEN PLANT CABLE INSTALLATION DETAILS POLE MOUNTED BULKHEAD - DIAGRAM
Electrical drawing	348-907410	0	100.10.398 Rev 1	0.84/53242 Sheet 1 Rev 1	NITROGEN PLANT CABLE INSTALLATION CONNECTION BOX - DIAGRAM
Electrical drawing	348-907447	0	100.10.399 Rev 1	0.84/53243 Sheet 1 Rev 0	NITROGEN PLANT CABLE INSTALLATION DETAILS BUILDING LIGHT FITURES - DIAGRAM
Electrical load list	348-907284	0	100.10.382 Rev 1	0.84/53229 Sheet 1 Rev 0	NITROGEN PLANT LOAD LIST MCC - DIAGRAM
Electrical schedule	348-907320	0	100.10.392 Rev 1	0.84/53239 Sheet 1 Rev 0	NITROGEN PLANT CABLE SCHEDULE MCC - DIAGRAM
Electrical schedule	348-907398	0	100.10.393 Rev 1	0.84/53240 Sheet 1 Rev 0	NITROGEN PLANT CABLE TERMINATION SCHEDULE MCC - DIAGRAM
Electrical schedule	348-907321	0	100.10.394 Rev 1	0.84/53240 Sheet 2 Rev 0	NITROGEN PLANT CABLE TERMINATION SCHEDULE MCC - DIAGRAM
Electrical schedule	348-907403	0	100.10.395 Rev 1	0.84/53240 Sheet 3 Rev 0	NITROGEN PLANT CABLE TERMINATION SCHEDULE MCC - DIAGRAM
Electrical schedule	348-907404	0	100.10.396 Rev 1	0.84/53240 Sheet 4 Rev 0	NITROGEN PLANT CABLE TERMINATION SCHEDULE MCC - DIAGRAM
Flow analysis report	348-326900	1	NGT-ME-N2-ANL-040 Rev 01	200-214628 Rev 1	NITROGEN PLANT HYDRAULIC ANALYSIS - DATA SHEET
Flow analysis report	348-325237	0	NGT-ME-N2-DAT-133 Rev 00	200-617212 Rev 0	NITROGEN PLANT MODEL INPUT DATA SHEET - DATA SHEET
Flow analysis report	348-324932	0	NGT-ME-N2-DAT-134 Rev 00	200-617213 Rev 0	NITROGEN PLANT SCENARIO 1 MAX FLOW CRT - DATA SHEET
Flow analysis report	348-325617	P		200-614590 Rev P	MEDUPI_N2_SCEN2_AVERAGE_FLOW_CRT.XLSX - DATA SHEET
Flow analysis report	348-326803	0	NGT-ME-N2-DAT-	200-614591 Rev 0	MEDUPI_N2_SCEN3_MAX_FLOW_DWST.XLSX - DATA SHEET

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			136 Rev 00		
Flow analysis report	348-325249	P	NGT-ME-N2-DAT-137 Rev 00	200-614592 Rev P	NITROGEN PLANT SCENARIO 4 AVERAGE FLOW - DATA SHEET
Flow analysis report	348-325250	P		200-614594 Rev P	FLOW ANALYSIS ON MEDUPI NITROGEN SUPPLY LINES - REPORT
General arrangement drawing	348-325198	1	100.10.018 Rev 1	0.84/46778-SHEET 1 Rev 1	GA NITROGEN PLANT GENERAL ARRANGEMENT - ARRANGEMENT
General arrangement drawing	348-325962	1	100.10.019 Rev 1	0.84/46779-SHEET 1 Rev 1	GA NITROGEN PLANT TRAINS 1 2 3 SKID SIDE PLUS TOP VIEW GENERAL ARRANGEMENT - ARRANGEMENT
General arrangement drawing	348-324776	1	100.10.100 Sheet 1 Rev 3	0.84/50708 Sheet 1 Rev 1	P20B NITROGEN GENERATOR PLANT GENERAL ARRANGEMENT - ARRANGEMENT
General arrangement drawing	348-324777	1	100.10.101 Sheet 1 Rev 3	0.84/50709 Sheet 1 Rev 1	UNIT 6 NITROGEN PLANT TURBINE HALL UNIT 6 PLAN ON PIPING ARRANGEMENT SHEET 1 OF 2 - ARRANGEMENT
General arrangement drawing	348-324814	1	100.10.101 Sheet 2 Rev 4	0.84/50709 Sheet 2 Rev 1	UNIT 6 NITROGEN PLANT TURBINE HALL UNIT 6 ELEVATIONS ON PIPING ARRANGEMENT SHEET 2 OF 2 - ARRANGEMENT
General arrangement drawing	348-324802	1	100.10.102 Rev 3	0.84/50710 Rev 3	UNIT 2, 3, 4, 5 NITROGEN PLANT TURBINE HALL UNIT 5, 4, 3 AND 2 PLANS AND ELEVATIONS ON PIPING ARRANGEMENT - ARRANGEMENT
General arrangement drawing	348-324825	3	100.10.103 Rev 3	0.84/50711 Sheet 1 Rev 3	UNIT 1 NITROGEN PLANT TURBINE HALL UNIT 1 ELEVATIONS ON PIPING ARRANGEMENT - LAYOUT DRAWING
General arrangement drawing	348-324775	2	100.10.104 Sheet 1 Rev 4	0.84/50712 Sheet 1 Rev 2	P20B NITROGEN GENERATION PLANT PLAN ON LP TRENCH PIPING ARRANGEMENT SHEET 1 OF 2 - LAYOUT DRAWING
General arrangement drawing	348-324778	1	100.10.104 Sheet 2 Rev 4	0.84/50712 Sheet 2 Rev 1	P20B NITROGEN GENERATION PLANT SECTIONS ON LP TRENCH PIPING ARRANGEMENT SHEET 2 OF 2 - ARRANGEMENT
General arrangement drawing	348-324796	1	100.10.105 Rev 5	0.84/50713 Rev 1	P20B NITROGEN GENERATION PLANT PLAN ON LP TRENCH PIPING ARRANGEMENT - ARRANGEMENT

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General arrangement drawing	348-324793	1	100.10.106 Sheet 1 Rev 5	0.84/50714 Sheet 1 Rev 1	P20B NITROGEN GENERATION PLANT PLAN ON LP TRENCH PIPING ARRANGEMENT SHEET 1 OF 2 - ARRANGEMENT
General arrangement drawing	348-324848	4	100.10.106 Sheet 2 Rev 4	0.84/50714 Sheet 2 Rev 4	P20B NITROGEN GENERATION PLANT PLAN ON LP TRENCH PIPING ARRANGEMENT SHEET 2 OF 2 - ARRANGEMENT
General arrangement drawing	348-324822	1	100.10.107 Sheet 1 Rev 1	0.84/50715 Sheet 1 Rev 1	UNIT 6 NITROGEN PLANT TURBINE HALL UNIT 6 LP TRENCH PLANS AND SECTIONS - SECTION
General arrangement drawing	348-324824	1	100.10.107 Sheet 2 Rev 1	0.84/50715 Sheet 2 Rev 1	UNIT 6 NITROGEN PLANT TURBINE HALL UNIT 6 LP TRENCH PLANS AND SECTIONS - SECTION
General arrangement drawing	348-325903	2	100.10.108 Rev 1	0.84/51644 Sheet 1 Rev 2	NITROGEN PLANT GENERAL ARRANGEMENT - ARRANGEMENT
HAZOP study report	348-325251	P	NGT-ME-N2-RPT-004 Rev 00	200-614596 Rev P	NITROGEN PLANT HAZOP 3 REPORT - REPORT
HAZOP study report	348-326261	0	NGT-ME-N2-RPT-021 Rev 00	200-625746 Rev 0	NITROGEN PLANT HAZOP 3 CLOSE-OUT REPORT - REPORT
Maintenance requirements	348-325256	P	NGT-ME-N2-RPT-010 Rev 00	200-616124 Rev P	MAINTENANCE REQUIREMENTS & CRITICAL SPARES REPORT - REPORT
Operating philosophy	348-324855	0	NGT-EL-N2-DSG-043 Rev 02	200-616130 Rev 0	NITROGEN PLANT OPERATING PHILOSOPHY - DESIGN REPORT
Pipe stress analysis report	348-325192	P	NGT-ME-N2-ANL-049 Rev 00	200-615960 Rev P	NITROGEN PLANT PIPE STRESS ANALYSIS - RELIABILITY ANALYSIS REPORT - REPORT
Pipe support design input	348-326519	0	NGT-ME-N2-RPT-028 Rev 00	200-616143 Rev 0	NITROGEN PLANT LOAD REGISTER FOR N2 PIPE SUPPORTS - DESIGN REPORT
Pipe support design report	348-326208	P	NGT-ME-N2-RPT-006 Rev 00	200-614597 Rev P	PIPE SUPPORT BRACKET DESIGN REPORT - REPORT

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Pipe support design report	348-326707	0	NGT-ME-N2-RPT-011 Rev ESKOM	200-620167 Rev 0	NITROGEN PLANT PIPE SUPPORT BRACKET DESIGN - DESIGN REVIEW REPORT
Pipe support design report	348-325958	0	NGT-ME-N2-RPT-012 Rev 00	200-620172 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-006 - DESIGN REPORT
Pipe support design report	348-326480	0	NGT-ME-N2-RPT-013 Rev 00	200-620177 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-007 - DESIGN REPORT
Pipe support design report	348-326210	0	NGT-ME-N2-RPT-014 Rev 00	200-620180 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-008 - DESIGN REPORT
Pipe support design report	348-325721	0	NGT-ME-N2-RPT-015 Rev 00	200-620182 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-009 - DESIGN REPORT
Pipe support design report	348-325722	0	NGT-ME-N2-RPT-016 Rev 00	200-620187 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-010 - DESIGN REPORT
Pipe support design report	348-325610	0	NGT-ME-N2-RPT-017 Rev 00	200-620202 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-011 - DESIGN REPORT
Pipe support design report	348-326780	0	NGT-ME-N2-RPT-018 Rev 00	200-620196 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-012 - DESIGN REPORT
Pipe support design report	348-324933	0	NGT-ME-N2-RPT-019 Rev 00	200-620200 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-013 - DESIGN REPORT
Pipe support design report	348-325300	0	NGT-ME-N2-RPT-022 Rev 00	200-616133 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-014 - DESIGN REPORT
Pipe support design report	348-326163	0	NGT-ME-N2-RPT-023 Rev 00	200-616135 Rev 0	NITROGEN PLANT PIPE SUPPORT PS-002 - DESIGN REPORT

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Pipe support design report	348-326681	0	NGT-ME-N2-RPT-025 Rev 00	200-616137 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-001 - DESIGN REPORT
Pipe support design report	348-326263	0	NGT-ME-N2-RPT-026 Rev 00	200-616138 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-015
Pipe support design report	348-326397	0		200-616142 Rev 0	NITROGEN PLANT PIPE SUPPORT DESIGN PS-016 - DESIGN REPORT - DESIGN REPORT
Pipe support drawing	348-324774	1	100.10.249 Rev 1	0.84/50690 Rev 1	NITROGEN PLANT PIPE SUPPORTS PS-002 FABRICATION DETAILS - DETAIL DRAWING
Pipe support drawing	348-27706	0	100.10.249 Rev B	0.84/51772 Sheet 1 Rev 0	PIPE SUPPORT DRAWING – N2 PLANT - PIPE SUPPORT ST01 - DRAWING
Pipe support drawing	348-324787	1	100.10.250 Rev 0	0.84/50691 Rev 1	NITROGEN PLANT PIPE SUPPORTS PS-003 FABRICATION DETAILS - DETAIL DRAWING
Pipe support drawing	348-27707	0	100.10.250 Rev B	0.84/51773 Rev 0	PIPE SUPPORT DRAWING – N2 PLANT –PIPE SUPPORT ST02 - DRAWING
Pipe support drawing	348-324791	1	100.10.251 Rev 4	0.84/50614 Rev 1	NITROGEN PLANT PIPE SUPPORTS PS-004 ASSEMBLY AND FABRICATION DETAILS - DETAIL DRAWING
Pipe support drawing	348-27709	0	100.10.251 Rev B	0.84/51774 Sheet 1 Rev 0	PIPE SUPPORT DRAWING – N2 PLANT – PIPE SUPPORT ST03 - DRAWING
Pipe support drawing	348-326108	0	100.10.251A Rev B	0.84/50792-SHEET 1 Rev 0	NITROGEN PLANT PIPE SUPPORT PS-004A ASSMBLY AND FABRICATION DETAILS - DETAILS
Pipe support drawing	348-324792	1	100.10.252 Rev 2	0.84/50615 Rev 1	NITROGEN PLANT PIPE SUPPORTS PS-005 ASSEMBLY AND FABRICATION DETAILS - DETAIL DRAWING
Pipe support drawing	348-27711	0	100.10.252 Rev B	0.84/51775 Sheet 1 Rev 0	PIPE SUPPORT DRAWING – N2 PLANT –PIPE SUPPORT ST04 - DRAWING
Pipe support drawing	348-325851	1	100.10.253 Rev 0		NITROGEN PLANT PIPE SUPPORT PS-006 ASSMBLY AND FABRICATION DETAILS - DETAILS
Pipe support drawing	348-325470	1	100.10.254 Rev 0		NITROGEN PLANT PIPE SUPPORT PS 007 ASSMBLY AND FABRICATION DETAILS - DETAILS
Pipe support drawing	348-325729	0	100.10.255 Rev B	0.84/50780-SHEET 1 Rev 0	NITROGEN PLANT PIPE SUPPORT PS 008 ASSMBLY AND FABRICATION DETAILS - DETAILS

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Pipe support drawing	348-326479	1	100.10.256 Rev 1	0.84/50781 Rev 1	NITROGEN PLANT PIPE SUPPORT PS 009 ASSMBLY AND FABRICATION DETAILS - DETAILS
Pipe support drawing	348-324941	1	100.10.257 Rev 0	0.84/50782 Rev 1	NITROGEN PLANT PIPE SUPPORT PS 010 ASSMBLY AND FABRICATION DETAILS - DETAILS
Pipe support drawing	348-326219	1	100.10.258 Rev 1	0.84/50783 Rev 1	NITROGEN PLANT PIPE SUPPORT PS 011 ASSMBLY AND FABRICATION DETAILS - DETAILS
Pipe support drawing	348-325856	1	100.10.259 Rev 0	0.84/50784 Rev 1	NITROGEN PLANT PIPE SUPPORT PS 012 ASSMBLY AND FABRICATION DETAILS - DETAILS
Pipe support drawing	348-325063	0	100.10.260 Rev 00	0.84/50830-SHEET 1 Rev 0	NITROGEN PLANT PIPE SUPPORT PS 013 ASSEMBLY AND FABRICATION DETAILS - DETAILS
Pipe support drawing	348-325257	1	100.10.261 Rev 0	0.84/50831 Rev 1	NITROGEN PLANT EXISTING PIPE SUPPORT PS 014 ASSEMBLY AND FABRICATION DETAILS - DETAILS
Pipe support drawing	348-326832	0	100.10.267 Rev A	0.84/50832-SHEET 1 Rev 0	NITROGEN PLANT EXISTING PIPE SUPPORT PS 015 ASSEMBLY AND FABRICATION DETAILS - DETAILS
Pipe support drawing	348-904964	0	100.10.268 Rev 0	0.84/51081 Sheet 1 Rev 0	PIPE SUPPORT PS-0016 ASSEMBLY & FABRICATION DETAILS - DETAILS
Piping and instrumentation diagram	348-324790	1	100.10.008 Rev 1	0.84/46768-SHEET 1 Rev 1	PROCESS AND INSTRUMENTATION DIAGRAM NITROGEN PLANT FD870 AIR DRYER PROCESS AND INSTRUMENTATION DIAGRAM - PIPING AND INSTRUMENTATION DIAGRAM
Piping and instrumentation diagram	348-324812	1	100.10.011 Rev 1	0.84/46771-SHEET 1 Rev 1	PROCESS AND INSTRUMENTATION DIAGRAM NITROGEN PLANT NGP250 NITROGEN GENERATOR TRAINS 1 2 AND 3 PROCESS AND INSTRUMENT DIAGRAM - PROCESS AND INSTRUMENT DIAGRAM
Piping and instrumentation diagram	348-324771	1	100.10.021 Rev 1	0.84/46781-SHEET 1 Rev 1	P AND ID NITROGEN PLANT NITROGEN PLANT OVERVIEW PROCESS AND INSTRUMENTATION DIAGRAM - PIPING AND INSTRUMENTATION DIAGRAM
Piping and instrumentation diagram	348-324786	2	100.10.026 Rev 2	0.84/46786 Sheet 1 Rev 2	PROCESS AND INSTRUMENT DIAGRAM NITOGEN PLANT AN44F BOOSTER TRAINS 1 2 AND 3 PROCESS AND INSTRUMENT DIAGRAM - PROCESS AND INSTRUMENT DIAGRAM

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Piping and instrumentation diagram	348-324947	0	100.10.065 Rev 0	0.84/50723-SHEET 1 Rev 0	P AND ID NITROGEN PLANT ZT160 AIR COMPRESSOR TRAIN 1 PROCESS AND INSTRUMENT DIAGRAM - DIAGRAM - DIAGRAM
Piping and instrumentation diagram	348-326214	0	100.10.159 Rev 0	0.84/50337-SHEET 1 Rev 0	P AND ID ZT160 AIR COMPRESSOR TRAIN 2 PROCESS & INSTRUMENT DIAGRAM-
Piping and instrumentation diagram	348-326477	0	100.10.160 Rev 0	0.84/50338-SHEET 1 Rev 0	P AND ID NITROGEN PLANT ZT160 AIR COMPRESSOR TRAIN 3 PROCESS & INSTRUMENT DIAGRAM - DIAGRAM
Piping and instrumentation diagram	348-325963	0	100.10.161 Rev 0	0.84/50339-SHEET 1 Rev 0	P AND ID NITROGEN PLANT FD870 AIR DRYER P&ID TRAIN 2 PROCESS AND INSTRUMENT DIAGRAM - DIAGRAM
Piping and instrumentation diagram	348-326206	0	100.10.162 Rev 0	0.84/50340-SHEET 1 Rev 0	P AND ID NITROGEN PLANT FD870 AIR DRYER P&ID TRAIN 3 PROCESS AND INSTRUMENT DIAGRAM - DIAGRAM
Piping and instrumentation diagram	348-326632	0	100.10.163 Rev 0	0.84/50341-SHEET 1 Rev 0	P AND ID NITROGEN PLANT NITROGEN PLANT NGP250 NITROGEN GENERATOR TRAIN 2 PROCESS AND INSTRUMENT DIAGRAM - DIAGRAM
Piping and instrumentation diagram	348-325731	0	100.10.164 Rev 0	0.84/50342-SHEET 1 Rev 0	P AND ID NITROGEN PLANT NITROGEN PLANT NGP250 NITROGEN GENERATOR TRAIN 3 PROCESS AND INSTRUMENT DIAGRAM
Piping and instrumentation diagram	348-324983	0	100.10.165 Rev 0	0.84/50343-SHEET 1 Rev 0	P AND ID NITROGEN PLANT NITROGEN PLANT AN44F BOOSTER TRAIN 2 PROCESS AND INSTRUMENT DIAGRAM - DIAGRAM
Piping and instrumentation diagram	348-326783	0	100.10.166 Rev 0	0.84/50344-SHEET 1 Rev 0	P AND ID NITROGEN PLANT NITROGEN PLANT AN44F BOOSTER TRAIN 3 PROCESS AND INSTRUMENT DIAGRAM - DIAGRAM
Piping arrangement drawing	348-326829	1	100.10.109 Rev 3	0.84/50717-SHEET 1 Rev 1	UNIT 1, 2, 3, 4, 5, 6 NITROGEN PLANT UNIT 6, 5, 4, 3, 2, AND 1 PIPING ARRANGEMENT TP DETAILS - ARRANGEMENT
Piping arrangement drawing	348-325771	0	100.10.113 Rev 0	0.84/51076-SHEET 1 Rev 0	NITROGEN PLANT NITROGEN STROAGE TANKS LINE ROAD CROSSING PIPE TRENCH LAYOUT - LAYOUT
Piping detail drawing	348-17191	0	100.10.220 Rev 0	0.84/51344 Sheet 1 Rev 0	DETAIL DRAWING N2 PLANT DWS VALVE BANK ON 100.10.206 - EQUIPMENT DETAIL DRAWING
Piping detail drawing	348-17202	0	100.10.221 Rev 0	0.84/51345 Sheet 1 Rev 0	DETAIL DRAWING N2 PLANT CRT VALVE BANK ON 100.10.209 - 219 - EQUIPMENT DETAIL DRAWING

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Piping detail drawing	348-17212	0	100.10.222 Rev 0	0.84/51346 Sheet 1 Rev 0	DETAIL DRAWING PIPE BRACKET ON 100.10.206 - EQUIPMENT DETAIL DRAWING
Piping isometric drawing	348-326736	2	100.10.200 Rev 6	0.84/50611 Sheet 1 Rev 2	ISO N2 PLANT DISTRIBUTION LINE FROM B.S.V TO CRT/DWST SPLIT 1 OF 4 - ISOMETRIC
Piping isometric drawing	348-326817	1	100.10.201 Rev 5	0.84/50611-SHEET 2 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM B.S.V TO CRT/DWST SPLIT 2 OF 4 - ISOMETRIC
Piping isometric drawing	348-326527	1	100.10.202 Rev 5	0.84/50611-SHEET 3 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM B.S.V TO CRT/DWST SPLIT 3 OF 4 - ISOMETRIC
Piping isometric drawing	348-325519	1	100.10.203 Rev 5	0.84/50611-SHEET 4 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM B.S.V TO CRT/DWST SPLIT 4 OF 4 - ISOMETRIC
Piping isometric drawing	348-326828	1	100.10.204 Rev 5	0.84/50612-SHEET 1 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM CRT /DWST SPLIT TO DWST 1 OF 3 - ISOMETRIC
Piping isometric drawing	348-325218	1	100.10.205 Rev 5	0.84/50612-SHEET 2 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM CRT /DWST SPLIT TO DWST 2 OF 3 - ISOMETRIC
Piping isometric drawing	348-326539	2	100.10.206 Rev 6	0.84/50612 Sheet 3 Rev 2	ISO N2 PLANT DISTRIBUTION LINE FROM CRT/DWST SPLIT TO DWST 3 OF 3 - ISOMETRIC
Piping isometric drawing	348-326540	1	100.10.207 Rev 5	0.84/50613-SHEET 1 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 1 OF 13 - ISOMETRIC
Piping isometric drawing	348-325221	2	100.10.208 Rev 6	0.84/50613 Sheet 2 Rev 2	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 2 OF 13 - ISOMETRIC
Piping isometric drawing	348-325220	2	100.10.209 Rev 6	0.84/50613 Sheet 3 Rev 2	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 3 OF 13 - ISOMETRIC
Piping isometric drawing	348-325521	1	100.10.210 Rev 4	0.84/50613-SHEET 4 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 4 OF 13 - ISOMETRIC
Piping isometric drawing	348-325765	2	100.10.211 Rev 6	0.84/50613 Sheet 5 Rev 2	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 5 OF 13 - ISOMETRIC
Piping isometric drawing	348-326153	1	100.10.212 Rev 5	0.84/50613-SHEET 6 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 6 OF 13 - ISOMETRIC

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Piping isometric drawing	348-326398	2	100.10.213 Rev 6	0.84/50613 Sheet 7 Rev 2	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 7 OF 13 - ISOMETRIC
Piping isometric drawing	348-326399	1	100.10.214 Rev 5	0.84/50613-SHEET 8 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 8 OF 13 - ISOMETRIC
Piping isometric drawing	348-326819	2	100.10.215 Rev 6	0.84/50613 Sheet 9 Rev 2	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 9 OF 13 - ISOMETRIC
Piping isometric drawing	348-326811	1	100.10.216 Rev 5	0.84/50613-SHEET 10 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 10 OF 13 - ISOMETRIC
Piping isometric drawing	348-325896	2	100.10.217 Rev 6	0.84/50613 Sheet 11 Rev 2	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 11 OF 13 - ISOMETRIC
Piping isometric drawing	348-326739	1	100.10.218 Rev 5	0.84/50613-SHEET 12 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 12 OF 13 - ISOMETRIC
Piping isometric drawing	348-326695	1	100.10.219 Rev 5	0.84/50613-SHEET 13 Rev 1	ISO N2 PLANT DISTRIBUTION LINE FROM LPM/DWST SPLIT TO CRT 13 OF 13 - ISOMETRIC
Piping isometric drawing	348-27532	0	100.10.223 Rev B	0.84/51746 Sheet 1 Rev 0	ISO N2 PLANT TRAIN #1TRAIN#1-FROM ZT 160 AIR COMPRESSOR TO FD870 AIR DRYER - DRAWING
Piping isometric drawing	348-27534	0	100.10.224 Rev B	0.84/51747 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #1 – FROM FD870 DRYER TO AIR RECEIVER - DRAWING
Piping isometric drawing	348-27537	0	100.10.225 Rev B	0.84/51748 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #1 – FROM AIR RECEIVER TO NGP250 NITROGEN GENERATOR - DRAWING
Piping isometric drawing	348-27540	0	100.10.226 Rev B	0.84/51749 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #1 – FROM NGP250 NITROGEN GENERATOR TO NITROGEN RECEIVER - DRAWING
Piping isometric drawing	348-27546	0	100.10.227 Rev B	0.84/51750 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #1 – FROM NGP250 NITROGEN GENERATOR ANALYSER TO NITROGEN RECEIVER - DRAWING
Piping isometric drawing	348-31485	0	100.10.228 Rev B	0.84/53426 Sheet 1 Rev 0	ISO N2 PLANT TRAIN#1 TRAIN#1-FROM NITROGEN RECEIVER TO AN44F BOOSTER - DRAWING
Piping isometric drawing	348-27552	0	100.10.229 Rev B	0.84/51752 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #1 – FROM NITROGEN RECEIVER TO AN44F BOOSTER FEED - DRAWING

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Piping isometric drawing	348-27675	0	100.10.230 Rev B	0.84/51753 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #3 – FROM ZT160 AIR COMPRESSOR TO FD870 AIR DRYER - DRAWING
Piping isometric drawing	348-27563	0	100.10.231 Rev B	0.84/51754 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #2 – FROM FD870 DRYER TO AIR RECEIVER - DRAWING
Piping isometric drawing	348-27570	0	100.10.232 Rev B	0.84/51755 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #2 – FROM AIR RECEIVER TO NGP250 NITROGEN GENERATOR - DRAWING
Piping isometric drawing	348-27574	0	100.10.233 Rev B	0.84/51756 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #2 – FROM NGP250 NITROGEN GENERATOR TO NITROGEN RECEIVER - DRAWING
Piping isometric drawing	348-27575	0	100.10.234 Rev B	0.84/51757 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #2 – FROM NGP250 NITROGEN GENERATOR ANALYSER TO NITROGEN RECEIVER - DRAWING
Piping isometric drawing	348-27578	0	100.10.235 Rev B	0.84/51758 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #2 – FROM NITROGEN RECEIVER TO AN44F BOOSTER - DRAWING
Piping isometric drawing	348-27581	0	100.10.236 Rev B	0.84/51759 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #2 – FROM NITROGEN RECEIVER TO AN44F BOOSTER FEED - DRAWING
Piping isometric drawing	348-27560	0	100.10.237 Rev B	0.84/51760 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #3 – FROM ZT160 AIR COMPRESSOR TO FD870 AIR DRYER - DRAWING
Piping isometric drawing	348-27677	0	100.10.238 Rev B	0.84/51761 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #3 – FROM FD870 DRYER TO AIR RECEIVER - DRAWING
Piping isometric drawing	348-27685	0	100.10.239 Rev B	0.84/51762 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #3 – FROM AIR RECEIVER TO NGP250 NITROGEN GENERATOR - DRAWING
Piping isometric drawing	348-27686	0	100.10.240 Rev B	0.84/51763 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #3 – FROM NGP250 NITROGEN GENERATOR TO NITROGEN RECEIVER - DRAWING
Piping isometric drawing	348-27688	0	100.10.241 Rev B	0.84/51764 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #3 – FROM NGP250 NITROGEN GENERATOR ANALYSER TO NITROGEN RECEIVER - DRAWING
Piping isometric drawing	348-27689	0	100.10.242 Rev B	0.84/51765 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #3 – FROM NITROGEN RECEIVER TO AN44F BOOSTER - DRAWING
Piping isometric drawing	348-27691	0	100.10.243 Rev B	0.84/51766 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #3 – FROM NITROGEN RECEIVER TO AN44F BOOSTER FEED - DRAWING
Piping isometric drawing	348-27692	0	100.10.244 Rev B	0.84/51767 Sheet 1 Rev 0	ISO-N2 PLANT – FROM 118M^3 BULK STORAGE VESSELS TO AN44F BOOSTER - DRAWING

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
Piping isometric drawing	348-27694	0	100.10.245 Rev B	0.84/51768 Sheet 2 Rev 0	ISO-N2 PLANT – FROM 118M^3 BULK STORAGE VESSELS TO AN44F BOOSTER - DRAWING
Piping isometric drawing	348-27696	0	100.10.246 Rev B	0.84/51769 Sheet 1 Rev 0	ISO-N2 PLANT TRAIN #1 – FROM AN44F BOOSTER TO 118M^3 BULK STORAGE VESSEL - DRAWING
Piping isometric drawing	348-27700	0	100.10.247 Rev B	0.84/51770 Sheet 2 Rev 0	ISO-N2 PLANT TRAIN #1 – FROM AN44F BOOSTER TO 118M^3 BULK STORAGE VESSEL - DRAWING
Piping isometric drawing	348-27703	0	100.10.248 Rev B	0.84/51771 Sheet 3 Rev 0	ISO-N2 PLANT TRAIN #1 – FROM AN44F BOOSTER TO 118M^3 BULK STORAGE VESSEL- DRAWING
Process flow diagram	348-324987	2	100.10.025 Rev 1	0.84/47016-SHEET 1 Rev 2	PFD NITROGEN PLANT NITROGEN PLANT PROCESS FLOW FLOW DIAGRAM - DIAGRAM - DIAGRAM
RAM study report	348-325636	1	NGT-ME-N2-RPT-008 Rev 01	200-615992 Rev 1	NITROGEN PLANT RELIABILITY, AVAILABILITY & MAINTAINABILITY STUDY REPORT - REPORT

APPENDIX F: NORMATIVE REFERENCES (EXCLUDING PUBLICLY AVAILABLE DOCUMENTS AND DOCUMENTS INCLUDED IN ANOTHER APPENDIX))

F.1 MEDUPI DOCUMENTS

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
Document	348-670608	3		200-11303 Rev 3	MEDUPI POWER STATION HEALTH, SAFETY AND ENVIRONMENTAL POLICY - PROCEDURE
Document	348-860843	3		200-129834 Rev 3	STORAGE AND PRESERVATION WORK INSTRUCTION - WORK INSTRUCTION
Document	348-597764	1A		200-13735 Rev 1A	PROCEDURE - COMMISSIONING AND COMPLETION OF POWER STATION PROJECTS AS PER 'NEC'
Document	348-883808	8		200-1680 Rev 8	DOCUMENT AND RECORD MANAGEMENT - WORK INSTRUCTION
Document	348-389557	3		200-1689 Rev 3	CONTRACTOR QUALITY REQUIREMENTS. 1253-PRO-010- SCOPE OF WORK
Document	348-880042	3	84CIVL053	200-16904 Rev 3	SPECIFICATION - STRUCTURAL CONCRETE 84CIVL053 REV 03
Document	348-694071	6		200-18202 Rev 6	KKS KEY PART MEDUPI POWER STATION - STANDARD
Document	348-31313	2		200-234039 Rev 2	200-234039 LICENCE IN TERMS OF SECTION 40 OF THE NATIONAL WATER ACT, 1998 (ACT NO 36 OF 19980 (THE ACT) - LICENCE
Document	348-912995	0	ESKSCAAC6 Rev 0	200-3583 Rev 0	SPECIFICATION FOR THE IDENTIFICATION OF THE CONTENTS OF PIPELINES AND VESSELS - SPECIFICATION
Document	348-884646	5	84CIVL007 Rev 05	200-4056 Rev 5	CONCEPTUAL ARCHITECTURAL DESIGN SPECIFICATION FOR STRUCTURES AND OTHER BUILDINGS
Document	348-882024	4		200-4190 Rev 4	THE APPLICATION OF KKS PLANT CODING
Document	348-885912	11		200-5343 Rev 11	MEDUPI POWER STATION PROJECT - LIST OF ABBREVIATIONS - LIST
Document	348-621432	2		200-53810 Rev 2	DOCUMENTATION HANDOVER LIST - GUIDELINE
Document	348-355152	11		200-6166 Rev 11	SPECIFICATION FOR THE PREPARATION OF ENGINEERED FILLS AND BACKFILL STRUCTURES EXCEPT TO ALL BACKFILL IN TURBINE HALL REV 11 - SPECIFICATION
Document	348-883860	4		200-64539 Rev 4	DOCUMENTATION FORMAT AND LAYOUT SPECIFICATION -SPECIFICATION

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
Document	348-80410	8		200-94660 Rev 8	ISSUING OF KKS CERTIFICATE WORK INSTRUCTION - WORK INSTRUCTION
Document	348-630398	5			KKS CODING AND LABELING KKS01 - STANDARD
Document	348-9974683	0	84CIVL052 Rev 0		CIVIL SPECIFICATION - LOW PRESSURE SERVICES (CIVIL DESIGN AND BUILDING WORKS) - DESIGN SPECIFICATION
Drawing	348-350048	13	J26182/A/TER/LAY/03 Rev 13	0.84/195 Rev 13	MEDUPI POWER STATION TERRACE AND CONTRACTORS YARDS ROAD LAYOUT - SITE LAYOUT PLAN
Drawing	348-350074	16	J26182/A/TER/SW/05 Rev 17	0.84/198-SHEET 5 Rev 16	STORMWATER LAYOUT
Drawing	348-350244	11	J26182/A/TER/SWL/13 Rev 12	0.84/199 Sheet 13 Rev 11	STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 13 - DIMENSION DRAWING
Drawing	348-350145	10	J26182/A/TER/SWL/09 Rev 11	0.84/199 Sheet 9 Rev 10	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 9
Drawing	348-350126	8	J26182/A/TER/SWL/01 Rev 10	0.84/199-SHEET 1 Rev 8	STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 1 - SECTIONAL
Drawing	348-350040	12	J26182/A/TER/SWL/10 Rev 12	0.84/199-SHEET 10 Rev 12	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 10
Drawing	348-349817	5		0.84/199-SHEET 11 Rev 5	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 11
Drawing	348-349925	6		0.84/199-SHEET 12 Rev 6	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 12
Drawing	348-349622	5		0.84/199-SHEET 14 Rev 5	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 14 OF 19
Drawing	348-349719	7	J26182/A/TER/SWL/15 Rev NONE	0.84/199-SHEET 15 Rev 7	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 15

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
Drawing	348-350132	11	J26182/A/TER/SWL/16 Rev NONE	0.84/199-SHEET 16 Rev 11	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 16
Drawing	348-349930	9	J26182/A/TER/SWL/17 Rev NONE	0.84/199-SHEET 17 Rev 9	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 17
Drawing	348-349884	15	J26182/A/TER/SWL/18 Rev 15	0.84/199-SHEET 18 Rev 15	STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 18
Drawing	348-349623	7		0.84/199-SHEET 19 Rev 7	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS
Drawing	348-350297	13	J26182/A/TER/SWL/02 Rev 13	0.84/199-SHEET 2 Rev 13	STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 2
Drawing	348-350236	5		0.84/199-SHEET 3 Rev 5	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 3 OF 19
Drawing	348-349525	5		0.84/199-SHEET 4 Rev 5	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 4
Drawing	348-349536	5	J26182/A/TER/SWL/05 Rev 5	0.84/199-SHEET 5 Rev 5	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 5 - LAYOUT
Drawing	348-349819	6		0.84/199-SHEET 6 Rev 6	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS
Drawing	348-349708	5		0.84/199-SHEET 7 Rev 5	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS
Drawing	348-349724	9	J26182/A/TER/SWL/08 Rev 9	0.84/199-SHEET 8 Rev 9	MEDUPI POWER STATION STORMWATER DRAINAGE LONGITUDINAL SECTIONS SHEET 8 - LAYOUT
Drawing	348-883279	11		0.84/3-SHEET 2 Rev 11	MEDUPI POWER STATION SITE LAYOUT SHEET 2
Template/Form	348-942820	3			CONTRACTOR'S DOCUMENT TRANSMITTAL FORM - TEMPLATE

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
Document	348-361813	1		200-26680 Rev 1	MEDUPI POWER STATION ARCHITECTURAL TECHNICAL SPECIFICATIONS FOR STRUCTURES AND OTHER BUILDINGS

F.2 ESKOM DOCUMENTS

Number	Title
240-100183119	Standard for fences in Eskom transmission substations
240-105020315	Standard for Low Pressure Valves
240-106628253	Standards for Welding Requirements on Eskom Plants
240-106628253	Control of Plant Construction Repair and Maintenance Welding Activities Standard
240-107981296	Constructability Assessment Guideline
240-110414644	Nitrogen System Standard
240-114967625	Operating Regulations for High Voltage Systems
240-123801640	Standard for Low Pressure Pipelines
240-129014618	Cyber Security Guidelines
240-150642762	Generation Plant Safety Regulations
240-49230046	Failure Mode and Effect Analysis (FMEA) Guideline
240-49230111	Hazard and Operability Analysis (HAZOP) Guideline
240-50056004	Constructability Analysis Guideline
240-107981296	Constructability Analysis Guideline
240-52844017	System Reliability, Availability and Maintainability Analysis Guideline
240-53113685	Design Review Procedure
240-53114026	Project Engineering Change Management Procedure
240-53114248	Thyristor and switch mode chargers, AC/DC to DC/AC converter and inverter/uninterruptible power supplies standard
240-54937439	Fire Protection/Detection Assessment Standard
240-54937450	Eskom Fire Protection and Life Safety Design Standard
240-55410927	Cyber Security Standard for Operational Technology
240-55714363	Eskom Generation Power Station Lighting and Small Power Installation Standard
240-56176097	Electrical Cable Schedule Template

Number	Title
240-56227413	Hydrogen Systems Standard
240-56227443	Requirements for Control and Power Cables for Power Stations Standard
240-56227516	LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltage up to and Including 1000V AC and 1500V DC Standard
240-56227927	ELECTRICAL LOAD LIST TEMPLATE
240-56355466	Alarm Management System Guideline
240-56355541	Control system Computer Equipment Habitat Requirement Guideline
240-56355728	Human Machine Interface Design Requirements Standard
240-56355729	Plant Control Modes Guideline
240-56355731	Environmental Conditions for process control equipment
240-56355815	Control & Instrumentation Field Enclosures and Cable Termination Standard
240-56355888	Temperature Measurement Systems Installation Standard
240-56355910	Management of Plant Software
240-56356376	Site commissioning for low pressure services
240-56356396	Earthing and Lightning Protection Standard
240-56357424	MV and LV Switchgear Protection Standard
240-56364545	Structural Design and Engineering Standard
240-56536505	Hazardous Location Standard
240-56737448	Fire Detection and Life Safety Design Standard
240-57127951	Standard for the Execution of Site Investigations
240-57127953	Execution of Site Preparation and Earthworks Standard
240-57127955	Geotechnical and Foundation Engineering Standard
240-57617975	New Low Voltage Motors Procurement Standard
240-58552870	Smart Plant for Owner Operators (SPO) Documentation Metadata Standard
240-60782552	Process Flow Diagram Standard
240-61379718	Instrument Schedule Template
240-61379755	Drive and Actuator Schedule Template
240-72344339	Virtual Signal List Template
240-72344727	Control System Architecture
240-77302094	ELECTRICAL TERMINATION SCHEDULE TEMPLATE

Number	Title
240-83539994	Standard for Non-Destructive Testing (NDT) on Eskom Plant
240-83561037	Reporting and Data Requirements Specification for Contractors
240-84418186	Road Specification Manual
240-85549846	Standard for Design of Drainage and Sewerage Infrastructure
240-86973501	Engineering Drawing Standard - Common Requirements
240-89147446	Instrument Piping for Coal Fired Power Plants Standard
240-93576498	KKS Coding Standard
IO Block Template.xlsm	IO Block Template

APPENDIX G: ELECTRICAL DRAWINGS

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
Electrical drawing	348-325001	0	100.10.017 Rev A	0.84/46777-SHEET 1 Rev 0	DISTRIBUTION BOARD WIRING DIAGRAM
Electrical drawing	348-325272	0	100.10.029 Rev A	0.84/46789-SHEET 1 Rev 0	NITOGEN PLANT ELECTRICAL POWER LCS TRAINS1 2 AND 3
Electrical drawing	348-324999	0	100.10.061 Rev A	0.84/47219-SHEET 1 Rev 0	NITROGEN PLANT LIGHTING AND SOCKET ARRANGEMENT

APPENDIX H: DATA BOOK REGISTER

Document Description	UID (ESKOM)	Revision	Alternate Identifier	Common Reference	Title
Data Book	348-9936989	0	NGNT-BOODB-001 Rev 0		H1 - NGP BOOSTER DATA BOOK - DATA BOOK
Data Book	348-26861	0	NGNT-BOODB-003 Rev 0		H1 - BOOSTER DATA BOOK - DATA BOOK
Data Book	348-9936995	0	NGNTMED-DRDB-001-A/C Rev 0		H1 - FD 870 DRYER DATA BOOK - DATA BOOK
Data Book	348-60647	0	NGNTMED-DRDB-001-B Rev 0		H1 - FD 870 DRYER DATA BOOK - DATA BOOK
Data Book	348-60649	0	NGNTMED-DRDB-001-C Rev 0		H1 - FD 870 DRYER DATA BOOK - DATA BOOK
Data Book	348-9937021	0	NGNTMED-FLDB-001-B-C Rev 0		H1 - DD850 FILTER DATA BOOK - DATA BOOK
Data Book	348-9937010	0	NGNTMED-FLDB-002 Rev 0		H1 - DDP130 FILTER DATA BOOK - DATA BOOK
Data Book	348-9936990	0	NGNTMED-MECDB-002 Rev 0		H2 - DISTRIBUTION LINE ERECTION DATA BOOK - DATA BOOK
Data Book	348-9937016	0	NGNTMED-MECDB-002-1 Rev 0		H2 - ERECTION DATA BOOK LINE NUMBER 100.10.219/215/216/217/218 - DATA BOOK
Data Book	348-9937018	0	NGNTMED-MECDB-002-2 Rev 0		H2 - ERECTION DATA BOOK LINE NUMBER 100.10.210/211/212/213 - DATA BOOK
Data Book	348-9936991	0	NGNTNED-SSDB-001 Rev 0		H1 - MANUFACTURING & ERECTION OF STRUCTURAL STEEL - DATA BOOK

Document Description	UID (ESKOM)	Revision	Alternate Identifier	Common Reference	Title
Data Book	348-9936992	0	NGNTNED-SSDB-002 Rev 0		H2 - MANUFACTURING & ERECTION OF STRUCTURAL STEEL - DATA BOOK
Data Book	348-60657	0	NGNTMED-NGDB-001-A Rev 0		H1 - NGP 250 N2 GENERATOR DATA BOOK - DATA BOOK
Data Book	348-60659	0	NGNTMED-NGDB-001-B Rev 0		H1 - NGP 250 N2 GENERATOR DATA BOOK - DATA BOOK
Data Book	348-60663	0	NGNTMED-NGDB-001-C Rev 0		H1 - NGP 250 N2 GENERATOR DATA BOOK - DATA BOOK

APPENDIX I: VENDOR DOCUMENT SUBMITTAL SCHEDULE (VDSS)

Documents Description	File Name
Medupi Hydrogen and Nitrogen Plant C&I VDSS	240-85521112 C&I VDSS.xlsx
C&I DOCUMENTATION DESCRIPTION	C&I documentation description.doc

APPENDIX J: INTERFACING SYSTEMS DOCUMENTS

Document Description	UID (ESKOM)	Rev.	Alternate Identifier	Common Reference	Title
Piping Layout drawing	348-597508	10	16591/00/00/530/007 Rev 10	0.84/2839-SHEET 7 Rev 10	LAYOUT POTABLE AND FIRE WATER RETICULATION LAYOUT AND SETTING OUT DETAILS
Piping arrangement drawing	348-597827	6	16951/00/00/530/010 Rev 6	0.84/2839-SHEET 10 Rev 6	VALVE PITS POTABLE WATER SYSTEM TERRACE VALVE PITS PLAN AND SECTIONS (PART 2) 0 1UGX
C&I Document	348-284211	4	ZAP-000165-EPC-001 Rev 4	200-100728 Rev 4	CBMS ENGINEERING PHILOSOPHIES AND CONCEPTS - OPERATING PHILOSOPHY
C&I Document	348-293023	2	ZAP-000165-CCTV-FDS-001 Rev 3	200-139150 Rev 2	CCTV SYSTEM FUNCTIONAL DESCRIPTION REFERENCE 20 - TECHNICAL SPECIFICATION

Document Description	File Name
Medupi Fibre Routing	CBMS Fibre loop.pdf