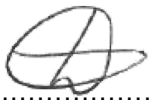
Eskom	Works Information	Peaking Generation

Title: **VANDERKLOOF CONTROL AND INSTRUMENTATION UPGRADE - SITE CONSTRUCTION**

Unique Identifier:	**160A/1487**
Alternative Reference Number:	**N/A**
Area of Applicability:	**Engineering**
Documentation Type:	**Works Information**
Revision:	**1**
Total Pages:	**96**
Next Review Date:	**N/A**
Disclosure Classification:	**CONTROLLED DISCLOSURE**

Compiled by



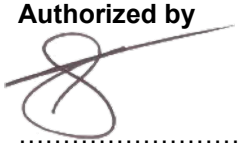
……..

Lubabalo Caba

Project Manager

Date: 14 November 2023

Authorized by



……..

Enrico Harker

Programme Manager

Date: 2023-11-14

PART 3: SCOPE OF WORK

Document reference	Title	No of pages
	This cover page	1
C3.1	*Employer*'s Works Information	94
	Total number of pages	95

C3.1: *EMPLOYER*'S WORKS INFORMATION

Contents

1. Description of the *works*

1.1 Executive overview

Vanderkloof Hydroelectric Power Station was first commissioned in 1976/7, and its equipment and components for electrical and control has been in operation for more than 40 years. The electrical and control equipment and components has surpassed its design life and have aged and therefore become obsolete.

Based on the approved concept design, the recommendation is to refurbish, replace and upgrade all obsolete equipment for the Control and Instrumentation, Excitation, LV switchgear, and Protection, Metering and Synchronising Scheme.

This document contains the Works Information for the Site Construction Works of the Control and Instrumentation upgrades for two units and station common plant. The document further illustrates the cabling works which interface to other disciplines.

The *Works* makes provision for the Site Construction which includes bill of materials, procurement, packaging, supply, delivery to site, transporting, off-loading, decommission, removal, floor preparation, assembly, installation, wiring, testing, and cold commissioning of Components and structures related to the Control and Instrumentation Upgrade project. The *Works* include the cabling works, instrumentation impulse lines tubing, instrument bracket manufacturing, level measurement instrument chamber manufacturing, pipe work: removal, welding, testing and installation for the Control and Instrumentation project.

The *Works* interfaces to the following projects:

- Excitation System Replacement
- LV Switchgear Refurbishment
- Generator Protection, Metering and Synchronising Scheme Replacement.

The *Contractor* performs the Site Construction at the Vanderkloof Power Station within the prescribed dates and times as indicated by the *Employer*. The onus is on the *Contractor* to ensure that the Works is completed within the agreed period.

The *Works* covers the following power station building and outside plant areas of the station:

- Unit 1 and 2 (i.e. Draft Tube Area, Turbine Floor, Machine Hall, Telecoms Room, Generator Transformer yard).
- Station's Common Plant (i.e. Station Board Room, Station Transformer yard, Server Room, Strainer Room, Control Room, Penstock and Dam Wall).

The *Works* execution will be done in two phases of which **Phase 1** will be during the first Unit Outage and **Phase 2** will be during the second Unit and Station Outage.

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

The *Employer*'s objective is to accomplish the implementation of the Control and Instrumentation, Excitation, LV Switchgear, Protection, Metering and Synchronising Schemes refurbishment programme within the stipulated power station's planned outage (shutdown) time frames. This programme is an execution of the *Employer*'s Life of Plant Plans (LOPP) needed to maintain the highest levels of reliability and performance for the remaining commercial life of the power station.

Therefore, the Site Construction works performed by the *Contractor* is an integral part of the deliverables of the programme.

1.3 Interpretation and terminology

The following definitions are used in this Works Information:

Definitions	Meaning given to the definition
Cold Commissioning	Means the functional test of each equipment Unit to be performed at the Construction Site without load in accordance with the Contract.
Consumables	Means all those items that are consumed, installed, added, or otherwise used in the process of performing the Works (but not limited to) rags, solvents, cable ties, lugs, heat-shrink, seals, O-rings, springs, and hydraulic fittings, etc.
Components	Means all materials (including instruments, cable trays, cables, hurting plugs, cable glands etc.), components, parts (including replacement parts), and accessories to be provided by the *Contractor* for incorporation into the plant.
Contractor	A person or firm that undertake a contract to provide construction works according to this Works Information and is not limited to supply of materials and skilled labour.
Contractor's Equipment	Means all apparatus, machinery, tools, instruments, materials, equipment, vehicles, storage container, and other things required for the performance of the services required for the Works excluding components, consumables, and any other things provided by the *Employer*.
Defects	Means any works provided under this Agreement which are not in accordance with the requirements of this Agreement.
Employer	'Eskom Holdings (Eskom) in the context of: • Owner • insurer of the Works • paymaster • a party to the contract
Good Industry Practise	Means the practices, methods, techniques, designs, skills, diligence, efficiency, reliability, and prudence which are generally and reasonably expected from reasonably skilled and experienced *Contractor* engaged in the same type of undertaking as envisaged under this Contract and which would be expected to result in the performance of its obligation by the *Contractor* in accordance with this Contract, Applicable Law as and Applicable Permits in reliable, safe economical and efficient manner.
Plant	Industrial site consisting of systems of technology used to perform specific set of functions.

Definitions	Meaning given to the definition
Requirements	A singular documented physical or functional need that a particular design, product, or process aims to satisfy.
System	An organised, purposeful structure that consist of interdependent and interrelated equipment. i.e. pump system, bearing system, etc.
Unit	A hydro turbine, generator, transformer, and all relevant equipment operated together to produce electricity.

The following abbreviations are used in this Works Information:

Abbreviation	Meaning given to the abbreviation
A	Amperes
AC	Alternative Current
BS	British Standard
BSPP	British Standards Pipe Parallel
BSPT	British Standard Pipe Tapered
C&I	Control and Instrumentation
D	Depth
DIN	Deutsch's Institute für Normung
EN	European Standard
EL.	Elevation
H	Height
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output
IP	Ingress Protection (IP rating)
ISO	International Organisation for Standard
kPa	Kilopascal
LV	Low Voltage
m.	Meters
m.a.s.l	Meters Above Sea Level
mm	Millimetre
MUC	Main Unit Controller

Abbreviation	Meaning given to the abbreviation
NDT	Non-Destructive Testing
NPT	National Pipe Tapered Thread
OEM	Original Equipment Manufacture
OTDR	Optical Time-Domain Reflectometer
PT	Penetrant Testing
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
RIOC	Remote I/O Common
RIOG	Remote I/O Generator
RIOT	Remote I/O Turbine
SANS	South Africa National Standards
SHEQ	Safety, Health, Environment and Quality
SST	Stainless Steel
TSM	Temperature and Speed Monitoring
U*	Unit 1 or Unit 2
UT	Ultrasonic Testing
V	Voltage
W	Width
WPQR	Welding Procedure Qualification Record
WPS	Welding Procedure Specification

2. Management and start up.

2.1 Management meetings

Meetings of a specialist nature may be convened as specified elsewhere in this Works Information or if not so specified by persons and at times and locations to suit the Parties, the nature and the progress of the *works*. Records of these meetings shall be submitted to the *Project Manager* by the person convening the meeting within five days of the meeting.

All meetings shall be recorded using minutes or a register prepared and circulated by the person who convened the meeting. Such minutes or register shall not be used for the purpose of confirming actions or instructions under the contract as these shall be done separately by the person identified in the *conditions of contract* to carry out such actions or instructions.

2.2 Documentation control

All contractual communications are through formal compiled letters or forms on the company's letterhead. The formal letters and or forms are attached to e-mails and not as a message in the e-mail itself. The receiver of the formal letters or forms signs off an acknowledgment of receipt of the communication and returns the acknowledgement of receipt to the sender of the formal communication.

2.3 Health and safety risk management

The *Contractor* shall comply with the health and safety requirements contained in this Works Information.

2.4 Environmental constraints and management

The *Contractor* shall comply with the environmental criteria and constraints stated in this Works Information.

a) Eskom's goal is to ensure zero harm to the environment, and to ensure than any possible impact is mitigated or managed. The Duty of Care and implementation of best practice is critical during operations, and full communication on environmental issues is required at all times.

b) All processes are subject to environmental review throughout the contract.

c) The *Contractor* complies with all National and Local legislation requirements as well as Eskom procedures and policy.

d) The following applies to promote Eskom's goal of zero harm to the environment:

- Respect and care for the natural environment and for each other
- Minimise or mitigate any impacts that may cause harm or pollution to the environment
- Report immediately an environmental incident requiring action, such as a spill

e) The *Contractor* develops a method statement/ operational plan for the management of waste material that is accepted by the *Project Manager* before site implementation

f) The method statement on waste management includes the identification of possible waste streams, temporary storage and disposal options for each waste type, and contingency plans in the case of any environmental incident.

g) The method statement on waste management includes / specifies:

- Demarcated storage areas are located in such a manner that it can provide optimum handling and transportation of waste material
- Stored in suitable labelled containers or drums / sealed if hazardous in bunded areas or spill platforms to prevent pollution or harm to the environment
- Duty of care and implementation of best practise

h) The *Contractor* provides Safety Data Sheets for all chemical or hazardous / potentially hazardous material brought onto site.

2.5 Quality assurance requirements

a) Quality management for the *works* is in accordance with Eskom Quality Supplier Management Specification 240-105658000 (QM-58).
b) The *Contractor* complies with the latest version of the ISO 9001 Quality Management System Requirements
c) The *Contractor* defines the level of QA/QC or inspection imposed on his sub*Contractor*s and *Contractor's*.
d) The programming of inspections, hold and witness points are agreed between the *Employer* and the *Contractor* prior to undertaking any of the *works*.
e) The QCP's make provision for signatures indicating Completion by the *Contractor* and acceptance by the *Employer* at the end of each activity.
f) The Quality Control Plan (QCP) manages the overall quality of the project. It lists detailed activities in order of execution where each activity is described and references the associated work packages. The work plan makes provision for signatures by the *Contractor* and acceptance by the *Employer* at the completion of each activity.
g) The *Contractor* prepares and submits fitment/installation procedures with quality check sheets as well as the Quality Control Plan. Quality acceptance criteria must be included in these procedures.
h) The *Contractor* defines the level of quality assurance or inspection imposed on his Sub-*Contractor*s and suppliers.
i) All technical design and implementation documentation and the QCP's are submitted to the *Employer* for acceptance prior to the *works* being executed.
j) The *Contractor* is made aware of the requirement that all documents or designs submitted for review to the *Project Manager* for acceptance, requires a process of review.

k) The *Contractor* documents all inspections as part of the quality assurance and control procedures. These documents are handed to the *Employer* as records.

2.6 Programming constraints

The *Contractor* submits a bar chart programme in MS Project detailing how the *works* will be executed within the stipulated dates. The programme indicates the Start date, Completion Date and duration of each activity.

2.7 *Contractor*'s management, supervision and key people

The *Contractor* provides a detailed organisational structure and resource plan, clearly indicating the lines of authority and communication in the working area as well as outside of the working area for the *works*.
a) The *Contractor* provides a list of all sub*Contractor*s, detailing their roles.
b) The *Contractor* does not modify any plant or materials unless accepted by the *Project Manager*, prior to implementation.
c) The *Contractor* notifies the *Project Manager* at least two weeks in advance of a Hold or Witness point on the *works* within the boundaries of South Africa unless otherwise agreed with the *Project Manager*

The *Contractor* does not operate any equipment on Site unless specific authorisation is obtained from the *Employer*.

2.8 Invoicing and payment

a) Within one week of receiving a payment certificate from the *Project Manager* in terms of core clause 51.1, the *Contractor* submits a tax invoice to the *Employer*, showing the amount due for payment equal to that stated in the *Project Manager's* payment certificate.
b) The *Project Manager* to be copied in on all electronic invoices emailed.
c) Failure to submit the invoice to the correct address could result in delays in payment.
d) The *Contractor*'s Tax Invoices comply with the requirements as stated in clause Z7 of the Contract Data
e) Invoices are submitted electronically to:
    - Local Eskom Invoices - invoiceseskomlocal@eskom.co.za
    - Foreign Eskom Invoices - invoiceseskomforeign@eskom.co.za
f) Details required when submitting invoices and additional data:
    - The subject line on your email should only contain your vendor number
    - Each invoice in PDF should be named with your invoice number only
    - All electronic invoices are sent in PDF format only
    - Attach the proof of delivery to your invoice
    - Where applicable, supporting documents is attached to the scanned PDF invoice as one attachment
    - A copy of the signed assessment certificate
    - CPA calculation sheet
    - Retention Certificate where it is a retention invoice
    - Any other appropriate documents, e.g.
        - For shipping invoices, please ensure the following documents are attached
        - Invoice (this should only reflect the shipping cost)
        - Commercial invoice
        - Delivery note
        - Your shipping costs calculation relevant to that invoice – not a generic calculation (The amount of the shipping costs calculation has to balance on the amount on the invoice.)
        - Forwarding agent's invoice
        - The customs document

Please do not attach unnecessary documents as this will make the file too large. The file should not be more than 10 Mega Bytes.

g) Other requirements:
    - For foreign invoices, suppliers will still be required to physically deliver hard copies of original documents to the respective Document Management centres even though the invoices have been submitted electronically
    - Ensure compliance with the tax requirements for submitting invoices electronically
    - Each PDF should contain one credit note, one debit note or one credit note only. More than one invoice can be submitted per email
    - Any CPA applicable is invoiced separately, so that if there are issues on the CPA, the rest of the invoices can be paid while the CPA issues are resolved
h) Include the following information on the Invoice:
    - Name and address of the *Contractor* and the *Project Manager*
    - The contract number and title
    - *Contractor*'s VAT registration number
    - The *Employer*'s VAT registration number 4740101508

- Total amount invoiced excluding VAT, the VAT and the invoiced amount including VAT
- *Contractor*'s company registration number if applicable
- *Contractor*'s banking details
- Name and address of recipient
- Tax invoice number and date of issue
- Description of goods/service provided
- Quantity or volume of goods/services
- Period time for which the Tax Invoice is being rendered
- Relevant Task Order Number (commencing with a 45 prefix)
- Relevant line-item number
- Statement whether value added tax is included or excluded.

2.9 Insurance provided by the *Employer*

a) In terms of clause 85, before the *starting date* and on each renewal of the insurance required in terms of this contract, the *Contractor* is required to submit certificates which state that the insurance required by this contract is in force.
b) Such insurances are those required in terms of the contract except to the extent stated in the contract the *Employer* is to provide any, or any part, of them.
c) Failure to provide such certificates of insurance for the Project Manager's acceptance by the starting date or renewal date as the case may be, may result in the *Employer* arranging such insurance on the *Contractor*'s behalf and at the *Contractor*'s expense.

2.10 Contract change management

Contract change management is managed in accordance with section 6 of the core clauses in ECC3. In summary, in the event that the *Employer/Contractor* notices a change, an event register is issued. If the event/change has cost implications then a quotation is submitted with the event register.

The *Project Manager* assesses the quotation and gives an instruction in writing to the *Contractor*.

2.11 Provision of bonds and guarantees

a) The form in which a bond or guarantee required by the conditions of contract is to be provided by the *Contractor* is given in Part 1 Agreements and Contract Data, document C1.3, Sureties.

b) The *Employer* may withhold payment of amounts due to the *Contractor* until the bond or guarantee required in terms of this contract has been received and accepted by the person notified to the *Contractor* by the *Project Manager* to receive and accept such bond or guarantee. Such withholding of payment due to the *Contractor* does not affect the *Employer's* right to termination stated in this contract.
c) The *Contractor* provides the bonds and guarantees as agreed to within 2 weeks after the Contract Date.

2.12 Records of Defined Cost, payments & assessments of compensation events to be kept by the *Contractor*

To substantiate the Defined Cost of compensation events, the *Employer* requires the *Contractor* to keep records of amounts paid by him, in the following format:

Type of cost	Type of record
People employed by the *Contractor* (labour)	Signed time sheets and payslip
Accommodation	Substantiating documentation (actual paid invoices)
Material	Register and substantiating documentation of materials used /paid invoices
Equipment	Register and substantiating documentation of Equipment used /paid invoices

2.13 Training workshops and technology transfer

Formal training is conducted as part of this contract before completion of the works.

3. Engineering and the *Contractor*'s design

3.1 *Employer's Design*

3.1.1 Site Characteristics

Vanderkloof is one of Eskom's hydroelectric power plants built in the Northern Cape Province, at the Vanderkloof Storage and Diversion Dam, on the Orange River. Vanderkloof Hydro Power Station has two generating units of 120MW each. Water is released from the storage dam via discharge and control structures to the inlet of the two generating units. The kinetic energy generated from the discharged water is converted to mechanical energy by means of Francis Turbines. The flow and arresting of water to the Francis Turbines are controlled by guide vanes. The turbines are connected to electrical generators which generate electricity into Eskom's national Interconnected Power System (IPS (Grid)). Vanderkloof generates during peak electricity demand times and in emergencies or when required by the national department of water affairs for dam level management.
The power station is situated approximately 220km west of Bloemfontein and 200km south of Kimberly, and there are tarred roads all the way to the powerhouse. The coordinates for the Power Station are 29°59'37"S;24°43'48"E.

Figure 1: Location of Vanderkloof Power Station

3.1.2 Systems Description

The two synchronous generating units are fitted with electrical and control panels for monitoring and sequence controls. The interfaces between different systems are hardwired.

3.1.3 Racking design

The *Employer* has incorporated the design for cabling and racking works which interfaces between electrical systems, control system and field instrumentation into this Works Information. The design specifies the racking requirement, the type of cables (Low voltage, control and network communication) required, estimation of the lengths of cables to be removed, cable trays to be installed and the amount of cables to be installed.
The implementation of the scope for electrical system (Excitation, LV Switchgear, Protection, Metering and Synchronising Scheme) works not included herein this Works Information is performed by Others.

3.1.3.1 Capacity of trays

Cable tray sizes stated in the estimation work (see appendix B) herein are specified based on the volume of cables running in a specific route. Cross section area of each cable is calculated from its outer diameter (OD), these cross-section areas of cables running in the same tray are then added and this will give the total cross section area in solid form. Therefore, suitable tray size is the total cross section area of cables in solid form plus 50% of additional spare capacity and air between the cables.

That is, cable cross section area (mm2), $A = \pi \times (OD/2)2$

Total cables cross section area, B = sum of cross sections of cables A's in mm2

Tray cross section area in mm2 = B + 20% air + 30% spare tray capacity

Cable tray sizes selected were normalized to manufacturers' standard sizes, available space on the plant to install such a tray and future capacity consideration.
Tray types and sizes selected are as follows (Tray Width x lip Height x steel Thickness in mm):

- Welded steel wire mesh tray 50x50x4 (WWMD50)
- Perforated steel tray 75x38 x1.6 (MCT75)
- Perforated steel tray 75x38 x1.6 (HCT75)
- Perforated steel tray 305x75 x1.6 (MCT300)
- Perforated steel tray 457x75 x2.0 (HCT450)

3.1.3.2 Loading on support structure and strength thereof

The following table shows distributed weights per meter of cable trays selected for this design:

	Description	Thickness (mm)	Length (mm)	Mass (kg/m)
1.	WWMD50	4	3000	2.5
2.	MCT75	1.5	3000	4.69
3.	HCT75	1.5	3000	6.97

4.	MCT300	1.5	3000	11.73
5.	HCT450	2.0	3000	23.49

Trays are supported by strut channels and cantilever arms depending on the load to be supported. Strut channels selected for this racking design are P1000, P1001, P2000, P4000 as shown here below.

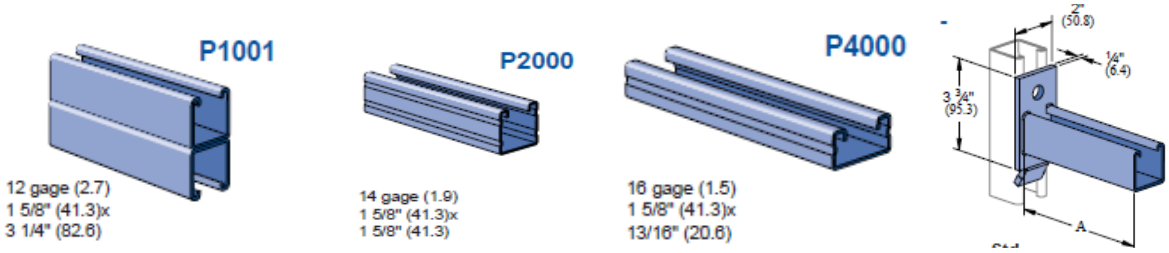


Figure 2: Cable trays support and cantilever

Cantilevers used on the design are Flat Plate Arm 200mm, 250mm and 350mm, and Full Double Arm 550mm constructed from P1000 and have the following design weight specifications:

Item	Description	Length (mm)	Unit Mass (kg)
1	Flat Plate Arm (P1000)	200	1.0
2	Flat Plate Arm (P1000)	250	1.2
3	Flat Plate Arm (P1000)	350	1.5
4	Full Double Arm (P1000)	550	2.97

The *Contractor* ensures that the OEM load specifications are not exceeded during installation.

3.1.4 Control Panels design

The control systems panels are located indoors within the power station building. The panels in the control room (EL. 1105MASL), and generator floor (EL. 1101MASL) will be replaced with similar size panels. Additional new panels will be installed on the turbine floor (EL. 1096.5MASL) and Lower Ground Basement (EL. 1143MASL).

The manufacturing and assembly of the control system panels including the control console is performed by Others. The design for control system panels provides the installation Works that the *Contractor* must perform (see Appendix B).

3.1.5 Field Instrumentation design

At Vanderkloof, the process sensors (instruments) determine the current states of the process. The field instrumentation uses the inputs to produce a measurement, for monitoring of various different process systems with medium such as oil, cooling water, and compressed air.

The *Employer*'s design provides the assembly specification and diagram of different field instruments such as pressure, level, temperature, flow, and limit switches. These instruments will be installed on the systems such as, but not limited to the Penstock, Tailrace piping and Channel, Turbine System, Turbine Bearing Assemblies, Turbine Lubrication System, Sealing Water System, Turbine Control, Generator System,

Generator Bearing Assembly, Generator Bearing Lubrication System and Piping System for Main Cooling Water (see Appendix F).

3.2 Parts of the works which the *Contractor* is RESPONSIBLE FOR

3.2.1 General Responsibilities of the *Contractor*

a) The *Contractor* is required to supply the Works
- in accordance with the Works Information
- in accordance with all National and International Standards, as well as the *Employer*'s Standards referenced in this Works Information
- in accordance with the Good Industry Practices, and
- in accordance with the *Employer*'s Safety, Health, Environmental, and Quality (SHEQ) policy.

b) The *Contractor* takes full professional accountability and liability for the Scope of Work performed by the *Contractor*.

c) The *Contractor* is responsible for transporting of all Components, Consumables, *Contractor*s Equipment, *Contractor*'s personnel, and other things required for the Works to Site.

d) The *Contractor* is responsible for the procurement, packaging, loading, transporting, receiving, unloading, storing, and protecting all Components, Consumables, *Contractor*'s Equipment, and other things required to perform their obligations stated in this Works Information.

e) The *Contractor* is required to furnish its work personnel with such *Contractor*'s Equipment as it is necessary to perform quality Works.

f) In performing the Works, the *Contractor* uses appropriate skills and trained labour, having regard to the nature of the works to be performed. The skills required for this Works include, qualified electricians, mechanical artisans (fitters and turners), instrument mechanicians (pipe bending and tubing) and coded welders.

g) The *Contractor* submits, if requested to supply the *Employer* with relevant training records for the *Contractor*'s personnel engaged or to be engaged in the performance of the Works to verify their ability to fulfil the task comprised in the Works.

h) The *Contractor* submits, if requested to supply the *Employer* with the curricula vitae of the *Contractor*s personnel engaged or to be engaged in the performance of the Works, which contains the experience of the *Contractor*'s personnel from similar projects.

i) The *Contractor* ensures that all Components, Instruments and Consumables used in the provision of the Works is in order and of good quality.

j) The *Contractor* throughout the Term of contract maintains a permanent presence on Site, suitably experienced, trained and qualified personnel to perform the Works. The *Contractor*'s team onsite includes a Supervisor/Site Representative who will be the *Employer*s single point of contact for administering this contract.

3.2.2 Bill of Materials

The *Contractor* prepares a complete bill of materials using the *Employer* returnable list (see Appendix B) and any other requirements specified in this Works Information, covering all Components and Consumables to be used by the *Contractor* for the Works. The description of an item shall be complete but concise, listing only those items that are significant, such as ratings, type, and manufacturer. A unit of

equipment, that is supplied with certificate of compliance, is not required to be broken down into more than one item on the parts lists.

3.2.3 Health & Safety Requirements

a) A task-based risk assessment and mitigation strategy is submitted and approved by the *Employer* before start of the works.

b) Work will commence as per *Employer*'s safety regulations laid down in the contract specification and the project safety file.

c) Mandatory safety gears will be used. All personal protective equipment (PPE) will be used as appropriate according to the nature of the task. For electrical works, provide non-conductive tools and PPE.

d) Working on live apparatus or live power cables is not allowed.

e) The *Contractor* ensures that adequate barricading and signage are provided around the affected area. Work will be executed through Permit to Work system.

f) The *Contractor* always maintains cleanliness in the work areas. Housekeeping will be of good standard and all debris must be removed by end of each workday.

g) The *Contractor* working at heights to wear their full body harness and should be anchored to a rigid point.

h) No workers are allowed to stand on top of the step ladder; workers should stand two rungs below from top of the step ladder. A co-worker must hold step ladder while in use.

i) Method statement and risk assessment to be daily briefed to all concerned personnel and signing on the Workers Register is required to commence with work.

3.2.4 Cables specification

a) The *Contractor* supplies low voltage cables, Control and Instrumentation cables, Ethernet copper cables, rugged fibre optic patch leads and optical fibre cables.

b) Before procurement of any cable, the *Contractor* supplies cable manufacturers ISO 9001 status and certification, cable type certificates, cable manufacturing specifications, typical manufacturing QC test certificates, cable marking examples for acceptance.

c) The *Contractor* supplies cables which conform to the 240-56227443: Requirements for Control and Power Cables for Power Stations standard and the 240-54937450: Fire Protection & Life Safety Design standard.

3.2.4.1 Low voltage cables

a) The cables used are PVC insulated with flame-retardant reduced halogen emission PVC outer sheath and bedding (emit a mass of not more than 15% halogen).

b) The low voltage cables with PVC insulation, LHFR PVC sheath unarmoured will be of type BVV.

c) The low voltage cables with PVC insulation, LHFR PVC sheath with round steel wire armoured around will be of type BVX.

d) The BVV or BVX type of cables will be used for power supplies, protection circuit, voltage, and current transformer (i.e., 110/220V DC, 230V AC).

e) The cables shall be manufactured to SANS 1507 and SANS 1411 Parts 1, 2, and 6. 8.3.3 Unarmoured and armoured power cables application.

f) The type of low voltage cables used for this Works Information are:

Table 1: Low Voltage Cables Technical Data

Cable Type	Number of conductors	Rated area (mm2) per conductor	Voltage Rating (V)	Mass (kg/m)	Overall Diameter (mm)
BVV02DCM	2	2.5	600/1000	0.40	11.3
BVV04DCM	4	2.5	600/1000	0.42	12.9
BVV03ECM	3	2.5	600/1000	0.56	13.1
BVX04DCM	4	2.5	600/1000	0.62	17
BVV04ECM	4	4	600/1000	0.64	14.6
BVX04ECM	4	4	600/1000	0.75	18

g) Normal colour coding of cables cores to SANS 1507 Table 1 shall be used for cables with:

- 2 cores: Red – Black
- 4 cores: Red – Yellow – Blue – Black

h) The individual cores shall be numbered or ferruled and shall be glanded and terminated in sequence as set out by the *Employer*.

i) All cables sheaths (low voltage cables) shall be black with colour traces or printing as follows:

Cable Trace Colour	Identifying Cable as Having
Blue	Low halogen emission, Flame Retardant Polyvinyl Chloride (LH PVC) bedding and sheath

3.2.4.2 Control and instrumentation cables

a) For all digital and analogue signals where low-level signals apply, thermoplastic insulated overall screened twisted pair UVG control cables shall be used except for cables in this category which run, over long distance outside of the building or buried in the ground.

b) The cores of cables shall be identified by the dielectric colour code as table below and the standard NWS 1525.

Single Conductor		Paired Cables		Triple Cable	
Conductor No.	Colour	Pair No.	Colours	Triple No.	Colours
1	Blue	1	Blue/Red	1	Blue/
2	Red				Red/
3	Grey	2	Grey/Yellow		Grey
4	Yellow			2	Yellow/
5	Green	3	Green/Brown		Green/
6	Brown				Brown
7	White	4	Blue/Red	3	White/
8	Black				Black/

9	Not	used			Pink

c) Where several cores are group together in a cable, each core shall be identified by the colour in the table above, and the by marking as detailed below:

- Group 1 One ring of Orange
- Group 2 Two rings of Orange
- Group 3 Three rings of Orange
- Group 4 Four rings of Orange
- Group 5 Five rings of Orange

d) The individual cores shall be numbered or ferruled and shall be glanded and terminated in sequence as set out by the *Employer*.

e) Type UVG cables will have a voltage rating of 300/500V with a rated conductor area of 0.5mm2 to 0.75mm2 and signal level of 1A shall not be exceeded.

f) The screen is 100% coverage of aluminium/polyester tape (38µm thickness), with multi-strand tinned copper drain wire.

g) Screens and drain wires will be terminated on one end in accordance with circuit diagrams or instruction provided by the *Employer*.

h) All cables sheaths (Control and Instrumentation cables) shall be black with colour traces or printing as follows:

Cable Trace Colour	Identifying Cable as Having
Blue	Low halogen emission, Flame Retardant Polyvinyl Chloride (LH PVC) bedding and sheath

i) The type of control and instrumentation cables used for this Works Information are:

Table 2: Control and Instrumentation Cables Technical Data

Cable Type	Number of Pairs	Number of Conductors	Rated area (mm2) per conductor	Voltage Rating (V)	Mass (kg/100m)	Overall Diameter (mm)
UVG02ACM	2	4	0.5	300/500V	7.4	8.2
UVG02BCM	2	4	0.75	300/500V	25(est.)	12
UVG04ACM	4	8	0.5	300/500V	9.8	8.9
UVG04BCM	4	8	0.75	300/500V	25(est.)	14
UVG08ACM	8	16	0.5	300/500V	16	10.9
UVG08BCM	8	16	0.75	300/500V	45(est.)	18
UVG12ACM	12	24	0.5	300/500V	26.7	13.4
UVG12BCM	12	24	0.75	300/500V	50(est.)	21
UVG20ACM	20	40	0.5	300/500V	34.7	15.2
UVG02CCM	2	2	1.5	300/500V	25(est.)	9.9
UVH02ACM	2	4	0.5	300/500V	25(est.)	10
UVK01BCM	1	3	0.75	300/500V	25(est.)	10.9(est.)

Cable Type	Number of Pairs	Number of Conductors	Rated area (mm2) per conductor	Voltage Rating (V)	Mass (kg/100m)	Overall Diameter (mm)
UVM01BCM	1	3	0.75	300/500V	25(est.)	10.9(est.)
UVM12BCM	12	36	0.75	300/500V	100(est.)	40(est.)

3.2.4.3 Network Communication cables

a) The *Contractor* supplies industrial Ethernet cable type CAT6A with the specific features:
- STP, SF/FTP or S/FTP
- 26AWG/24AWG/23AWG
- PVC/PE/LSZH Jacket optional
- Speed up to 1000Mb/s over 100m of CAT6 cable.

b) The *Contractor* supplies the shielded RJ-45 connectors which meet the standard EIA/TIA-568B or 568A. The boot for the RJ-45 should be of different colours i.e., yellow, blue, black, green, and grey.

c) The *Contractor* supplies industrial Heavy Duty Duct (HDD) Fibre Optic cable with the specific features:
- Multicore (8 cores)
- Multimode
- OM4 fibre standard
- Patch Panel connectors to be ST type.

d) The *Contractor* supply Fibre Optic fly leads type ST-LC and ST-ST or LC-LC with specific features:
- 2 cores
- Multimode
- OM4 fibre standard

3.2.5 Decommission Works

Decommissioning of the existing control and instrumentation equipment is a joint responsibility of the *Contractor* and the *Employer*.
The *Contractor* decommissions the specified plant and relocates it to the area identified by the *Employer*. All removed plant components remain the property of the *Employer*. The *Employer* provides a storage/ laydown area for all decommissioned materials.

The *Contractor* makes good (restores to match surfaces and finishes of surrounding) all areas where plant components and cabling were removed.

a) The *Employer* provides supervision to the *Contractor* when removing wiring, terminations and marking of cables for removal or re-use.

b) The *Contractor* performs the removal of wiring, terminations and marking of cables for removal or re-use.

c) The *Contractor* removes cable glands and drops decommissioned cables into the cable tray and either removes the cables or cap them according to cable removal list. Capping and leaving redundant cables on the racks are the exception to the rules and is only allowed with acceptance of the *Employer*.

d) The *Contractor* removes the specified decommissioned panels & cubicles and relocates it to an area identified by the *Employer*.

e) The *Contractor* removes the specified decommissioned junction boxes and relocates it to an area identified by the *Employer*.

f) The *Contractor* removes the specified decommissioned instruments and tubing and relocates it to an area identified by the *Employer*.

g) The *Contractor* blanks the specified process pipework's as per *Employer*s design requirements.

h) The *Contractor* removed the existing Control Console section plates and its accessories inside the Control Console and relocate to area identified by the *Employer*. Note that the removal of the section plates requires a cut out through 6mm stainless steel on the existing frame. The sections are divided into top, middle and bottom plates for both the Units and Station Control Console.

i) The *Contractor* removes all redundant cable racks and relocates it to an area identified by the *Employer*.

j) The *Contractor* catalogues and transports removed cables to the laydown area.

k) The *Contractor* catalogues all capped cables, showing type, lengths, routing etc.

3.2.6 Racking installations

a) The *Contractor* supplies industrial hot dip galvanised after manufacture to SANS 121:2001 or ISO 1461:2009 wire mesh, perforated return flange cable trays and other cable trays accessories. Only approved cable trays are allowed.

b) The *Contractor* is responsible for the measurement, supply, and installation of the cable trays as per *Employer*'s design.

c) The *Contractor* performs cable racks loading calculation-based on cable routing lists provided by the *Employer*.

d) The *Contractor* ensures that the installed cable trays interconnect between the different systems of the Work.

e) Manufacturer's standard fittings are used, and if manufacturer fittings are inadequate as per the requirement's, fabricated fittings are used as per *Employer*'s acceptance.

f) The cable trays and their supports should be strong enough to meet the load requirements to support 150% rack capacity for intended cable types.

g) Cable trays support structures are anchored into the existing concrete building structure according to the *Employer*'s design and specification.

h) Cable trays are installed neatly and are vertical, horizontal, or parallel with the features of the building.

i) Joints are kept as close as possible to the support.

j) A minimum space is maintained between installations of trays and the building structure in order to secure cables and for general maintenance purpose.

k) Expansion joints are provided in the cable trays where it passes through the building expansion joint.

l) Earth continuity is installed inside the cable tray and fixed to all joint and fitting connections. Separate bare copper 6mm2 grounding cable for cable trays are provided by the *Contractor* and connected to the station earth bar by the *Contractor*.

m) The *Contractor* applies cold galvanizing paint on all cut sections of the cable trays; deburr all cut edges. Galvanization painting as per ISO12944: Corrosion Protection Standards.

n) Apply edging rubber with embedded clipping steel on all sharp edges and ends of the cable trays.

o) The *Contractor* installs galvanized open ended 20mm bosal conduit from the main cable tray for routing cables to the instrument harting plug point. The conduit must be fixed with 20 mm raised metal hospital saddles. Distance between saddles will not exceed one metre. PVC end caps shall be utilised on all opened ended bosal conduits. Racking cantilever brackets are utilised for vertical or horizontal support where required (fig. 2 above). The estimated provision for each installation should be a six-metre length of conduit.

p) After the completion of a section of the cable tray, a continuity test is performed to ensure earth continuity of the system.

3.2.7 Cabling installations

a) The *Contractor* indicates the specific tests performed on the different type of cables and provides the type test certificates before the first delivery of the cables.

b) All cables site test is in accordance with SANS 97, 1507, 1339, 1411 and other relevant standards.

c) All cabling is inspected and tested by the *Contractor* prior to installation and again prior to termination. At each stage both insulation and continuity are tested. The *Employer* witnesses the testing.

d) Cables having 110V grade insulation or higher are tested with a 1000V megger. For the acceptance of a cable, the insulation reading must not be less than 50MΩ.

e) Prior to installing the cables in the cable trays, the *Contractor* examines the cable paths and ensures all areas are free of debris that may interfere with the cable installation. Surface areas of the cable tray components likely to come into contact with cable must not cause damage to the cable when installed correctly.

f) The *Contractor* installs and routes cables on the cable trays as per cable installation list provided by the *Employer*. The *Contractor* uses suitable *Contractor*'s Equipment (acceptable rollers) to pull the cable into the tray.

g) The control and instrumentation cables are routed on cable trays that are separate from power cables. Network communication cables are routed in the wire mesh. Where the control and power cables are running close to each other, a separation of 1000mm must be maintained, and cross at 90o.

h) Cables generally have pulling tension restriction which must not be exceeded. The maximum pulling tension can be obtained from the cable manufacturer.

i) Cable should be placed and not dropped into the cable tray, cable ladder or wire mash.

j) Cables are strapped neatly and fastened to the cable trays using cable ties to prevent movement of the cables under normal use and during fault conditions. Generally, the spacing between cable fastening should be adequate to prevent cable bowing over time (every 500mm on every vertical or horizontal side mounted rack). Cable ties should be correctly sized and only tightened enough to secure the cable without indenting the insulation sheath.

k) On vertical runs the fastening must be able to withstand the forces exerted by the weight of the cable. The cable weight should be supported in such a manner as to prevent damage to the cable tray or cables.

l) Cable ties on the control and instrumentation cables must not be too tight. Any cable within a tied bundle must be able to move through that tie with slight resistance. Control and network communication cables cannot withstand the same heavy-duty 'lashing' as power cables. The tie must not be too thin as it may cut into the sheath of the cable.

m) The minimum bend radius for cables should be maintained.

n) The cable entry for the control panels is bottom or top depending on the location of the control cubicles.

o) The slack on the cabling is kept to a minimum.

p) No tee offs or joining of cabling is performed, other than at the terminals.

q) The Contractor prepares cables for termination which includes supplying and fitting of cable numbers, fitting of glands, striping cable ends; heat shrinking of cable ends, cores & screens (in either black, blue or red heat shrink); lugging conductors, labelling conductors.

3.2.8 Fire Blocking of Cable Penetrations

The repair or sealing to existing and new fire blocking of any cable penetrations that are disturbed for the purpose of cable routing, is carried out by the *Contractor* according to the following requirements:

a) Supply, deliver and offload the fire stopping (retardant) material which is necessary to conduct the repairs.

b) Supplies third party test certificates for the proposed fire-stop material.

c) Provide all necessary equipment, tools & material required to complete the fire stopping.

d) Provide supervision and resources to complete the fire stopping.

e) The work is performed by a SAQCC Accredited service provider.

f) Persons competent in fire blocking of penetrations are used and proof of competency is required.

g) All fire stops have a fire rating in accordance with SANS 1077 or equivalent of the fire rating up to the structure or partition, or two (2) hours, whichever is the greater against the spread of fire and smoke.

h) Fire stop material meets Factory Mutual (FM) Approval, Underwriters Laboratory (UL) requirements.

i) Fire stopping systems are required to have been fire tested to the requirements of SANS1077, IEEE 634, ASTM (American Society for Testing and Materials) E814.

j) Fire stop material is non-toxic, asbestos free and lead free.

k) Fire stop material is resistant to chemicals, oils, and lubricants.

l) Fire stops are weather resistant and suitable for both indoor and outdoor use.

m) Fire stops not to affect cable ratings.

n) Any cables entering/leaving a wall, floor or penetration are coated on both sides of the wall/floor to a length of 2 meters.

o) Fire stops must be capable of being easily re-opened to allow the installation of future services.

p) Proprietary fire protection cable coating material, suitable for grouped electrical cables and of the fire-retardant intumescent type shall be used.

- Proposed fire stop material that has extensively been used on Peaking sites include:
  - Product: Mineral Wool Panel – Mandoval Vermiculate
  - Product: Pyro-safe WB – Mandoval Vermiculate

q) Cables shall be coated in lengths of two metres every 5 meters.

3.2.9 Plinth and wall preparation (Civil Works)

a) The *Contractor* is responsible for the floor preparation and constructing of the plinth where necessary for the control panels (refer to section 8.2 Civil and Engineering Works).

b) The *Contractor* repairs and restore floors to match the existing, where panels had been removed.

c) The *Contractor* repairs and restore walls to match the existing, where junction boxes had been removed.

d) The *Contractor* core drills the floor for accessing cables as per *Employer*s requirements.

e) The *Contractor* mounts the panel metal plinths where supplied/required.

f) The *Contractor* seals and paints the plinths to match the surroundings and to ensure the IP rating of the panels.

3.2.10 Cubicles installations

a) The *Contractor* installs new control cubicles on their correct position and fix with rawl bolts as per panel installation list.

Description	Size (mm)	Cable Entry
Unit 1 and 2 Main Unit Controller	2000(H) X 1600(W) X 800(D)	Bottom
Unit 1 and 2 Turbine Governor Controller	1800(H) X 800(W) X 600(D)	Bottom
Unit 1 and 2 Temperature and Speed Monitoring	1800(H) X 800(W) X 600(D)	Bottom
Unit 1 and 2 Remote I/O Generator	2000(H) X 800(W) X 800(D)	Top
Unit 1 and 2 Remote I/O Turbine	2000(H) X 800(W) X 800(D)	Top
Unit 1 and 2 Remote I/O Common	2000(H) X 800(W) X 800(D)	Bottom
Station Control Panel	2000(H) X 800(W) X 800(D)	Bottom
Station Remote I/O Panel	2000(H) X 800(W) X 800(D)	Bottom
National Control Centre	2000(H) X 800(W) X 800(D)	Bottom

b) The *Contractor* ensures correct levelling of panels.

c) The *Contractor* ensures that the panels doors can be opened or closed easily.

d) The *Contractor* ensures that the IP rating of the panels is maintained.

3.2.11 Junction Boxes installations

a) The *Contractor* supply and install new junction boxes which contains specification in the table below:

Table 3: Junction Boxes Technical Data

Specification	Description
Dimension	1000(H) x 800(W) x 250mm(D) ; 600(H) x 600(W) x 200mm(D)
Steel enclosure with galvanised plain mounting plate	Yes
Double door for 1000(H) x 800(W) x 250mm(D)	Yes
Single door for 600(H) x 600(W) x 200mm(D)	Yes
Door lock	Double bar
Colour	Powdered coated in RAL 1015 (Light Ivory)
M8 x 25 shouldered back-studs for installing mounting plate and step slides, leaving a space of 10mm.	Yes

Specification	Description
Mounting plate	Galvanised micro-perforated plate
Gland plate with marking for easy drilling and to guarantee the maximum access surface.	Yes
Easily removable door	Yes
Door opening	120^{o}
Earth stud inside the door and inside the enclosure, and earth strap.	Yes
Ingress protection	IP66 for the single door and IP55 for the double door according to IEC 60529

b) The junction boxes are installed with WTR 4SL spring loaded with link terminals.
Junction boxes are installed as per 240-56355815: Field Instrument Installation Standards for Junction Boxes and Cable Termination.

3.2.12 Control Consoles Section Plates installations

a) The *Contractor* installs newly manufactured Control Console section plates.

b) The *Contractor* ensures that the Control Console section plates is securely fixed to the frame.

Description	Size (mm)	Cable Entry
Unit 1 and 2 Control Console	Top section 700(H) x 1950(W) Middle section 1081(H) x 1950(W) Bottom section 602(H) x 1950(W)	Bottom
Station Control Console	Top section 700(H) x 1950(W) Middle section 1081(H) x 1950(W) Bottom section 602(H) x 1950(W)	Bottom

3.2.13 Glanding installations

a) The *Contractor* measures and supplies new gland plates where required. Punching/drilling of gland plates in accordance with gland plate design provided by the *Employer*.

b) The *Contractor* supplies and install cable glands and shrouds.

c) Cable gland holes are sized according to the manufactures specifications in order to maintain the IP rating of the panels or junction box.

Table 4: Cable Gland Technical Data

Gland Type	Gland Size	Dimension (mm)	Material
Compression	00		PVC Grey Polyamide
Compression	00	16/20	Nickel-plated brass
Compression	0	20	Nickel-plated brass
Compression	1	20	Nickel-plated brass
Compression	2	25	Nickel-plated brass

Gland Type	Gland Size	Dimension (mm)	Material
Compression	3	32	Nickel-plated brass
Compression	4	40	Nickel-plated brass
Armoured	1	20	Nickel-plated brass
Armoured	2	25	Nickel-plated brass

d) Top entry cable glands are fitted with appropriate shroud.

e) Appropriate glands are used for top entry to ensure a watertight installation between the gland and the gland plate. (IP 65 panel rating is retained).

f) It is the *Contractor*s responsibility to ensure cables are glanded such that cables don't cross each other. Cables must be neat and professional in all circumstances.

3.2.14 Wiring and Termination

a) The *Contractor* wires all incoming cables to the control (cubicles) panels using the panel termination list provided by the *Employer*.

b) The *Contractor* wires inside the junction boxes using the junction box termination list provided by the *Employer*.

c) The *Contractor* wires all cables to the field instruments using the instruments termination list provided by the *Employer*.

d) The connection between the field instrumentation and the control system is done using harting plugs to allow ease of maintenance. A short length cable (approximately half a meter) is used to connect the instrument and the other part of the harting plug.

e) There is no bare wire or loose strands exposed between a lug and the insulation of the wire to which the lug is crimped.

f) The use of an approved wire-stripping device is required, and stripping of insulation does not cause damage to conductors or the remaining insulation.

g) All lugs are of the compression type.

h) Lugs are compatible to the wiring. The same supplier lugs are used throughout the panels and junction boxes.

i) Lugs must fit cross-area of the conductor to which they are crimped. The correct crimping tool is used.

j) Bootlace ferrules are acceptable for signal wiring terminated on devices and modules. The correct crimping tool is used (minimum six di crimper).

k) Where two conductors are connected to a terminal, lugs, and ferrules to be fitted in such a manner as to allow the wires to be terminated in parallel.

l) Not more than two conductors (lugs) to be connected to any one side of a terminal.

m) Wiring is neat, braced and placed in secure PVC grey slotted panel trunking to prevent vibration and the possibility of forces being exerted on termination arrangements. Stick on plastic bracing support is not allowed.

n) Stripping of insulation is carried out so that there is no damage to the conductors or the remaining insulation.

o) Stranded wire less than 6mm2 to be terminated with pre-insulated crimped connectors of approved types.

p) Dimensions of the tongue and terminal are compatible. No cutting or modification of the lugs is acceptable.

q) A sample of each type of lug, wires, tools and finished connection is submitted to the *Employer* for approval before wiring commences.

r) A hooked blade lug to be used on screw-clamped spring-loaded insertion type terminals.

s) Torquing of termination connection to specification using calibrated torque wrenches.

t) All spare cores on cables are ring lugged and connected to earth on one side.

u) All spare cores are grouped and labelled with the cable number they belong to.

3.2.15 Network Communication Cabinet Works

a) The *Contractor* supplies and installs Fibre Optic standard 8U rack wall mount patch panels, with an IP rating of 65 at the location identified by the *Employer*.

b) The patch panels are installed with brush panels and fibre patch leads.

c) The works requires splicing of Fibre Optic cables and issuing of OTDR test certificates.

d) The installation complies with the 240-7073288: Measurement Methods and Test Procedures.

e) OTDR to be done from both ends with Jump box.

f) All Fibre Optic cable cores will be splices and terminated in the panels.

g) Patch Panel connectors to be ST type.

h) Patch (Fibre Optic) cables leaving panels to be Ruggedized.

3.2.16 Instrumentation Works

The Contractor procures, assembles, supplies, configures, bench tests all instruments and installs field instrumentation and its accessories that are suitable for the works and conforms with, the Employers detailed design drawings, standards for field instrumentation and mechanical works, DIN2353 standards and this Works Information, during cold commissioning the Contractor performs function test for each instrument verifying the process simulation to the HMI.

a) Seals and flanges
   - Gaskets on the transmitters are compatible with the Hydraulic Oil.
   - No asbestos gaskets are allowed.
   - Hydraulic sealant is used at the coupling points where NPT fitting is to be installed.
   - No Teflon tape is used for sealing on this system. NPT fittings are used on the couplings and Parallel threads will be used on the transmitter. Care must be taken when assembling the transmitter/manifold. The manifold has Teflon seals which will not interact with the hydraulic oil.
   - Gaskets installed at flanges are selected based on the specifications of the water or oil involved.
   - Gaskets are installed to allow ease of maintenance.
   - Flanges are selected based on the current system design standards.
   - By-Pass lines are to be installed so that frictional losses are minimized, and maintenance can be carried out easily where necessary.

- All flanges and fittings are torqued to manufacturer's recommendations.
- Seal bonded washers. (Dowty gasket seal plated carbon steel with buna O-ring)

b) Maximum pressure rating
- Manifolds – The manifold is rated to 4 times its operating value and complies with ASME standards.
- Instrument – The instrument installed have a burst pressure capacity which is similar setting as the safety valves for a pressurised vessel.
- Mechanical equipment – All fittings and couplings selected based on the maximum possible operating pressure and include a safety factor of at least two.

c) Existing pipe fitting and tubing
- Most of the existing impulse lines are copper tubing routed from tap-off point to instrument will be decommissioned.
- All existing tap-off points to be penetrant tested to assess the condition of the weld.

d) Pipes
- All pipes to be used in all mechanical designs will conform to the EN standard as per the original plant design. The material of all pipes is P195GH Carbon Steel as per BS EN 10216-2. The *Contractor* is required to provide this material for pipes or an alternative carbon steel material superior to P195GH Carbon Steel as per BS EN 10216-2. If the *Contractor* submits an equivalent material to the specification (within the BS EN domain), the proposed material is reviewed for acceptance. If however the *Contractor* submits a foreign material to the BS EN domain, a PMA (particular material appraisal) is completed for this material and reviewed for acceptance. A 3.1 material certificate as per EN 10204 is supplied with the material. Refer to the tender technical evaluation criteria for more information on how the *Contractor* will be technically evaluated regarding the materials.
- Galvanising of pipework where necessary.
- All piping to be de-burred and flushed to remove any debris and swarf.
- Refer to the different drawings for size specifications of the pipes for the different systems.
- The piping for cooling water system is hot dip galvanised and coated to required stipulated colour in accordance with approved corrosion protection specification as supplied by the *Contractor* and approval by the *Employer*.

e) Flat Plates
- All flat plates to be used in all mechanical designs will conform to the EN standard as per the original plant design. The material of all flat plates is P235GH carbon steel as per BS EN 10028-2. The *Contractor* is required to provide this material for flat plates or an alternative carbon steel material superior to P235GH carbon steel as per BS EN 10028-2. If the *Contractor* submits an equivalent material to the specification (within the BS EN domain), the proposed material is reviewed for acceptance. If however the *Contractor* submits a foreign material to the BS EN domain, a PMA (particular material appraisal) is completed for this material and reviewed for acceptance. A 3.1 material certificate as per EN 10204 is supplied with the material. Refer to the tender technical evaluation criteria for more information on how the *Contractor* will be technically evaluated regarding the materials.
- The flat plates include all flat bars, square or rectangular bars, plates, flanges (blank and slip-on), angle irons and U-channels. The dimensions for each of these components is system specific and is indicated on the drawings.
- Refer to the different drawings for size specifications of all flat plate products for the different systems.

f) Branches

- This section covers all systems where new branches will have to be welded. The nozzle/stub/branch will have to be manufactured for each system as per the required dimensions for each specific system. All stubs can be manufactured from the following billet as all dimensions will comfortably fall within this dimensional and material requirement:
    - Forged round bar
    - Size: Ø30mm (OD) x 1m (Length)
    - Material: P235GH Carbon Steel as per BS EN 10273
- The *Contractor* is required to provide this material or an alternative carbon steel material superior to P235GH carbon steel as per BS EN 10273. If the *Contractor* submits an equivalent material to the specification (within the BS EN domain), the proposed material is reviewed for acceptance. If however the *Contractor* submits a foreign material to the BS EN domain, a PMA (particular material appraisal) is completed for this material and reviewed for acceptance. A 3.1 material certificate as per EN 10204 is supplied with the material. Refer to the tender technical evaluation criteria for more information on how the *Contractor* will be technically evaluated regarding the materials.

g) Fittings

- All fittings, including carbon steel and stainless-steel fittings, is designed specifically for each different system and application. The pressure ratings of the fittings are compared to the system operating specifications and reviewed accordingly in terms of system operating medium, system pressure, temperature, material requirements, etc. The size and type of fittings are indicated on the detailed design drawings provided by the *Employer* for the respective subsystems.
- All carbon steel fittings are of the following material: ASTM SA-105N. A PMA is completed to use the ASME material on a BS designed system. If the *Contractor* submits an equivalent material to the specification (within the BS EN domain), the proposed material is reviewed for acceptance. If however the *Contractor* submits a foreign material to the BS EN domain, a PMA (particular material appraisal) is completed for this material and reviewed for acceptance. A 3.1 material certificate as per EN 10204 is supplied with the material. Refer to the tender technical evaluation criteria for more information on how the *Contractor* will be technically evaluated regarding the materials.
- All stainless-steel fittings are of the following material: 316 austenitic stainless steel. A PMA is completed to use the ASME material on a BS designed system. If the *Contractor* submits an equivalent material to the specification (within the BS EN domain), the proposed material is reviewed for acceptance. If however the *Contractor* submits a foreign material to the BS EN domain, a PMA (particular material appraisal) is completed for this material and reviewed for acceptance. A 3.1 material certificate as per EN 10204 is supplied with the material. Refer to the tender technical evaluation criteria for more information on how the *Contractor* will be technically evaluated regarding the materials.
- Refer to the different drawings for size specifications of the fittings for the different systems.

h) Tubing

- The stainless-steel tubing is 12mm in outside diameter and has a 2mm wall thickness.
- The material of the tubing is 316 austenitic stainless steel. A PMA is completed to use the ASME material on a BS designed system. If the *Contractor* submits an equivalent material to the specification (within the BS EN domain), the proposed material is reviewed for acceptance. If however the *Contractor* submits a foreign material to the BS EN domain, a PMA (particular material appraisal) is completed for this material and reviewed for acceptance. A 3.1 material certificate as per EN 10204 is supplied with the material.
- Tubing length will vary depending on the location of the instruments.

i) Manifolds
- Manifolds have a ½ Inch BSP female thread and a ½ inch male BSP. All seals must be PTFE (Teflon). The manifolds have an isolation valve, vent valve and a vent pin. The valve should also be of the lockable type.

j) Location of instrumentation
- The instrument will not be safety risk for routine inspection and will not pose a physical slipping risk and therefore injure an operator when doing routine inspection.
- All local indication is read easily while standing on ground level.
- The instrument is located in an area which can be accessed without the need for a High Voltage (HV) permit where practically possible.
- The instrumentation is installed in easy to reach locations and grouped together where possible as per *Employer*s detailed design drawings.
- The transmitters are located at a reasonable height to ensure ease of maintenance.
- All representations of identical data will have the same format (decimal points) and units wherever the process data is displayed for operation use.

k) Support structure
- Any support structure ensures minimal vibration is transferred to the transmitters.
- It ensures that the tubes are secured during operation of the hydraulic system.
- Non-slipcover plates are installed where required and handles available for easy access of equipment.
- The structure is correctly coated and painted according to the preferences of the *Employer*.

l) Welding and Non-Destructive Testing (NDT)
- The welding is done as per the Eskom Standard 240-106628253 (Standard for welding requirements on Eskom plant). The *Contractor* complies with section 8.5 in Eskom Standard 240-106628253 (Standard for welding requirements on Eskom plant) where it states that the *Contractor* is ISO 3834-2 accredited to be allowed to weld on Eskom Level 1 plant.
- The *Contractor* is in possession of a valid ISO 3834 – 2 Certificate. The *Contractor* submits all pages of the ISO 3834 – 2 certificates to the *Employer* for acceptance as part of the tender returnable documents. The ISO 3834-2 certificate should include material groups 1 and 8 as per ISO/TR 15608, construction standard EN 13480 and welding processes MMA (111) and TIG (141).
- The Eskom welding standard will apply to all systems. All carbon steels can be regarded as ISO/TR 15608 material group 1.2 for welding purposes. All stainless steels can be regarded as ISO/TR 15608 material group 8.1 for welding purposes.
- Qualified Welding Procedure Specifications (WPS) & Welding Procedure Qualification Record (WPQR). The *Contractor* is required to perform the following high-level welds as per the different designs: set-on stub fillet welds, bracket fillet welds, fillet welds for flanges, pipes and guide plates and butt welds. The *Contractor* submit WPS's and WPQRs for between 80% to 100% of all the required welds as per the design, specifically including the required butt welds. If the *Contractor* supplies between 80% and 100% of the WPS's, the *Contractor* will score 5/5 for this section. (The *Contractor*'s WPS's and WPQRs to be signed off by IWE/IWT and the AIA; all destructive and non-destructive test results as required by the Welding Code BS EN 15614 must be submitted as proof of qualification).
- A potential sub-*Contractor* is scored as per the evaluation criteria stipulated for the *Contractor*, without any exceptions, except if an exception is clearly stated.

- The *Contractor* is responsible to prepare all components for welding.
- The *Contractor* provides NDT in terms of penetrant testing, ultrasonic testing and pressure testing as per the Works Information. NDT should be performed as per the Standard for Non-Destructive Testing (NDT) on Eskom Plant (Document number 240-83539994). A Level 3 NDE Technician is required to perform NDT on Eskom Plant. The *Contractor* must supply proof that they are an acceptable Eskom vendor for NDT purposes or are sub-contracting to an acceptable Eskom vendor for NDT purposes.
- Set-on Stub Fillet Welds
    - The condition of existing branches to be re-used is checked by performing penetrant testing to identify any surface weld defects. If the NDT indicate weld defects, the weld will have to be repaired or a new branch/stub/nozzle will have to be welded.
    - All new set-on stub welds are required to be penetration fillet welds, followed with 100% penetrant testing as NDT.
    - Quality level B (as per BS EN ISO 1517) is permitted as limits for weld imperfections.
    - The *Contractor* is required to send their WPS for the different required set-on stub fillet welds.
- Bracket Fillet Welds
    - 10% of all new fillet welds on the brackets is followed with penetrant testing as NDT.
    - Quality level D (as per BS EN ISO 1517) is permitted as limits for weld imperfections.
    - The *Contractor* is required to send their WPS for the different required fillet welds.
- Fillet Welds (Flanges, guide plates, etc.)
    - 100% of all new fillet welds on all other fillet welds (excluding brackets and set-on stubs) is followed with penetrant testing as NDT.
    - Quality level B (as per BS EN ISO 1517) is permitted as limits for weld imperfections.
    - The *Contractor* is required to send their WPS for the different required fillet welds.
- Butt Welds
    - All new butt welds are followed with penetrant testing and ultrasonic testing as NDT.
    - Quality level B (as per BS EN ISO 1517) is permitted as limits for weld imperfections.
    - The *Contractor* is required to send their WPS for the different required butt welds.
- Pressure Testing on Impulse Lines
    - Pressure testing to be performed on all systems to 1.25 times the system pressure as per the Pressure Equipment Regulations.
    - If the pressure test is not possible on systems categorised as SEP (or Not Regulated) according to SANS 347, a leak test is sufficient, which is performed under normal operating conditions of the specific system.
- Tube Bending NDT
    - Five samples of the same tubing (size and material) is bent prior to implementation of all tubes for the various systems. Wall thickness is recorded on the intrados and extrados of the bends, as well as ovality checks before approval is granted for all tubing to be implemented on all systems.

- The minimum allowable wall thickness on the extrados is 1.37mm. The ovality is reviewed by using BS EN 13480-2 as reference.

- Branch Stub for Temperature probes
  - All stubs can be manufactured from the following billet as all dimensions will comfortably wall within this dimensional and material requirement:
    i. Forged round bar
    ii. Size: Ø25mm (OD)
    iii. Material: P235GH Carbon Steel as per BS EN 10273
  - The Contractor is required to supply this material or an alternative carbon steel material superior to P235GH carbon steel as per BS EN 10273. If the Contractor submits an equivalent material to the specification (within the BS EN domain), the proposed material is reviewed for acceptance. If however the Contractor submits a foreign material to the BS EN domain, a PMS is completed for this material and reviewed for acceptance. A 3.1 material certificate as per EN 10204 is supplied with the material.

m) Pressure transmitters
- The installation of the transmitters includes pressure gauges on the same process line depending on the *Employer*'s design.
- The *Contractor* procures components, manufactures, assembles and supplies support structure (mounting brackets) for the pressure transmitters as per detailed design drawings provided by the *Employer* and ensure that the structure do not interfere with instrumentation or maintenance activities. The *Contractor* conforms to the *Employer*'s welding requirements.

n) Level transmitters
- The *Contractor* procures, assembles, supplies and installs standpipes, level instruments, valves, flanges necessary to complete the installation. The *Contractor* modifies the existing plant by cutting, drilling, welding, blanking etc. as necessary to install the new complete level devices.
- The level transmitters are installed with a standpipe chamber or stilling well.
- The standpipe or stilling well is of suitable dimension as per detailed design provided by the *Employer* to allow sufficient oil flow into the system and to be able to read accurate measurement.
- The standpipe chamber is installed with isolation valves to isolate the process medium from the instrument for maintenance purpose.
- Standpipes are installed with vent line and drain lines as applicable depending on the system.

o) CW Flow transmitters
- The existing flowmeters will be replaced with new Electromagnetic flowmeters with a digital local display.
- Flowmeters are installed in a welded socket in the pipe. The *Contractor* is required to remove the existing pipe sections, clean, modify pipe work by cutting, welding existing and new pipe sections and flanges as per the *Employer's* design. Installs the new modified pipe sections and flow meter, aligns as per the *Employer's* design.
- The *Contractor* cleans the weld, performs NDT, corrosion protects, and provides weld and pressure test certificates.
- The *Contractor* paints, installs gaskets and installed the pipe section and instrument.
- The *Contractor* provides pre-manufactured spool pieces, with matching flanges with flow inserts, as per the *Employer*s detailed design drawings where appropriate.

- The *Contractor* procures (four) and installs the spool pieces for the DWM2000 magnetic flowmeter that are pre-manufactured by the OEM for pipes that are DN40 in size.
- The *Contractor* removes, cleans, blanks-off, modifies, performs welds and weld tests, corrosion protects, pressures tests pipe sections on or off site that cannot be premanufactured to accommodate the new designs as per the *Employer*'s design.
- The *Contractor* procures and installs insulating gasket, sleeve, and washers for galvanic insulation between stainless steel and carbon / mild steel pipe work.

p) Oil Flow
- Various oil systems are currently installed with multiple oil flow detectors. The *Contractor* is required to replace these devices with new flow switches. The installation will require the removal of existing pipe work, cleaning, cutting, welding and fitting of a welded-on stub and installs the new flow switch.
- Oil flow switches will follow the same welding requirements as the temperature probe stubs.

q) Temperatures
- Some Pt100 RTD with terminal head will be inspected and re-used. The *Contractor* will either replace the ceramic block for termination, or clean and cut the socket for the thermowell, weld a new socket, pressure test, and replace with the new probes.
- Where new probes are required, the *Contractor* will be required to cut, weld a stub, pressure test and installs a thermowell, and the new temperature probes.

r) Water in oil instruments
- Each oil system is currently installed with multiple water in oil detectors. The *Contractor* is required to replace these devices with new point level detection devices. The installation will require the removal of existing flanges, cleaning, cutting, welding and fitting of a new flange with a welded-on stub and installs the new probe.

s) Limits switches
- The plant is installed with limits switches for the brakes, guide vanes shear pins and guide vanes locks. The *Contractor* is required to replace the limit switches as per *Employer*'s design.

Note: The basic design specification for the mechanical changes required to interface some of the instruments to the existing plant will be provided at a later stage when access to the plant is available for verification. This part of the scope of work will require similar components and resources as defined for other instruments that have completed basic designs. The *Contractor* makes provision for this scope of work as part of this contract.

3.2.16.1 Pressure Instruments specification

The *Contractor* is responsible to supply the differential pressure transmitters which contains technical data as table below:

Table 5: Differential Pressure Transmitter Technical Data

Instrument features	Description
Model	EJX110A-JHS4G-919EB
Type	Differential pressure transmitter
Output signal	4-20mA with digital communication (HART protocol)
Measurement Span/Range	-50 to 500kPa (10 to 2000inH2O)
Process connections	½NPT female process connector on the top of the 3-valve manifold
Bolts and nuts material	316L SST

Instrument features	Description
Installation	Horizontal piping and left side high pressure
Amplifier housing	Cast aluminium alloy
Electrical connection	M20 female, two electrical connections and a blind plug
Integral indicator	Digital indicator with the range setting switch
Mounting brackets	304 SST 2-inch pipe mounting, flat type (for horizontal piping)
Manifold	S3/FTHAX-ZH. 3 Valve Direct Mount Manifold

The *Contractor* is responsible to supply the pressure transmitters which contains technical data as table below: Prior to procurement the *Contractor* verify the range measurement with the *Employer*.

Table 6: Gauge Pressure Transmitter Technical Data

Instrument features	Description
Model	EJX530A-JBS8N-019EF, EJX530A-JCS8N-019EF, EJX530A-JDS8N-019EF
Type	Pressure transmitter
Output signal	4-20mA Output with digital communication (HART protocol)
Measurement Span/Range	B: -0.1 to 2MPa
	C: -0.1 to 10MPa
	D: -0.1 to 50MPa
Wetted parts materials	Process connection: 316 SST, Diaphragm: Hastelloy C-276
Process connection	G½ DIN 16 288 male
Bolts and nuts material	316L SST
Installation	Horizontal piping and left side high pressure
Amplifier housing	Cast aluminium alloy
Electrical connection	M20 female, two electrical connections with bind plug
Integral indicator	Digital indicator with the range setting switch
Mounting brackets	304 SST 2-inch pipe mounting
Manifold	P2/W4GW4GTV2AH-R. 2 Valve Block and Vent Gauge Valve

The *Contractor* is responsible to supply the pressure gauges which contains technical data as table below: Prior to procurement the *Contractor* verify the range measurement with the *Employer*.

Table 7: Pressure Gauge Technical Data

Instrument features	Description
Model	151.10
Type	Bourdon tube pressure gauge
Scale range	0 – 1500kPa
	0 – 3000kPa
	0 – 6000kPa
	0 – 10000kPa (10MPa)

Instrument features	Description
Design	EN 837-1
Accuracy class	1.0
Nominal size	100mm
Permissible temperature	Ambient: -20 to +60 °C
Ingress protection per IEC/EN 60529	IP 65
Process connection	Copper alloy, Lower mount G ½ B
Pressure element	Measuring System 316L
Dial	NS 50, 63: Plastic ABS, with pointer stop pin
Pointer	NS 50, 63: Plastic, black
Case	Stainless steel, natural finish. Sealing towards process connection with O-ring. With all scale ranges, the filling plug can be vented for internal pressure compensation.
Window	Glass, crystal clear
Ring	Crimped triangular bezel, stainless steel, glossy finish
Filing liquid	Glycerine

The *Contractor* is responsible to supply the pressure instruments accessories which contains technical data as table below: Prior to procurement the *Contractor* verify the range measurement with the *Employer*.

Table 8: Stainless Steel Instrumentation Quick Connect Body

Instrument features	Description
Part Number	SS-QC4-B-4PM
Body Material	316 Stainless Steel
Connection Size	1/4 inch
Connection Type	Male NPT
Series	QC4

Table 9: Stainless Steel braided flexible hose with Quick Connectors

Instrument features	Description
Part Number	SS-810-1-8
Tube Part Number	SS-4BHT--12
Body Material	316 Stainless Steel
Connection 1 Size	1/2 inch
Connection 1 Type	Swagelok Tube Fitting
Connection 2 Size	1/2 inch
Connection 2 Type	Male NPT
Length	300

3.2.16.2 Level Instruments specification

The *Contractor* is responsible to supply the reed level transmitters which contains technical data as table below: Prior to procurement the *Contractor* verify the range measurement with the *Employer*.

Table 10: Reed Level Transmitter Technical Data

Instrument features	Description
Model	MPJ5-M280 and MPJ5-M505
Type	Reed Level Transmitter for the process industry.
Measuring principle	Continuous level measurement transmitter with reed measuring resolution of 5mm, inserted in round hollow float of 52x52mm and stopper at the end and head mounted transducer type: 2252.
Power supply	24V DC
Output signal	4-20mA
Process connection	½" BSP male tapered compression fitting
Measuring range	MPJ5-M280: 200mm with top dead-band of 100mm and bottom dead-band of 50mm.
	MPJ5-M505: 360mm with top dead-band of 100mm and bottom dead-band of 50mm.
Guide tube diameter	12mm
Maximum guide tube length	MPJ5-M280: 350mm
	MPJ5-M505: 500mm
Head- mounted transmitter	PR 5343A 2-wire level transmitter (0 – 100kΩ)
Connection cable to transmitter	2-wire
Ingress protection per IEC/EN 60529	IP 65
Ambient Temperature	-40 ^{o}C to +120 ^{o}C
Float and guide tube material	Stainless steel

The *Contractor* is responsible to supply the reed sensor for bypass level indicators which contains technical data as table below: Prior to procurement the *Contractor* verify the range measurement with the *Employer*.

Table 11: Reed Sensor for Bypass Level Indicators Technical Data

Instrument features	Description
Model	MPJ5-M1500
Type	Reed sensor for bypass level indicators
Measuring principle	Sensor for continuous level measurement of liquids in bypass level indicators, with programmable and configurable head mounted. Installation of head-mounted transmitter in the connection housing possible.
Power supply	24V DC
Output signal	4-20mA
Process connection	½" BSP male tapered compression fitting

Instrument features	Description
Measuring range	1400mm with top dead-band of 50mm and bottom dead-band of 50mm.
Guide tube diameter	14mm
Maximum guide tube length	1500mm
Head- mounted transmitter	PR 5343A 2-wire level transmitter (0 – 100kΩ)
Connection cable to transmitter	2-wire
Ingress protection per IEC/EN 60529	IP 65
Ambient Temperature	-40ºC to +120ºC
Accessories	Steel pipe clamps for 60mm diameter pipe

The *Contractor* is responsible to supply the magnetic display for bypass level indicator which contains technical data as table below: Prior to procurement the *Contractor* verify the range measurement with the *Employer*.

Table 12: Magnetic Display for Bypass Level Indicator Technical Data

Instrument features	Description
Model	BMD-SA
Type	Magnetic display for bypass level indicator
Measuring principle	Display bar for visualisation of levels in combination with bypass level indicators. Measured value display by means of rollers or permanent magnets.
Chamber	OD 42 x 2mm
Chamber end top	Vent flange
Chamber end bottom	Flange with drain plug BSP½”
Process connection	Side-Side, Flange DN10 – DN25, PN40, DIN 2635
Distance centre-to-centre M…	
Material	Stainless steel 316Ti (1.4571)
Maximum pressure	64bar and 100bar
Float	Type ZTS35/18, material Titanium Grade 2, S.G. minimum 800kg/m^3 max pressure 16bar.
Medium temperature	-200 ... +450 °C
Case	Aluminium
Length	1400mm
Display element	Plastic rollers, PBT, red/white
Indicator window	Polycarbonate profile
Ingress protection per IEC/EN 60529	IP 65

The *Contractor* is responsible to supply the magnetic switch for bypass level indicator which contains technical data as table below:

Table 13: Magnetic Switch for Bypass Level Indicator Technical Data

Instrument features	**Description**
Model	BGU
Type	Magnetic switch for bypass level indicator
Contact	Reed contact
Contact type	1 change-over contact
Switch behaviour	Bistable
Switching power	230V AC
Case	Stainless steel

The *Contractor* is responsible to supply the point level detectors which contains technical data as table below:

Table 14: Conductive Point Level Detection Technical Data

Instrument features	**Description**
Model	11375Z
Type	Conductive Point Level Detection
Measuring principle	Conductive
Characteristic / Application	One rod probe for high temperature and high pressure. Corrosion resistance
Supply / communication	Relay (FTW325)
Medium temperature	-40 ^{o}C to +200 ^{o}C
Operating pressure	Up to 50bar
Process connection	G½
Length	120mm
Sensor Length	50 to 2000mm
Minimum conductivity of medium	20µS/cm
Ingress protection	IP65
Additional Device	
Model	FTW325
Device type	Transmitter
Power supply	20 to 60V DC
Mounting type	DIN rail
Switch output	SPDT
Module for non-hazardous area	Yes

3.2.16.3 Flow Instruments specification

The *Contractor* is responsible to supply the flow transmitters which contains technical data as table below:

Table 15: Electromagnetic Flow Meter Technical Data 1

Instrument features	Description
Model	DWM2000
Type	Electromagnetic Flow Meter V741421C320100000
Output signal	4-20mA
Power supply (instrument terminal)	24V DC
Function	For monitoring flow velocity in pipes
Display units, 1st line	m/s
Display units, 2nd line	m^3/h
User interface	2-line LCD indicator with 4 buttons keypad
Full-scale range	1,2,3,4,5,6,7 or 8m/s Programmable
Maximum allowed operating pressure	25bar
Ingress protection	IP 55
Electromagnetic compatibility	EN 50081-1; EN 50082-2
Housing without stainless housing	Aluminium with epoxy finish
Sensor insulation	Ceramic [Zirconium oxide]
Spool piece	316L [1.4404] stainless steel
Cable entry	Nickel-plated brass
Gasket, sensor	FKM/ FPM
Gasket, housing cover	Perbunan

Table 166: Electromagnetic Flow Meter Technical Data 2

Instrument features	Description
Model	200B3DASSR2MXI
Type	Electromagnetic Flow Meter
Output signal	4-20mA
Power supply (instrument terminal)	24V DC
Meter Size	DN200
Signal Converter	Beta Converter
Lining Material	Durathane Rubber
Electrode Material	316 Stainless Steel
Converter Mounting	Integral Mounting

3.2.16.4 Temperature Instruments specification

The *Contractor* is responsible to supply the temperature transmitters which contains technical data as table below: Prior to procurement the *Contractor* verify the probe length with the *Employer*.

Table 177: Resistance Thermometer Without Thermowell Technical Data

Instrument features	Description
Model	TR10-H
Type	Resistance thermometer without thermowell
Sensor measuring element	Pt100
Sensor range	-196 to +600ºC
Connection method	Dual element 2 x 3-wire
Validity limits of class accuracy per EN 60751	Class A
Connection head	BSS
Ingress protection	IP 65
Cable entry	Standard M20 x 1.5 or ½ NPT
Probe length	600mm (est.); 675mm with 150mm flexible rod
Protruded fixed threaded connection	Yes

The *Contractor* is responsible to supply the RTD (Resistance Temperature Detector) which contains technical data as table below: Prior to procurement the *Contractor* verify the probe length with the *Employer*.

Table 188: RTD Pt100 Sensor Technical Data

Instrument features	Description
Type	RTD
Sensor measuring element	Pt100
Sensor range	-50 to +400ºC
Cable length	10m (est.) embedded steel braided cable.
Probe length	100mm (est.); 130mm (est.); 240mm (est.)
Probe diameter	5mm (est.)
Probe material	Stainless steel
Threads	M8 with nut
Electrical connection	3 wires
Accuracy	Class A

The *Contractor* is responsible to supply the Platinum Resistance Thermometer Pt100 RTD with Terminal Head which contains technical data as table below: Prior to procurement the *Contractor* verify the probe length with the *Employer*.

Table 199: Pt100 RTD with Terminal Head

Instrument features	Description
Type	RTD
Sensor measuring element	Pt100
Sensor range	-50 to +400°C
Probe length	50mm; 100mm; 200mm.
Probe diameter	5mm (est.)
Probe material	Stainless steel
Threads	G ½"
Electrical connection	3 wires
Tolerance Band	Class A
Head type	316 stainless steel, IP68
Head accessory	Ceramic terminal block

The *Contractor* is responsible to supply the Thermowell for Pt100 RTD which as per table below:

Table 20: Thermowell

Type	Threaded or push-in/weld-in protection tube (Thermowell)
Material	Stainless Steel 316L
Process thread	G1/2 male
Connection to thermometer	G1/2 female
Total length	70mm, 120 mm
Head Length	20 mm
Insertion length	50mm, 100 mm
Tube dimension:	9.53 x 1.22 mm

3.2.17 Protective Earthing

a) The *Contractor* earths all control panels, instruments (including instruments brackets), junction boxes and cables trays to the station earthing system and complies with the Earthing and Lightning Protection standard.

b) The installation is earthed properly in accordance with the Installation and Mitigation Guidelines – Section 2: Earthing and Cabling.

3.2.18 Marking and Labelling of Cables and Core Tags

a) The *Contractors* provides marking, printing, and labelling for the works provided under this Contract. Labelling is according 240-62629353: Specification for Panel Labelling Standard

b) The *Contractor* labels all incoming cable to the control panels and junction box at the glanding point and at instrument glanding point.

c) Cable identification numbers are permanently fixed to the cable at both ends. The *Contractor* supply the 70mm yellow labels and affix these to the cables using clear 70mm sleeve. The *Contractor* prints the cable numbers using the cable schedule provided by the *Employer*.

d) The *Contractor* ensures that the cable numbers affixed to the cable are the same.

e) The *Contractor* labels all wires with core-tags, which indicates the terminal strip and terminal numbers. All core-tag for the terminals is 23mm yellow PVC and the wiring on the panel doors are 15mm yellow PVC tags.

f) The *Contractor* labels all field instruments using 70mm tags yellow labels and affix them using clear 70mm sleeves. The core tag used for the instruments are 15mm yellow PVC tag.

g) Conductive stick-on labels are not acceptable.

h) Horizontal Terminal Strip: Tag is readable from left to right.

i) Vertical Terminal Strip: Tag is readable from bottom to top.

3.2.19 Junction boxes and Patch Panels Labelling

The *Contractor* labels the junction boxes and patch panels with the full KKS codes as provided by the *Employer*. The labelling (nameplate) is attached on the front of the junction boxes and patch panels. The labelling is according 240-71432150: Plant Labelling Standard. The labelling of the junction boxes and patch panels consist of the following:

a) Material

- The nameplate is created with white graflux and uses a slid in aluminium holder.
- Colour coded plastic should be used for internal panels.
- Label thickness: 1.5mm.

b) Ergonomic Requirements

- Consistency maintained when attaching labels on the panels.
- Labels are fitted in a manner not to hamper routine operation and maintenance activities.
- The location of labels on an item should ensure readability during normal operation of plant without compromising identity of exact equipment. If not possible, consult the *Employer*.
- Labels are mounted so that the text runs in a horizontal plane reading from left to right to the nearest fixed point that is being described.

c) Environmental Factors

All plant labels are as permanent as the normal life expectancy of the plant and be capable of withstanding the following environmental conditions:

- Rain
- Hail
- Temperature variance as required by plant
- Wind and Dust erosion
- Ultraviolet rays (sun)

- Corrosion.

d) Notation of KKS Code

Single spacing between unit, system, equipment, and components as per 240-71432150 standard is used in all labels.

e) Engraving

- Arial font is used on all labels.
- Standard vertical characters are used.
- Narrow (condensed), broad (extended) characters are not acceptable.
- Horizontal lines are evenly spaced amongst the height of the label.
- If the label description is too long to fit in one line and requires going over multiple lines, it should be spread evenly across the height of the label.
- All labels have character fill in black.
- Label Type EH – Junction Box label:

  Fixing Method: Adhesive.

  - Alphanumeric Characters: 10mm High.
  - Description Characters: 10mm High.
  - White background.

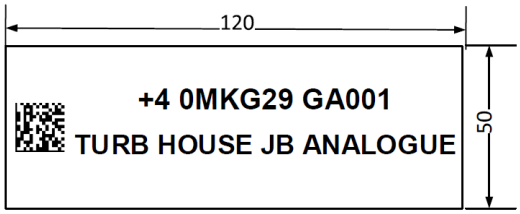


Figure 3: Example of Junction Box Labelling

3.2.20 Codification

a) Vanderkloof Hydroelectric Power Station subscribes to the KKS codification. All drawings and equipment lists are coded according to the KKS codification including descriptions.
b) The *Contractor* utilise the KKS codification when labelling Instruments and Components, which is provided with the detailed design drawings of the *Employer*.

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

3.3.1 Engineering Change Management process

The *Contractor* takes notes of the *Employer's* process of authorising the design which is the Engineering Change Procedure (240-53114026). Engineering changes includes any proposed change originating from engineering, *Contractor*s, project management and construction management.

The Engineering Change Procedure applies to the *Employer's* personnel or *Contractor* performing engineering or change related work where the quality of the engineering work performed is the direct responsibility for the *Employer*. The process consists of:

a) Concept Design
b) Basic Design
c) Detailed Design

The *Contractor* submits as a minimum the following data in neat files for acceptance by the *Employer* during the Technical Evaluation:

a) Completed Relevant Technical Schedules B
b) Deviation Schedule
c) Bill of Materials
d) Technical Datasheet of all Components, instruments, and its accessories.
e) Example of Method Statement
f) Example of Quality Control Plan including all intervention points.
g) Proof of relevant work experience and skills.

3.3.2 Design Review Procedure

The *Contractor* is made aware of the Design Review Procedure (240-53113685). The process of the review consists of:

a) Contract Review (technical clarification review)
b) Design “Freeze” Review

3.3.3 Process for submission of documents

Where the *Contractor* performs the design, the *Contractor* submits all documentation according to the accepted engineering management plan. The process for the submission of documentation is described below and applicable to each end-of-phase design review:

a) The *Contractor* submits the documents/drawings to the *Project Manager* with the appropriately reference Design Review Template.
b) The *Employer's* Document Controller registers the documents
c) The *Employer's* Document Controller supplies the documents/drawings to all relevant parties within the *Employer's* project team.
d) The *Employer's* project team reviews the documents/drawings and submits all comments or inputs to the *Project Manager* and the *Project Manager* submits to the *Contractor* for consideration.
e) The *Contractor r*evises the design, documents and/or drawings to address the *Employer's* comments and resubmits to the *Project Manager*.
f) Once all the *Employer's* comments have been addressed and no major deficiencies are found, the *Contractor* arranges a Design Review session.
g) If no fundamental errors are found in the design during the Design Review session, the *Contractor* compiles the Design Review minutes or report and submits it to the *Project Manager*.
h) The *Employer's* Document Controller registers the report.
i) The *Employer's* project team reviews the *Contractor's* report/minutes. If the report/minutes are not acceptable, the *Contractor* revises the report/minutes and resubmits to the *Project Manager*.
j) The *Project Manager* accepts the *Contractor's* design once the report/minutes are accepted by the *Employer's* project team.
k) The *Contractor* submits all technical documentation and drawings for acceptance by the *Employer* prior to Site Construction Works.

3.3.4 Time Required for Acceptance of Designs

Where the *Contractor* performs the design, not later than one month after receipt, the *Project Manager* returns one copy of the drawing marked “Accepted”; “Accepted as Noted” or “Not Accepted”, as may be

appropriate. The notations “Accepted” and “Accepted as Noted” authorize the *Contractor* to proceed with the manufacture of the Plant covered by such drawings subject to the corrections, if any, indicated thereon. Where prints or drawings have been “Not Accepted” or “Accepted as Noted” the *Contractor* makes the necessary revisions on the drawings and submit further copies for acceptance in the same procedure as for the original submission of drawings.

3.3.5 General documentation requirements for acceptance of *Contractor's* design

Where the *Contractor* performs the design, the *Contractor* submits all documentation according to the accepted engineering design requirements and standards.

a) All documentation complies with the latest Eskom's Classification and Designation of Technical Documentation Standard, 240-54179170; Eskom's Documentation Management Standard, 32-644 rev1, NRS 002.
b) The documentation supplied is in South African English and SI units are used.
c) The *Contractor* provides documentation in the electronic media using Microsoft Office, unless otherwise stated.
d) The *Contractor* implements a comprehensive document management system of the control of all documents, revision status “as-designed”, “as-manufactured”, “as-commissioned” and “as-built”.
e) The *Employer* does not accept scanned electronic copies of documentation or drawings.
f) The *Contractor* submits electronic copies of PDF drawings upon first issue and each time drawing updates are required.
g) The final as-built drawing in an electronic format is submitted in MicroStation (DGN) or format that is compatible with MicroStation.
h) Multilayer drawings are not acceptable.
i) All documents and drawing submissions are prepared and signed-off by suitably qualified personnel.
j) The *Employer* allocates numbers to the documentation and drawings, which the *Contractor* indicates on the documentation and drawings.
k) The *Contractor* uses the pre-approved templates provided by the *Employer* for documentation and drawings. The drawings make provision for the Eskom border.
l) All documentation required at the various acceptance stages are submitted in a hard copy and a software copy format.

3.3.6 Detail design documentation requirements for acceptance of the *Contractor's* design

a) FAT procedures to be used for the junction boxes.

3.3.7 Site Construction documentation requirements for acceptance of the *Contractor's* Work

The *Contractor* submits all technical documentation acceptance prior to Site Construction Work which includes:

a) Work Method Statements.
b) Quality Control Plans and Check Sheets.
c) Cable drum test certificate.
d) Others certificate and reports as required.

3.4 Equipment required to be included in the works

The *Contractor* is to make use of the following minimum standard equipment in order to complete the *works*:

a) Plier Crimping Tool for Bootlace Ferrule
- Knipex Plier Crimping Tool for Bootlace Ferrule – 97 53 14, 0.08-10mm² 6 Di Crimper or
- Phoenix Contact Plier Crimping Tool – 1212046, 0.14mm² to 6 mm² or
- Hellermann Tyton YAC9 Bootlace Ferrule Crimper, 0.08-6mm² or Equivalent

b) Wire Stripper
- Hellermann Tyton Wire Stripper 1-3.2mm² or
- RS PRO 170mm Wire Stripper 0.2mm-6mm or Equivalent

c) Pre-insulated Lug Crimping Tool
- Hellermann Tyton YYT1 Pre-insulated Terminal Crimper

d) Torque Terminal Screwdriver
- Phoenix Contact Torque Screwdriver, TSD-M 1,2Nm – 1212224 (0.3 → 1.2Nm) or
- Wera ¼ inch Hex Pre-Settable Torque Screwdriver, 0.3 → 1.2Nm or Equivalent

e) Multimeter
- Fluke 789 ProcessMeter, 1A Multi-Function Calibrator or Equivalent

f) Industrial Pipe Bender
- Tube bender for 12mm (outside diameter) tubing/piping, 20mm and 25mm for the bosal conduit. The *Contractor* provides the tube bender bend die size to the *Employer* for acceptance.

g) Pipe Cutter

h) Industrial Drill Machine
- Hilti drill machine
- Magnetic drill machine
- Rotary hammer drill

i) Grinder

j) Industrial Welding equipment
- Cutting torch
- Welding gas cylinder (Argon, Oxygen)
- All related equipment for welding requirements

k) The *Contractor* provides any other equipment not listed to perform the *Works*.

3.5 As-built drawings, operating manuals and maintenance schedules

3.5.1 General

a) The *Contractor* submits, to the *Employer*, final As-built documentation of the Works within 60 days of completion of the Works.

b) The *Contractor* submits three full sized hardcopies plus two electronic copies of the As-built documentation. The electronic copies are submitted on individual USB flash drives.

c) The *Contractor* provides documentation in the electronic media using Microsoft Office or “searchable” PDF format.

d) The *Employer* allocates numbers to the documentation and drawings, which the *Contractor* indicates on the documentation and drawings.

e) The documentation is submitted in loose leaf binders to ISO format and normally A4 size. The use of oversize pages is kept to a minimum and does not exceed page height unfolded. Fixings are “D” ring and are of the snap close type. Post binders or other fixings are not acceptable. Binders do not exceed 80mm in overall thickness. The document identity appears on both the front cover and on the spine.

3.5.2 Manuals

a) The *Contractor* provides technical manual for each equipment or component used in the works, which is supplied by the *Contractor*.

b) The *Contractor* incorporates the operating description, all necessary technical data, design data, and drawings into the manuals.

3.5.3 Signed-off documentation

a) Copies of all tests, indicating the results of all tests performed, are submitted to the *Employer*.

b) The *Contractor* supplies the *Employer* with Instruction, Technical or Operating and Maintenance Manuals that includes:

   i) Signed-off test certificates

   ii) Signed-off Quality Control Plan and Check sheets

c) The final issues of all manuals and drawings are submitted (4) weeks after Completion for acceptance by the *Project Manager*. All documentation duplicates reflect the original’s quality.

4. Procurement

4.1 People

4.1.1 Minimum requirements of people employed on the Site

The *Contractor* ensures that all foreign personnel who are not South African citizens or permanent Residents comply with the relevant legislation to perform work within the Republic of South Africa. The *Contractor* ensures that there are at all times sufficient suitably qualified, experienced and skilled staff to carry out and supervise all activities.

4.1.2 BBBEE and preferencing scheme

The *Contractor* complies with and fulfils the *Contractor's* obligations in respect of the Broad Based Black Economic Empowerment (as per clause Z3) and Supplier Development and Localisation Obligations.

4.2 Subcontracting

4.2.1 Preferred sub*Contractor*s

None

4.2.2 Subcontract documentation, and assessment of subcontract tenders

The *Contractor* will provide the *works* as if he had not subcontracted and are liable and accountable for all actions of his sub*Contractor*s.

4.2.3 Limitations on subcontracting

The *Contractor* may be requested by the *Employer* to submit details of the qualifications and

experience for each category of personnel and specialists for which a rate is submitted.

4.2.4 Attendance on sub*Contractor*s

Not applicable.

4.3 Plant and Materials

4.3.1 Quality

The *Contractor* procures, assembly and delivers all Components, Instruments and Consumables required for the Works, that are new and of the best quality, of the class most suitable for the purpose specified and governed by the national and international recognised standard: ASME (The American Society Of Mechanical Engineers), IEC, DIN and SANS. Other standards are submitted to the *Project Manager* for approval.

4.3.2 Procurement Process

The Procurement Process applies *Contractor* bidding for the related Works. The process consists of:

a) Submission of the tender returnable
b) Technical Evaluation
c) Contract Award

4.3.3 Product Support

a) All Components and devices supplied by the *Contractor* have a useful life of 12-15 years and are supported for by their respective OEMs (Original Equipment Manufacturer) over this period.

b) The *Contractor* supplies a data book containing all the pertinent information for all items supplied including to but not limited to the following features:
- OEM
- OEM Part number specific to the variant of the item
- Serial number
- Technical data sheets
- OEM's Operating manual
- OEM's Installation manual
- OEM's Maintenance manual
- OEM's configuration manual
- Configuration files
- Hardware interface
- Software for interfacing
- Configuration licenses
- Special programming tools
- Special maintenance tools
- OEM's warrantee certificates
- Links to OEM Portals to verify items by serial number.

4.3.4 Defects correction

a) The *Contractor* is responsible for all defects and/damage of the Works until and including the delivery to site, installation on the plant until handover.

b) The *Contractor* offers a standard 52 weeks warranty/defect period on workmanship and 36 months on material used.

c) The *Contractor* clearly states, in writing, the warrantee period on their product and the components supplied.

d) During the warrantee period the faulty devices are to be investigated by the *Contractor* and a failure report provided to the *Employer* stating the reason for failure.

e) The *Contractor* inspects the *Works* on or before the defects date and provides the *Employer* with an inspection report.

f) The *Contractor* liaises with the *Employer* three months prior to the defects date to confirm availability.

g) The *Contractor* corrects all defects and latent defects identified before the end of the defect's correction period.

h) The *Contractor* ensures that commissioning spares are available on site at all times during the contract. Spares, as per the spares list shall be issued to the *Employer* before handover of any plant or subsystem.

4.3.5 Plant & Materials provided "free issue" by the *Employer*

The Contractor is required to collect the control system panels (cubicles), which were manufactured and supplied by Others, at Acacia Power Station in Cape Town (33°52'59"S;18°32'08"E) and deliver them to Vanderkloof Power Station (29°59'37"S;24°43'48"E). The Contractor ensures the proper packaging and caring of the goods while transporting and is liable for all damages until handover. All other Plant and Materials are to be provided by the Contractor.

4.3.6 *Contractor*'s procurement of Plant and Materials

a) The *Contractor* procures and supplies Components, Materials and Consumables for *Works* using the bill of materials approved by the *Employer*.

b) A Bill of Quantity for the works is provided for tender pricing purposes (see appendix B). It is the *Contractor's* responsibility to procure, store and manage Components, Materials and Consumables in an auditable manner providing the *Employer* with weekly/monthly feedback on quantities and cost.

c) The *Contractor* ensures that all Components, Materials and Consumables are adequately transported and delivered to Site at least 45 days prior to the start of the *Works.*

d) The *Contractor* submits a complete pre-delivery checklist to ensure all prerequisites have been complied with for the equipment to be transported to Site. The *Employer* signs off on the checklist prior to equipment being transported to Site.

e) The *Contractor* indicates the type of transport used and mitigation measures in place to protect the equipment and materials from damage.

f) The *Contractor* is responsible for offloading and movement of Components, Materials and Consumables to the storage area.

4.3.7 Spares and consumables

a) The *Contractor* supplies consumables as per list in appendix B, and include any insignificant items that forms part of the consumables such as washer, raw bolts, welding rod, etc.

b) The *Contractor* supplies critical spares, their quantities are listed in appendix C.

c) The *Contractor* includes the itemised cost of the spares in the Tender and is part of the supply.

d) The *Employer* performs an assessment of the spares list provided by the *Contractor* and from this select spares that are retained by the *Employer* and is used in the event of failure.

4.4 Marking Plant and Materials outside the Working Areas

N/A.

4.5 *Contractor*'s Equipment (including temporary works)

N/A.

4.6 Cataloguing Requirements by the *Contractor*

The *Contractor* catalogues all spare equipment provided using the *Employer's* template.

5. Construction

5.1 Temporary works, Site services & construction constraints

5.1.1 *Employer*'s Site entry and security control, permits, and Site regulations

a) Before work starts on Site, a Site inaugural meeting is held between the Contractor and the Employer, where details of the Works are discussed and clarified:

- The Contractor's Site Supervisor is on Site for the entire duration of the Works.
- General access to the power station is controlled and Site induction must be completed before work will be allowed to start.
- It is mandatory that the Contractor adheres to all security regulations in force during the period of the contract.
- Before entry to the Site will be allowed, everyone will undergo an alcohol breathalyser test which needs to be passed.
- There are five Life-saving Rules to which the Contractor is required to always adhere to.

5.1.2 Restrictions to access on Site, roads, walkways and barricades

The *Contractor* satisfies himself and comply with the Site conditions presented during induction.
The *Contractor* is required to comply with all Site restrictions pertaining to the Site's roads, walkways and barricades.

5.1.3 People restrictions on Site; hours of work, conduct and records

Normal working hours are as follows:

- Monday to Thursday (07:00 – 16:15).
- Friday (07:00 – 12:000).

Outage working hour is as follows:

- Monday to Saturday 07:00 – 17:30.

Sunday (off day)

It is very important that the *Contractor* keeps records of his people on Site, including those of his Sub-*Contractor*s which the *Project Manager* have access to at any time. These records may be needed when assessing compensation events.

5.1.4 Health and safety facilities on Site

The health and safety facilities on Site will be discussed in detail during the Site induction.

5.1.5 Environmental controls, fauna & flora, dealing with objects of historical interest

a) The Contractor's attention is drawn to the fact that the Power Station is situated in a highly sensitive area with respect to the environment.

b) The Contractor acquaints himself with all statutory and local environment regulations and adheres to these without exception.

c) The Contractor complies with the Hazardous Chemical Regulations when using any hazardous chemicals, as well as complying with the requirements of the National Environmental Management Act 107 of 1998 as amended.

5.1.6 Title to materials from demolition and excavation

The *Contractor* has no title to plant and/or materials resulting from him carrying out the *Works*.

5.1.7 Cooperating with and obtaining acceptance of Others

The following NEC3 core clauses will apply 11.2 and 25.1.

5.1.8 Publicity and progress photographs

No notice boards, advertising rights, media relations, photography and progress photographs will be allowed without appropriate authorisation.

5.1.9 *Contractor*'s Equipment

a) The *Contractor* provides the *Employer* with a complete list of materials, tools, equipment, and machinery that does not permanently form part of the Works before bringing it to Site.

b) The *Contractor's* potable electrical tools are checked by the *Employer* prior to use.

c) Any electrical Plant or appliance used by the *Contractor* conforms to the applicable South Africa safety standards and is maintained in a safe and proper working condition.

d) . The *Employer* has the right to stop the *Contractor*'s use of any electrical appliance that is being used unsafely or not complying with the relevant legislation or regulations.

e) The *Contractor* provides and maintains all test and measuring equipment required for all tests to the required accuracy.

f) The type and class of equipment used is subject to the acceptance by the *Employer*.

g) The *Contractor's* measuring equipment is accompanied by valid calibration certificates from an approved authority.

The *Project Manager* may at any stage during the contract require such equipment to be checked by an approved laboratory or South Africa Bureau of Standards.

5.1.10 Equipment provided by the *Employer*

The *Employer* will make available his fixed overhead cranes. Only authorised personnel allowed to operate these. The Power Station has one main overhead crane in the “Machine Hall”. The crane consists of a 100t main hoist which is operated via a Cabin and a 25t auxiliary hoist on the same crane, which is operated via the cabin or remote control. No mobile crane (forklift) is available on site.

a) It is the *Contractor* responsibility to ensure that all necessary arrangement and preparation are made for the use of this crane.

b) The *Contractor* ensures that the crane is capable of handling the loads to be lifted and any limitation with respect to height and operation.

c) The *Contractor* notes that there is only one crane that service all units, and that the crane may be required for other work during the outage (shutdown).

d) The *Employer* provides a qualified crane operator. The crane is operated only by the *Employer*.

Scaffolding is supplied by Others who perform the erection, securing, modification and dismantling. The *Contractor* organises where the scaffolding should be erected when required.

5.1.11 Site services and facilities

5.1.11.1 *Employer's* Site entry and security control, permits, and Site regulations

Before work starts on Site, a Site inaugural meeting is held between the *Contractor* and the *Employer*, where details of the Works are discussed and clarified:

- The *Contractor's* Site Supervisor is on Site for the entire duration of the *Works*.
- General access to the power station is controlled and Site induction must be completed before work will be allowed to start.
- It is mandatory that the *Contractor* adheres to all security regulations in force during the period of the contract.
- Before entry to the Site will be allowed, everyone will undergo an alcohol breathalyser test which needs to be passed.
- There are five Life-saving Rules to which the *Contractor* is required to adhere to at all times.

5.1.11.2 Electricity Supply

a) All points of supply are provided in terms of availability and location. The *Employer* indicates which supply points may be used.
b) 220V AC electrical supply is generally available in the power station complex.
c) 380V AC supply is also available- the *Contractor* ensures they have the correct matching plugs.
d) The *Contractor* verifies extension lead requirements.

5.1.11.3 Water Supply

a) All points of supply are provided in terms of availability and location.
b) The *Employer* indicates which supply points may be used.

5.1.11.4 Compressed Air Supply

a) All points of supply are provided in terms of availability and location.
b) The *Employer* indicates which supply points may be used.
c) The *Contractor* verifies compressed air hose requirements.

5.1.11.5 Area for Site establishment and Storage

a) A Site Establishment and storage area is indicated to the *Contractor* by the *Employer*.
b) Security to the *Contractor's* storage area and facility is the responsibility of the *Contractor*.
c) The area allocated to the *Contractor* is reinstated to its former condition on handover of the Works.

5.1.11.6 Sanitary facilities

The *Contractor* makes use of the *Employer's* facilities in the power station.

5.1.11.7 Office Space

a) The *Employer* is not able to offer office space to *Contractors* for the period of work on Site.

b) Parking space is available outside of the station building for the *Contractor* to utilise for temporary office space.

c) A power supply of 230V AC, 10Amps is available to the *Contractor* for office space outside of the station building.

d) Ablution facilities are not available, and the *Contractor* provides its own Ablution facilities.

5.1.11.8 Telecommunications

Telephone connections are not available. The *Contractor* makes provision for his own Telecommunication requirements.

5.1.11.9 Others

The *Contractor* shall provide everything else necessary for Providing the Works.

5.1.12 Facilities provided by the *Contractor*

a) The *Contractor* provides, erects and maintains for own use, adequate size office accommodation and stores together with such, lighting and heating as may be required in the area designated by the *Project Manager*.

b) The *Contractor* is to dismantle and clear off site all such temporary structures and associated foundations and infrastructure. The *Contractor* provides facilities as deemed necessary.

c) The *Contractor* should make provision for accommodation, vehicles, kitchen - and office space (mobile container) and Equipment etc.

d) The *Contractor* removes all this Equipment and waste which was generated during the installation and commissioning within 24 hours after Completion.

5.1.13 Existing premises, inspection of adjoining properties and checking work of Others

Not Applicable.

5.1.14 Survey control and setting out of the *works*

a) The *Employer* evaluate the *Contractor's* civil works changes required to existing and new floorplan with regards to the type of concrete used, core drilling, paint and weight distribution.

b) The *Contractor* is responsible to survey the Works to ensure that the work to be performed allow for sufficient space for installation.

5.1.15 Excavations and associated water control

Not Applicable.

5.1.16 Underground services, other existing services, cable and pipe trenches and covers

The *Contractor* minimises interference of any nature with regards to existing services, cable and pipe trench covers. In the event that the *Contractor* damages one of the above, the penalty would be for the *Contractor.*

5.1.17 Control of noise, dust, water and waste

Not Applicable.

5.1.18 Sequences of construction or installation

All activities are performed according to the Programme accepted by the *Employer*.

5.1.19 Giving notice of work to be covered up

Not Applicable.

5.1.20 Hook ups to existing works

a) The machine hall panels are installed in the space attached to the generator enclosure. The generator enclosure is built up of beams that can restrict the installation of new panels.
b) The existing racking will be used to attach the extension of the new rack.

5.2 Completion, testing, commissioning and correction of Defects

5.2.1 Work to be done by the Completion Date

On or before the Completion Date the *Contractor* shall have done everything required to Provide the Works. The *Project Manager* cannot certify Completion until all the work has been done and is also free of Defects which would have, in his opinion, prevented the *Employer* from using the works and Others from doing their work.

5.2.2 Performance tests after completion

Not Applicable

5.2.3 Access given by the *Employer* for correction of Defects

Should defects or damage be noted after completion of the *Works*, the *Employer* will grant the *Contractor* access to the site to correct the defects.

5.2.4 Use of the *works* before Completion has been certified

The *Employer* may use any part of the works before Completion has been certified but in doing so the *Employer* takes over the part of the works except if the use is for a reason stated in the Works Information.

5.2.5 Materials facilities and samples for tests and inspections

a) The *Contractor* is responsible for and provides all necessary apparatus, equipment, materials, and labour to carry out the tests to the *Employer's* satisfaction.
b) The *Contractor* provides but not limited the following equipment for the onsite testing (with valid calibration certificates):
    - Insulation resistance tester
    - Multimeter
    - Tools
    - Dry block (Temperature) calibrator
    - Process calibrator (multifunction)
    - Oscilloscope
    - Portable Flow meter
    - Hand Pump with pressure module

c) Should the *Contractor* make use of a component that is not listed in the approved list of components, the component may be subjected to testing which may include destructive testing. The *Contractor* provides the component at his cost.

d) The *Contractor* provides installation certificates and reports which includes:

- Welding certificate.
- Pressure test certificate.
- AIA reports
- COC for panel heating, lighting and 220V AC utility circuits.

5.2.6 Commissioning

5.2.6.1 Cold Commissioning

The purpose of the cold commissioning is to ensure that all the Plant and Materials are correctly

installed. The provisions of the project commissioning project must be strictly adhered to as well as the other requirements described:

a) The *Contractor* certify that the plant is wired in accordance with the schematic wiring and termination diagrams issues to him/her, updated where necessary, to represent true record of the cabling and terminations as installed.

b) The *Contractor* performs the point-to-point loop insulation resistance check and blue lining of drawings for all wiring and labelling including conformance to the standards and requirements.

c) The *Contractor* performs meggering/ insulating testing of all power cables.

d) The *Employer* conduct quality control check which includes:

- Verification of panels (panel erection checks).
- Verification of cabling (cabling erection checks).

  Verification of instruments installation

5.2.6.2 Hot Commissioning

Hot commissioning and testing proceed only after all defects identified on cold commissioning had been cleared and the *Employer* had performed a safety clearance (certificate) for the works. The *Employer* performs power supplies checks (using *Employer's* DC supply check procedure) and powering of C&I equipment. The *Employer* prepare documentation for simulation of PLC I/O modules and perform verification with the assistance of the *Contractor*. The test includes:

- Verification of analog input signals (loop checks from field instruments to the control system).
  - Pressurize pressure transmitter using calibrated external hand pump at different setpoint and compare the readings between the process calibrator, control system, trends and HMI graphical representation.
  - Insert temperature probes into a calibrated dry block and heat up to different setpoints and compare the readings between the process calibrator, control system, trends and HMI graphical representation.
  - Physically adjust the medium levels and compare the local indications with the process calibrator, control system, trends and HMI graphical representation.

- Open valves, run pumps to simulate the normal process flows and compare results to a calibrated external flow meter, with control system, trends and HMI graphical representation.
- Activated field limit switches and compare results with the control system, trends and HMI graphical representation.

- Verification of analog output signals (loop checks from control system to the field instruments).
- Verification of digital input signals (loop checks from field devices and other systems to the control system).

Verification of digital output signals (loop checks from the control system to the field devices or other systems).

5.2.7 Start-up procedures required to put the *works* into operation

The *Contractor* is onsite for power-up and thereafter to commence with verification, testing, commissioning and optimisation activities to obtain a fully functional systems.

5.2.8 Take over procedures

a) The *Contractor* provides signed off check sheets, and up to date and Execution QCP as evidence that system is completed and commissioned successfully. The *Contractor*, plant safety officer, production representative, engineering representative will perform a plant walk down and complete acceptance documents before handover.

5.2.9 Access given by the *Employer* for correction of Defects

Access, depending on availability, will be granted to the *Contractor* for correcting defects.

5.2.10 Performance tests after Completion

The *Contractor* performs any testing that may need to be repeated to verify the performance.

5.2.11 Training and technology transfer

The *Contractor* provides operator, maintenance and engineering training on the installed equipment/systems. Training includes demonstration on the installed equipment.

5.2.12 Operational maintenance after Completion

Not Applicable.

6. Plant and Materials standards and workmanship

6.1 Investigation, survey and Site clearance

a) The *Contractor* is responsible for taking measurement and clarify the scope on site.

b) Site access and access to the plant equipment is restricted. The *Contractor* makes prior arrangements with the *Employer* for access.

c) No dismantling, movement, or sampling of the existing equipment and/or structure is permitted.

6.2 Civil engineering and structural works

a) The construction of civil structures is in accordance with the standardized specification for civil engineering design and construction. Structural design and construction conform to the Eskom Structural Design and Engineering Standard 240-56364545.

b) The construction of the concrete works is in accordance with SANS 2001 CC1: Concrete Works (Structural) and SANS 1200 series specifications for civil construction.

c) The design of civil engineering works meets the requirements of the permissible floor loading criteria and O&M Manuals.

d) Where holes are required through concrete, in the case of reinforced concrete the indicated positions where core drilling will be carried out must be done without obstructing the rebar. Holes are drilled through concrete only where it is acceptable and does not compromise the structural integrity. The *Contractor* takes adequate measures to locate rebar ensuring that it is safe to core. The reinforcement and concrete drawings are analysed when selecting core positions. If it is required that reinforcement be maintained, a scan (Concrete Ground Penetrating Radar System) is performed to determine the position of the rebar, embedded objects, and features. Holes through concrete are sleeved with PVC sleeve.

e) Floor repairs and preparation is in accordance with SANS 10400-J. Appropriate grouting is used for levelling, cavities, and gaps. Proprietary grout to be cement-based and must match the existing.

f) Anchor bolts can be made of Grade 4.8 or Grade 8.8 which are designed to resist tension and shear. Anchor bolt systems are in accordance with the manufacturer's recommendations.

g) The *Contractor* is required to provide a detailed Quality Control Plan and Construction Method Statement for related civil works.

h) The *Contractor* provides the preliminary design of all civil engineering work for review and acceptance by the *Employer*.

6.3 Electrical and Mechanical engineering Works

6.3.1 Standards

Numerous documents such as standards and specifications are referenced within this Works Information. All these referenced documents including the normative references which must be adhered to during the implementation of the *works*.

Where a SANS, IEC or any other standard referenced has been replaced by a newer standard, the *Contractor* is required to adhere to the latest revision of the newer standard. Where a SANS, IEC or any other standard referenced is composed of several parts, all applicable parts are to be adhered to.

All national and international standards referenced are not bound in this document but are obtained by the *Contractor* at his/her own expense. Documents developed by the *Employer* as referenced of this Works Information are provided to the *Contractor* on request or after the contract is awarded.

The following specifications are required to be complied to:

Document Number	Document Title
240-56227443	Requirements for Control and Power Cables for Power Stations Standard
240-56355754	Field Instrument Installation Standard
240-56355815	Field Instrument Installation Standards for Junction Boxes and Cable Termination
240-56355731	Environmental Conditions for Process Control Equipment Used at Power Stations
240-56356396	Earthing and Lightning Protection Standard
240-54937450	Fire Protection & Life Safety Design Standard
240-62629353	Specification for Panel Labelling Standard
240-109607332	Plant Labelling Abbreviation Standard
240-70413291	Specific for Electrical Terminal Blocks
240-7073288	Measurement Methods and Test Procedures
240-71432150	Plant Labelling Standard
240-75655504	Corrosion Protection Standards for the New Indoor and Outdoor Eskom Equipment, Components, Materials and Structures Manufactured from Steel
240-106628253	Standard for Welding Requirements on Eskom plant
240-83539994	Standard for Non-Destructive Testing (NDT) on Eskom Plant
240-87660096	Non-Destructive Testing Inspection Qualification Standard
240-83539806	Manual Ultrasonic Wall Thickness Testing on Eskom Power Plants Standard
BS EN 10028	Flat products made of steels for pressure purposes.
BS EN 10216	Seamless steel tubes for pressure purposes.
BS EN 10273	Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties.
BS EN 13480	Metallic industrial piping.
GGS 1427	Instrument Piping for Fossil and Hydro Power Stations
IEC 60297	Mechanical Structure for Electronic Equipment
IEC 60801-2	Electromagnetic Compatibility for Industrial-process Measurement and Control Equipment – Part 2: Electrostatic Discharge Requirements
IEC/TR 61000-5-2	Installation and Mitigation Guidelines – Section 2: Earthing and Cabling
ISO12944-5	Corrosion Protection Standards
SANS 10142-1:2017	The wiring of premises Part 1: Low-voltage installations
SANS 1091	National colour standard
SANS 1411-1:2008	Materials of insulated electric cables and flexible cords Part 1: Conductors
SANS 1411-4:2008	Materials of insulated electric cables and flexible cords Part 4: Cross-linked polyethylene (XLPE)

Document Number	Document Title
SANS 1411-5:2008	Materials of insulated electric cables and flexible cords Part 5: Halogen-free, flame-retardant materials
SANS 1411-6:2008	Materials of insulated electric cables and flexible cords Part 6: Armour
SANS 1507-1:2015	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 1: General
SANS 1507-2:2015	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 2: Wiring cables
SANS 1507-4:2015	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 4: XLPE Distribution cables
SANS 1507-5:2015	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 5: Halogen-free distribution cables
SANS 1803-1:2009	Lugs and ferrules for insulated electric cables Part 1: Copper conductors
SANS 60793-1-40:2001	Measurement Methods and Test Procedures
SANS 60811-1-4	Common Test Methods for Insulating and Sheathing Materials of Electric and Optical Cables
SANS 121:2011	Hot Dip Galvanised Coating on Fabricated Iron and Steel Articles – Specification and Test Methods
32-727	Eskom Safety Policy

6.4 Workmanship

The *Contractor* demonstrates high-level of skills, professionalism and expertise when planning and executing the Work. The work to be delivered should meet a standard of quality that is acceptable by the *Employer* and should be functional, safe, and usable.

7. List of drawings

7.1 Drawings issued by the *Employer*

This is the list of drawings issued by the *Employer* at or before the Contract Date and which apply to this contract.
Note: Some drawings may contain both Works Information and Site Information.

Drawing number	Revision	Title
Cable racking and Panel location diagrams		
0.39/491		Plant Layout Station Level 1096,5 m.a.s.l
0.39/826		Station Electrical Power System Cable Layout
0.39/1292		Control Block & Surface Building Panel Layout
Unit panel layout specification and termination diagrams		
18.39/U*/2735	0a	U1 and U2 Main Unit Controller
18.39/U*/2736	0a	U1 and U2 MUC Remote I/O Generator
18.39/U*/2737	0a	U1 and U2 MUC Remote I/O Turbine
18.39/U*/2738	0a	U1 and U2 MUC Remote I/O Common
18.39/U*/2739	0a	U1 and U2 Control Console
18.39/U*/2740	0a	U1 and U2 Turbine Governor Control
18.39/U*/2741	0a	U1 and U2 Temperature & Speed Monitoring
Junction box layout specification and termination diagrams		
18.39/U*/2743	0a	U1 and U2 Generator Junction Box
18.39/U*/2744	0a	U1 and U2 Turbine Pit Junction Box
Station panel layout specification and termination diagrams		
18.39/2745	0a	Station Controller
18.39/2746	0a	Station Remote I/O
18.39/2751	0a	Station Control Console
18.39/2747	0a	National Control Centre interface
18.39/2748	0a	Standby Control Centre interface
Pressure instrument assembly diagrams		
18.39/U*/2754	0a	U1 and U2 Governor Air Oil Receiver Pressure Transmitters and Brackets
18.39/U*/2755	0a	U1 and U2 Governor Actuator Oil Pressure Transmitters and Brackets
18.39/U*/2757	0a	U1 and U2 Thrust Bearing HP Oil Pressure Transmitters and Brackets
18.39/U*/2758	0a	U1 and U2 Turbine Bearing Oil Pressure Transmitters and Brackets
18.39/U*/2756	0a	U1 and U2 Guide Vane Servo Motor 1 Opening and Closing Pressure Transmitter and Brackets

Drawing number	Revision	Title
18.39/U*/2759	0a	U1 and U2 Main Cooling Water Inlet Pressure Transmitters and Brackets
18.39/U*/2760	0a	U1 and U2 Shaft Seal Water Pressure Transmitter and Bracket
18.39/U*/2761	0a	U1 and U2 Penstock Water Pressure Transmitter and Bracket
18.39/U*/2762	0a	U1 and U2 Main Strain Water Inlet Differential Pressure Transmitters and Brackets
18.39/U*/2764	0a	U1 and U2 Dam Level Water Pressure Transmitters and Brackets
18.39/U*/2763	0a	U1 and U2 Brake Air Pressure Transmitters and Brackets
18.39/U*/2753	0a	U1 and U2 Governor Air Pressure Transmitter and Bracket
18.39/U*/2598	0a	U1 and U2 Draft Tube Pressure Transmitter and Bracket
Level instrument assembly diagrams		
18.39/U*/2765	0a	U1 and U2 Governor Receiver Air Oil Level Transmitter
18.39/U*/2766	0a	U1 and U2 Governor Sump Oil Level Transmitter
18.39/U*/2767	0a	U1 and U2 Turbine Guide Bearing Sump Oil Level Transmitter
18.39/U*/2768	0a	U1 and U2 Thrust & Guide Bearing Sump Oil Level Transmitter
18.39/	0a	Station Head Tank Water Level Transmitter
Flow instrument assembly diagrams		
TBA1	0a	U1 and U2 Main Cooling Water Inlet Flowmeter Spool Piece
TBA2	0a	U1 and U2 Main Cooling Water Outlet Flowmeter Spool Piece
TBA3	0a	U1 and U2 Thrust & Guide Bearing Cooling Water Inlet Flowmeter Spool Piece
TBA4	0a	U1 and U2 Turbine Bearing Cooler 1A/ 1B Cooling Water Outlet Flowmeter Spool Piece
TBA5	0a	U1 and U2 Governor Oil Cooler Cooling Water Outlet Flowmeter Spool Piece

APPENDIX A: SCHEDULES A AND B

a. **SCHEDULE A:** PARTICULARS OF *EMPLOYER'S* REQUIREMENTS

b. **SCHEDULE B:** GAURANTEES AND TECHNICAL PARTICULARS OF PLANT AND MATERIALS OFFERED

c. Notes with regards to the completion of the schedule

d. Where there is insufficient space provided in Schedule B, particulars must be furnished on a separate sheet marked with the number of the Schedule A item referred to.

e. If a blank space is left in Schedule B next to the *Employer's* requirements listed in Schedule A it is assumed that the Tenderer does comply with this requirement.

f. Where the Tenderer does not comply with the *Employer's* requirements these deviations must be clearly stated on Schedule B.

Datasheets: Actual OEM datasheets must be submitted, in hard copy as part of the tender documentation

Method Statement: Actual Method Statement must be submitted, samples from other similar projects are acceptable provided it is appropriate.

NB: Soft copies of documents and data sheets will not be accepted for evaluation.

	Technical Schedules	**Weighting**			
1	**Cabling and Racking**	**20%**	**100%**	**Schedule A**	**Schedule B**
1.1	Tenderer supplies the required **industrial cable racks** as per *Works Information section 3.1.3* and 3.2.6		25%	Datasheets	
1.2	Tenderer supplies the required **industrial cable wire mesh** as per *Works Information section 3.1.3* and 3.2.6		15%	Datasheets	
1.3	Tenderer supplies the required **cable rack earthing** as per *Works Information section 3.1.3 and 3.2.6*		10%	Datasheets	
1.4	Tenderer supplies the required **low voltage cables** as per *Works Information section 3.2.4.1 and 3.2.7*		15%	Datasheets	
1.5	Tenderer supplies the required **control and instrumentation cables** as per *Works Information section 3.2.4.2 and 3.2.7*		20%	Datasheets	
1.6	Tenderer supplies the required **network communication cables** as per *Works Information section 3.2.4.3 and 3.2.7*		15%	Datasheets	
2	**Components and Consumables**	**4%**	**100%**	**Schedule A**	**Schedule B**
2.1	Tenderer supplies the required **Components** as per *Works Information appendix B*		50%	Datasheets	
2.2	Tenderer supplies the required **Consumables** as per *Works Information appendix B*		50%	Datasheets	
3	**Instrumentation Works**	**20%**	**100%**	**Schedule A**	**Schedule B**
3.1	Tenderer supplies the required **pressure transmitters** as per *Works Information section 3.2.16.1*		10%	Datasheets	
3.2	Tenderer supplies the required **differential pressure transmitters** as per *Works Information section 3.2.16.1*		8%	Datasheets	
3.3	Tenderer supplies the required **pressure gauge** as per *Works Information section 3.2.16.1*		5%	Datasheets	
3.4	Tenderer supplies the required **Reed Level transmitters** as per *Works Information section 3.2.16.2*		10%	Datasheets	
3.5	Tenderer supplies the required **Reed Sensor for Bypass level indicators** as per *Works Information section 3.2.16.2*		10%	Datasheets	

	Technical Schedules	Weighting			
3.6	Tenderer supplies the required **Magnetic Display for Bypass Level Indicator** as per *Works Information section 3.2.16.2*		10%	Datasheets	
3.7	Tenderer supplies the required **Magnetic Switch for Bypass Level Indicator** as per *Works Information section 3.2.16.2*		4%	Datasheets	
3.8	Tenderer supplies the required **Conductive Point Level Detection** as per *Works Information section 3.2.16.2*		4%	Datasheets	
3.9	Tenderer supplies the required **Electromagnetic Flow Meter** as per *Works Information section 3.2.16.3*		5%	Datasheets	
3.10	Tenderer supplies the required **Temperature instruments** as per *Works Information section 3.2.16.4*		5%		
3.11	Tenderer supplies the required **tubing and fittings** as per *Works Information 3.2.16* and attached drawings		10%	Datasheets	
3.12	Tenderer supplies the required **manifolds** as per *Works Information 3.2.16* and attached drawings		5%	Datasheets	
3.13	Tenderer supplies the required **isolation valves** as per *Works Information 3.2.16* and attached drawings		5%	Datasheets	
3.14	Tenderer supplies the required **instruments accessories** as per *Works Information section 3.2.16* and attached drawings		5%	Datasheets	
4	**Junction Boxes**	**5%**	**100%**	**Schedule A**	**Schedule B**
4.1	Tenderer supplies Junction Boxes as per *Works Information section 3.2.11*		100%	Datasheet	
5	**Network Cabinet and Server Racks**	**10%**	**100%**		
5.1	Tenderer supplies the required Network Cabinet as per *Works Information section 3.2.15*		100%	Datasheet	
6	**Dispatch, Delivery and Offloading**	**2%**	**100%**	**Schedule A**	**Schedule B**
6.1	Tenderer to ensure equipment is adequately protected during transportation and delivery to site		50%	Yes	
6.2	Tenderer to inspect equipment for any damages prior to installation		50%	Yes	
7	**Decommissioning**	**5%**	**100%**	**Schedule A**	**Schedule B**
7.1	Decommissioning of cables and placing in allocated area as per *Works Information section 3.2.5*		20%	Method statement	
7.2	Decommissioning of panels and placing in allocated area *Works Information section 3.2.5*		15%	Method statement	
7.3	Decommissioning of junction boxes and placing in allocated area *Works Information section 3.2.5*		5%	Method statement	
7.4	Decommissioning of instrument, tubing and placing in allocated area *Works Information section 3.2.5*		20%	Method statement	
7.5	Decommissioning of control console section plates and placing in allocated area *Works Information section 3.2.5*		10%	Method statement	
7.6	Blanking of process pipework's *Works Information section 3.2.5*		5%	Method statement	
7.7	Provide catalogue of all decommissioned items *Works Information section 3.2.5*		5%	Method statement	
7.8	Manage decommissioning and implementation Impairment plan for the *Works*		10%	Method statement	
7.9	Site of decommissioned devices, panels, junction boxes and other equipment repaired to match surrounding environment as per *Works Information section 3.2.5*		10%	Method statement	
8	**Installation**	**20%**	**100%**	**Schedule A**	**Schedule B**

	Technical Schedules	Weighting			
8.1	Tenderer supplies installation procedures and scope of work for acceptance by *Employer*		5%	Sample	
8.2	Tenderer supplies a complete quality control plan and check sheets for acceptance by *Employer*		15%	Sample	
8.3	Tenderer supplies a bar chart program for acceptance by *Employer*		5%	Sample	
8.4	Tenderer supplies a Safety File for acceptance by *Employer*		5%	Yes	
8.5	Tenderer repair and sealing fire blocking of cables penetration as per *Works Information section 3.2.8*		5%	Method statement	
8.6	Tenderer to prepare plinth as per *Works Information section 3.2.9*		10%	Method statement	
8.7	Tenderer install panels as per *Works Information section 3.2.10*		15%	Method statement	
8.8	Tenderer supplies and install junction boxes as per *Works Information section 3.2.11*		15%	Method statement	
8.9	Tenderer supplies and install network cabinet as per *Works Information section 3.2.15*		15%	Method statement	
8.10	Tenderer assembly, supplies and install instruments and its accessories as per *Works Information section 3.2.16*		10%	Method statement	
9	**Site Testing and Commissioning**	**10%**	**100%**	**Schedule A**	**Schedule B**
9.1	Tenderer to provide testing certificate as per *Works Information*, i.e. Cable drum test certificate, COC for electrical, NDT welding certificate, pressure test certificate, AIA report		55%	Sample of Certificates	
9.2	Tenderer to commission the Works on site as per *Works Information section 5.2*		5%	Yes	
9.3	Tenderer to submit detailed QCP for testing		40%	Sample of QCP	
10	**Maintenance and Spares**	**2%**	**100%**	**Schedule A**	**Schedule B**
10.1	Tenderer to provide spares for Consumables, Components, and Instruments		50%	Yes	
10.2	All spare instruments are configured		50%	Yes	
11	**Documentation**	**2%**	**100%**	**Schedule A**	**Schedule B**
11.1	All documentation complies with procedure 240-86973501		7%	Yes	
11.2	*Employer* does not accept scanned electronic copies of documentation or drawings		6%	Yes	
11.3	Tenderer provides documentation in electronic media using Microsoft Office and “searchable” PDF format		4%	Yes	
11.4	Tenderer uses the templates provided by the *Employer* for documentation and drawings		6%	Yes	
11.5	Tenderer provides operating and maintenance manuals of the Works		10%	Yes	
11.6	Tenderer provides a Works plan using Microsoft Office Project		10%	Yes	
11.7	Tenderer provides technical quality control documentation		10%	Yes	
11.8	Provide all settings document for all configurable devices		10%	Yes	
11.9	Provide all settings backups of all installed configurable devices		10%	Yes	
11.10	Provide software and hardware to access all configurable devices, for the purposes of the *Employer* to load backups to restore the system in event of failure.		7%	List	
11.11	Tenderer compiles a comprehensive commissioning report including all test procedures		10%	Yes	

	Technical Schedules	Weighting			
11.13	Tenderer provides proof of warranty redeemable by Eskom from date of purchase		10%	Yes	
Schedule A&B Scoring		**100%**			

APPENDIX B: SUMMARY OF DELIVERABLES

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
1	**Panel Decommissioning**				
1.1	Automatic Relay Panel 1800(H) x 2700(W) x 900(D)	**2**	items	Remove	Section 3.2.5
1.2	Turbine Gauge Board 1800(H) x 2400(W) x 600(D)	**2**	items	Remove	Section 3.2.5
1.3	Digital Governor 1395(H) x 900(W) x 550(D)	**2**	items	Remove	Section 3.2.5
1.4	Supervisory Relay Panel 1800(H) x 600(W) x 600(D)	**2**	items	Remove	Section 3.2.5
1.5	Maxi flex 1395(H) x 900(W) x 550(D)	**2**	items	Remove	Section 3.2.5
1.6	Interbud 1395(H) x 900(W) x 550(D)	**2**	items	Remove	Section 3.2.5
1.7	Unit Control Console	**2**	items	Remove	Section 3.2.5
1.8	Station Control Console	**1**	items	Remove	Section 3.2.5
1.9	Solenoid Drives 1800(H) x 900(W) x 600(D)	**2**	items	Remove	Section 3.2.5
2	**Cable Decommissioning**				
2.1	BVS4BCV	**6000**	meters	Remove	Section 3.2.5
2.2	BVS12BCV	**5000**	meters	Remove	Section 3.2.5
2.3	BVS20BCV	**4000**	meters	Remove	Section 3.2.5
2.4	BVX2DCV	**400**	meters	Remove	Section 3.2.5
2.5	BVX7DCV	**200**	meters	Remove	Section 3.2.5
2.6	BVX12DCV	**400**	meters	Remove	Section 3.2.5
2.7	BVX2ECV	**3000**	meters	Remove	Section 3.2.5
2.8	BVX3ECV	**300**	meters	Remove	Section 3.2.5
2.9	BVX4ECV	**100**	meters	Remove	Section 3.2.5

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
2.10	BVX2HCV	**1000**	meters	Remove	Section 3.2.5
2.11	BVX4HCV	**200**	meters	Remove	Section 3.2.5
2.12	TVH10BV	**2000**	meters	Remove	Section 3.2.5
3	**Instrumentation Decommissioning**				
3.1	Pressure transmitter	**26**	items	Remove	Section 3 .2.5
3.2	Pressure switch	**30**	items	Remove	Section 3.2.5
3.3	Level instrument	**34**	items	Remove	Section 3.2.5
3.4	Flowmeter	**20**	items	Remove	Section 3.2.5
3.5	Temperature switch	**12**	items	Remove	Section 3.2.5
3.6	Copper pipe tubing	**5000**	meters	Remove	Section 3.2.5
3.7	Junction Boxes	**10**	items	Remove	Section 3.2.5
4	**Cable Trays**				
4.1	Welded (HDG) galvanised Wire mesh trays 50X50mm comes with joiner sets	**2000**	meters	Supply and install	Section 3.2.6; Appendix D figure 5
4.2	Welded (HDG) galvanised Wire mesh trays 114X50mm comes with joiner sets	**2000**	meters	Supply and install	Section 3.2.6; Appendix D figure 5
4.3	Medium duty (HDG) galvanised perforated tray (MCT75) 114x38x1.6mm	**1000**	meters	Supply and install	Section 3.2.6; Appendix D figure 5
4.4	Medium duty (HDG) galvanised perforated tray (MCT300) 305x76x1.6mm	**1000**	meters	Supply and install	Section 3.2.6; Appendix D figure 5
4.5	Heavy duty (HDG) galvanised perforated tray (MCT75) 76x38x1.6mm	**500**	meters	Supply and install	Section 3.2.6; Appendix D figure 5
4.6	Heavy duty (HDG) galvanised perforated tray (MCT450) 457x76x1.6mm	**1000**	meters	Supply and install	Section 3.2.6; Appendix D figure 5
4.7	Bosal Conduit - 20mm	**200**	meters	Supply and install	Section 3.2.7
4.8	Raised Hospital Saddles – 20mm	**500**	each	Supply and install	Section 3.2.7
5	**Earthing**				
5.1	Twisted bare copper earthing wire 16 mm sq.	**4000**	meters	Supply and install	Section 3.2.17
5.2	Copper bar 25x2.5mm	**100**	meters	Supply and install	Section 3.2.17

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
6	**Cabling**				
6.1	BVV2DCM	**2000**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.2	BVV3ECM	**500**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.3	BVV4DCM	**500**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.4	BVX4DCM	**500**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.5	BVV4ECM	**500**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.6	BVX4ECM	**500**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.7	UVG2ACM	**10000**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.8	UVG02BCM	**2000**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.9	UVG02CCM	**1000**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.10	UVG04ACM	**1000**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.11	UVG04BCM	**500**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.12	UVG08ACM	**4000**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.13	UVG12ACM	**4000**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.14	UVG20ACM	**500**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.15	UVH02BCM	**500**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.16	UVK01BCM	**4000**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.17	UVM12BCM	**1000**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.18	Heavy Duty Duct Multi-Mode F/O 8core	**2000**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.19	RG58 co-axial cable, outdoor GPS antenna cable	**200**	meters	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.20	Ruggedised MM F/O 25m Patch lead (2 core, ST-LC)	**10**	each	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8
6.21	Ruggedised MM F/O 25m Patch lead (2 core, ST-ST)	**6**	each	Supply and install	Section 3.2.4, 3.2.7 and 3.2.8

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
7	**Control Panels and Junction Boxes Installation**				
7.1	Unit 1 and 2 Main Unit Controller Local	**4**	items	Install	Section 3.2.9 and 3.2.10
7.2	Unit 1 and 2 Main Unit Controller Remote IO Generator	**2**	items	Install	Section 3.2.9 and 3.2.10
7.3	Unit 1 and 2 Main Unit Controller Remote IO Turbine	**2**	items	Install	Section 3.2.9 and 3.2.10
7.4	Unit 1 and 2 Main Unit Controller Remote IO Common	**2**	items	Install	Section 3.2.9 and 3.2.10
7.5	Unit 1 and 2 Digital Governor	**2**	items	Install	Section 3.2.9 and 3.2.10
7.6	Unit 1 and 2 Temperature and Speed Monitoring	**4**	items	Install	Section 3.2.9 and 3.2.10
7.7	Unit 1 and 2 Control Console	**2**	items	Install	Section 3.2.12
7.8	Station Control Console	**1**	items	Install	Section 3.2.12
7.9	National Control Centre interface	**1**	items	Install	Section 3.2.9 and 3.2.10
7.1	Station Controller	**1**	items	Install	Section 3.2.9 and 3.2.10
7.11	Station Remote IO	**1**	items	Install	Section 3.2.9 and 3.2.10
7.12	Unit 1 and 2 Gen Terminal Junction Box Enclosure (1000(H) x 800(W) x 250mm(D))	**2**	items	Supply and install	Section 3.2.9 and 3.2.11
7.13	Unit 1 and 2 Turbine Pit Junction Box Enclosure (600(H) x 600(W) x 250mm(D))	**2**	items	Supply and install	Section 3.2.9 and 3.2.11
8	**Control Panel and Junction Boxes Cable Wiring Terminations**				
8.1	Unit 1 and 2 Main Unit Controller Local	**600**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.2	Unit 1 and 2 Main Unit Controller Remote IO Generator	**600**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.3	Unit 1 and 2 Main Unit Controller Remote IO Turbine	**700**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.4	Unit 1 and 2 Main Unit Controller Remote IO Common	**400**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.5	Unit 1 and 2 Digital Governor	**200**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
8.6	Unit 1 and 2 Temperature and Speed Monitoring	**600**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.7	Unit 1 and 2 Control Console	**300**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.8	Station Control Console	**100**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.9	National Control Centre interface	**50**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.10	Station Controller	**200**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.11	Station Remote IO	**200**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.12	Unit 1 and 2 Gen Terminal Junction Box (1000(H) x 800(W) x 250mm(D))	**500**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
8.13	Unit 1 and 2 Turbine Pit Junction Box (600(H) x 600(W) x 250mm(D))	**200**	items	Install	Section 3.2.13 and 3.2.14; Appendix E figure 6, 7, 8 and 9
9	**Network Communication Cabinets**				
9.1	Cabinet for FO patch panels, 8U wall mounted, 19" network cabinet	**6**	items	Supply and install	Section 3.2.15
10	**Pressure Instruments**				
10.1	Pressure transmitter EJX530A-JBS8N-019EF	**10**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
10.2	Pressure transmitter EJX530A-JCS8N-019EF	**10**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
10.3	Pressure transmitter EJX530A-JDS8N-019EF	**5**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
10.4	Differential Pressure transmitter EJX110A-JHS4G-919EB	**10**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
10.5	Bourdon Tube Pressure Gauge	**22**	each	Supply and install	Section 3.2.16
10.6	2 Way Valve-Manifold	**25**	each	Supply and install	Section 3.2.16
10.7	3 Way Valve-Manifold	**6**	each	Supply and install	Section 3.2.16
10.8	Stainless Steel Instrumentation Quick Connect Body, SS-QC4-B-4PM, 316 Stainless Steel	**25**	each	Supply and install	Section 3.2.16

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
10.9	Stainless Steel braided flexible tube with quick connectors - SS-810-1-8	**10**	each	Supply and install	Section 3.2.16
10.10	Field Mate Versatile Device Management Software	**1**	each	Supply	
10.11	USB Field Mate Modem: BRAIN / HART	**2**	each	Supply	
10.12	Installation mechanical bracket for single pressure transmitter	**12**	each	Manufacture and install	Appendix F figure 10 and 12
10.13	Installation mechanical bracket for redundant pressure transmitter	**16**	each	Manufacture and install	Appendix F figure 13 and 15
11	**Level instruments**				
11.1	Reed Level Transmitter MPJ5-M280 with PR5343A transmitter	**4**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16; Appendix F figure 18
11.2	Reed Level Transmitter MPJ5-M505 with PR5343A transmitter	**8**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16; Appendix F figure 16 and 17
11.3	Reed Level Transmitter MPJ5-M350 with PR5343A transmitter	**4**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16; Appendix F figure 16 and 17
11.4	Reed Sensor for Bypass Level Indicators MPJ5-M1500 with PR5343A transmitter	**8**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16; Appendix F figure 16 and 17
11.5	Loop link 5909 communication interface	**2**	each	Supply	
11.6	11.6PReset software (configuration software)	**2**	each	Supply	
11.7	BMD-SA Magnetic Display for Bypass Level Indicator	**4**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16;
11.8	BGU Magnetic Switch for Bypass Level Indicator	**6**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16;
11.9	Flange for BMD-SA Magnetic Display for Bypass Level Indicator	**8**	each	Supply and install	Section 3.2.16
11.10	Decommission, Fabrication and Installation	**8**	each	Decommission, supply and install	
11.11	Level chamber with sight glass	**5**	each	Supply and install	
11.11.1	Decommission, Fabrication (pipe work) and Installation	**4**	each	Decommission, supply and install	
12	**Flow instruments**				
12.1	DWM2000 Electromagnetic Flow Meter	**12**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
12.2	Flow switch – Flowphant T_DTT32-A1111AEX1AB, with connecting plug 51006327	**6**	each	Supply and install	Section 3.2.16

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
12.2.1	Removal, Fabrication and Installation	**4**	each	Removal, supply and install	Section 3.2.16
12.3	Brach/Stub/Nozzle weld for spool pieces	**40**	each	Supply and install	Section 3.2.16
12.4	200B3DASSR2MXI Electromagnetic Flow Meter	**3**	each	Supply and install	Section 3.2.16
12.4.1	Removal, Fabrication and Installation	**2**	each		Section 3.2.16
12.5	DWM2000 Spool pieces for DN40 pipe with welding socket	**4**	each	Supply and install	Section 3.2.16
12.6	200NB SA312 SS316 pipe	**6**	each	Supply, manufacture and install	Section 3.2.16
12.7	100NB SA312 SS316 pipe	**2**	each	Supply, manufacture and install	Section 3.2.16
12.8	200NB to JIS B2220 K (ASTM A240 GR316) Flange	**8**	each	Supply, manufacture and install	Section 3.2.16
12.9	100NB to JIS B2220 10K (ASTM A240 GR316) Flange	**4**	each	Supply, manufacture and install	Section 3.2.16
12.10	200NB to JIS B2220 10K Carbon Steel Flange	**2**	each	Supply, manufacture and install	Section 3.2.16
12.11	100NB to JIS B2220 10K Carbon Steel Flange	**2**	each	Supply, manufacture and install	Section 3.2.16
12.12	40NB to JIS B2220 10K Carbon Steel Flange	**4**	each	Supply, manufacture and install	Section 3.2.16
13	**Position and Detector Instruments**				
13.1	Limit switches	**40**	each	Supply and install	Section 3.2.16
13.2	Point level detector 11375Z	**6**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
13.3	FTW325 Transmitter	**6**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
14	**Temperature instruments**				
14.1	Temperature probes TR10-H (Pt100, 600mm probe length for Turbine Bearing systems)	**4**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
14.2	Temperature probes TR10-H (Pt100, 675mm probe length with 150mm flexible rod for Thrust Guide Bearing systems)	**8**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
14.3	Temperature probes (Pt100, 100mm probe length with embedded steel braided cable)	**10**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
14.4	Temperature probes (Pt100, 130mm probe length with embedded steel braided cable)	**4**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
14.5	Temperature probes (Pt100, 240mm probe length with embedded steel braided cable)	**4**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
14.6	Pt100 RTD with Terminal Head (50mm probe length)	**100**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
14.7	Pt100 RTD with Terminal Head (100mm probe length)	**20**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
14.8	Pt100 RTD with Terminal Head (200mm probe length)	**4**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
14.9	Temperature probes (Pt100 white ceramic terminal block)	**200**	each	Supply and install	Section 3.2.13, 3.2.14 and 3.2.16
14.10	Stub Weld, (thermowell)	**40**	each	Supply and install	Section 3.2.16
15	**Instrument accessories**				
15.1	Seamless Instrumentation Grade 316 Austenitic stainless-steel tubing 12 mm OD x 2.0 mm wall thickness, in length of 6 meters	**400**	meters	Supply and install	Section 3.2.16
15.2	1/2'' Flexible hose pipe (Parker 301SN-6) - Nitrile (NBR) Inner Tube, Two High-Tensile Steel Wire Braid Reinforcement & Synthetic Rubber Cover pipe with length of 330 mm end to end. Both sides of end fittings to be a straight female 12 mm swivel nuts type 316 SS, both end fittings to be ASME standard. Maximum working pressure 330 bar.	**100**	each	Supply and install	Section 3.2.16
15.3	1/4'' Flexible hose pipe single wire braided (with max pressure of 18Mpa) hose pipe with length of 330 mm end to end. One side of end fitting to be a straight female 12 mm swivel type 316 SS and the other end to be a 90° female 12 mm swivel type 316 SS, both end fittings to be ASME standard. To be pressure tested to 8Mpa.	**20**	each	Supply and install	Section 3.2.16
15.4	12 mm hydraulic pipe clamp with polyproline support body, carbon steel weld base plate, top plate and M6 bolts.	**600**	each	Supply and install	Section 3.2.16
15.5	**90**-degree elbow fittings for 12 mm tubing. Material Grade 316 stainless-steel with 12L nut and ferrule both sides, fittings to be according to ASME standard.	**200**	each	Supply and install	Section 3.2.16
15.6	T-piece for 12 mm tubing. Grade 316 stainless-steel with 12L nut and ferrule all three sides fittings. Fittings to be according to ASME standard	**200**	each	Supply and install	Section 3.2.16
15.7	Union fittings Grade 316 stainless-steel with 12L nut and ferrule for 12 mm tubing both sides. Fittings to be according to ASME standard.	**200**	each	Supply and install	Section 3.2.16
15.8	½'' Female BSPP to 12L male. Material Grade 316 stainless-steel with nut and ferrule on the 12L side. Fittings to be according to ASME standard.	**200**	each	Supply and install	Section 3.2.16
15.9	3/8'' Male BSPP to 12L male Grade 316 stainless-steel with nut and ferrule on the 12L side. Fittings to be according to ASME standard.	**200**	each	Supply and install	Section 3.2.16
15.10	3/8" Male BSPP to 12L male ASTM SA-105N carbon steel with nut and ferrule on the 12L side. Fittings to be according to ASME standard.	**100**	each	Supply and install	Section 3.2.16
15.11	½'' Male BSPP to 12L male Grade 316 stainless-steel with nut and ferrule on the 12L side. Fittings to be according to ASME standard.	**400**	each	Supply and install	Section 3.2.16
15.12	½'' Male BSPP to 12L male ASTM SA-105N carbon steel with nut and ferrule on the 12L side. Fittings to be according to ASME standard.	**100**	each	Supply and install	Section 3.2.16
15.13	1/4'' Male BSPP to 12L male Grade 316 stainless-steel with nut and ferrule on the 12L side. Fittings to be according to ASME standard.	**200**	each	Supply and install	Section 3.2.16
15.14	1/4" Male BSPP to 12L male ASTM SA-105N carbon steel with nut and ferrule on the 12L side. Fittings to be according to ASME standard.	**100**	each	Supply and install	Section 3.2.16
15.15	1/2'' Male NPT to 12L male Grade 316 stainless-steel with nut and ferrule on the 12L side. Fittings to be according to ASME standard.	**50**	each	Supply and install	Section 3.2.16

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
15.16	1/4'' Male NPT to 12L male Grade 316 stainless-steel with nut and ferrule on the 12L side. Fittings to be according to ASME standard.	**50**	each	Supply and install	Section 3.2.16
15.17	3/8'' Male NPT to 12L male Grade 316 stainless-steel with nut and ferrule on the 12L side. Fittings to be according to ASME standard.	**50**	each	Supply and install	Section 3.2.16
15.18	½'' Male BSPP to 1/2'' male BSPP grade 316 stainless steel. Fittings to be according to ASME standard	**50**	each	Supply and install	Section 3.2.16
15.19	½'' Male BSPP to 1/4'' male BSPP grade 316 stainless steel. Fittings to be according to ASME standard	**50**	each	Supply and install	Section 3.2.16
15.20	½'' Male BSPP to 3/8'' male BSPP grade 316 stainless steel. Fittings to be according to ASME standard	**50**	each	Supply and install	Section 3.2.16
15.21	½'' Male BSPP to 1/2'' male NPT grade 316 stainless steel. Fittings to be according to ASME standard	**50**	each	Supply and install	Section 3.2.16
15.22	½'' Male BSPP to 1/4'' male NPT grade 316 stainless steel. Fittings to be according to ASME standard	**50**	each	Supply and install	Section 3.2.16
15.23	½'' Male BSPP to 3/8'' male NPT grade 316 stainless steel. Fittings to be according to ASME standard	**50**	each	Supply and install	Section 3.2.16
15.24	1/2'' Male NPT to ½'' male NPT grade 316 stainless steel. Fittings to be according to ASME standard	**50**	each	Supply and install	Section 3.2.16
15.25	1/2'' Male NPT to ¼'' male NPT grade 316 stainless steel. Fittings to be according to ASME standard	**50**	each	Supply and install	Section 3.2.16
15.26	1/2'' Male NPT to 3/8'' male NPT grade 316 stainless steel. Fittings to be according to ASME standard	**50**	each	Supply and install	Section 3.2.16
15.27	½'' Female BSPP T-piece grade 316 stainless-steel fittings on all three sides. Fittings to be according to ASME standard	**25**	each	Supply and install	Section 3.2.16
15.28	½'' male BSPP grade 316 stainless steel blank stud. Fittings to be according to ASME standard	**100**	each	Supply and install	Section 3.2.16
15.29	¼'' male BSPP grade 316 stainless steel blank stud. Fittings to be according to ASME standard	**100**	each	Supply and install	Section 3.2.16
15.30	3/8'' male BSPP grade 316 stainless steel blank stud. Fittings to be according to ASME standard	**100**	each	Supply and install	Section 3.2.16
15.31	¼'' Male BSPP to 1/4'' male BSPP grade 316 stainless steel. Fittings to be according to ASME standard	**50**	each	Supply and install	Section 3.2.16
15.32	1/2" Forged Elbow. EN16Mo3 As per BS EN 10253-Forged Carbon Steel	**100**	each	Supply and install	Section 3.2.16
15.33	1/2'' Teflon seal to fit 1/2" BSPP male fittings.	**400**	each	Supply and install	Section 3.2.16
15.34	1/2'' Seal Bonded Washer (Dowty gasket seal plated carbon steel with buna O-ring).	**400**	each	Supply and install	Section 3.2.16
15.35	1/4'' Seal Bonded Washer (Dowty gasket seal plated carbon steel with buna O-ring)	**100**	each	Supply and install	Section 3.2.16
15.36	3/8'' Seal Bonded Washer (Dowty gasket seal plated carbon steel with buna O-ring)	**200**	each	Supply and install	Section 3.2.16
15.37	BALL VALVE WITH FEMALE BSPP ENDS: 1/2" BSPP Grade 316 Stainless Steel Ball Valve with lockable handle. Max. allowable (Working) Pressure of 69 bar.	**50**	each	Supply and install	Section 3.2.16
15.38	ISOLATION VALVE WITH FEMALE NPT ENDS: 3/8" NPT Stainless Steel Ball Valve with lockable handle. Max. allowable (Working) Pressure of 69 bar. Part Number: 521561	**25**	each	Supply and install	Section 3.2.16

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
15.39	ISOLATION VALVE FEMALE BSPP ENDS: 1/2" both sides, mild steel	**100**	each	Supply and install	Section 3.2.16
15.40	ISOLATION VALVE WITH BLEED VALVE: Pressure gauge Shut-off valve with vent screw (bleed valve). PN400 with ½" BSPP male inlet and ½" female outlet union nut, Carbon Steel	**100**	each	Supply and install	Section 3.2.16
15.41	NEEDLE SHUT-OFF VALVES: Type S350 High Pressure Needle Valve ½" BSPP female both sides. PN400, 1.0460 Carbon Steel. Part number S350.03.104.	**50**	each	Supply and install	Section 3.2.16
15.42	NEEDLE SHUT-OFF VALVES: Type S350 High Pressure Needle Valve ½" BSPP female both sides. PN400, 1.4571 Stainless Steel. Part number S350.03.204	**50**	each	Supply and install	Section 3.2.16
15.43	3-Piece Ball Valve (PEKOS FIG.K 809 SGSGV CL800 1/2" BSPP) Description: 3-piece, full bore, soft seat ball valve with ½" BSPP female flanges on both ends. Material: ASTM SA-105N (Flanges and Body); Grade 316 stainless steel (ball)	**10**	each	Supply and install	Section 3.2.16
15.44	3-Piece Ball Valve (FIG.K 809 SGSGV CL800 1/2" BW). Description: 3-piece, full bore, soft seat ball valve with flanges prepared for butt welding a ½" pipe on both ends. Material: ASTM SA-105N (Flanges and Body); Grade 316 stainless steel (ball)	**10**	each	Supply and install	Section 3.2.16
16	**Consumables**				
16.1	20mm Gland Hole blanks plug	**200**	each	Supply	
16.2	25mm Gland Hole Blanks plug	**200**	each	Supply	
16.3	Labelling Type: 15mm Sleeves (Clear). Size: 1-2mm	**20**	BX	Supply	
16.4	Labelling Type: 23mm Sleeves (Clear). Size: 1-2mm	**20**	BX	Supply	
16.5	Labelling Type: PVC tags (yellow). Size: 15mm	**20**	BX	Supply	
16.6	Labelling Type: PVC tags (yellow). Size: 23mm	**20**	BX	Supply	
16.7	70X10 Cable Sleeves	**20**	BX	Supply	
16.8	70X10 Yellow Cable Labels	**20**	BX	Supply	
16.9	Black Cable Ties T120R	**200**	100/PKT	Supply	
16.10	Black Cable Ties T50R	**200**	100/PKT	Supply	
16.11	Black Cable Ties T30R	**200**	100/PKT	Supply	
16.12	Black Cable Ties T18R	**200**	100/PKT	Supply	
16.13	Black Cable Ties T16R	**200**	100/PKT	Supply	
16.14	Black Heat shrink (Shrink ratio 2:1) Size 12.7/6.4mm	**4000**	meters	Supply	
16.15	Black Heat shrink (Shrink ratio 2:1) Size 19.1/9.5mm	**4000**	meters	Supply	

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
16.16	Black Heat shrink (Shrink ratio 2:1) Size 9.5/4.7mm	**500**	meters	Supply	
16.17	Black Screen Heat shrink (Shrink ratio 3:1) Size 1.5/0.5mm	**4000**	meters	Supply	
16.18	Clear Cable Spiral Wrapping (Bind) Ty-Rap	**500**	meters	Supply	
16.19	Earth (Green/ Yellow) Single Core Multi Stranded Panel Wire 1.5mm	**400**	meters	Supply	
16.20	Size 0 Black Shrouds	**1000**	each	Supply	
16.21	Size 0 Glands	**1000**	each	Supply	
16.22	Size 00 Black Shrouds	**1000**	each	Supply	
16.23	Size 00 Glands	**1000**	each	Supply	
16.24	Size 1 Black Shrouds	**1000**	each	Supply	
16.25	Size 1 Glands	**1000**	each	Supply	
16.26	Size 2 Black Shrouds	**500**	each	Supply	
16.27	Size 2 Glands	**500**	each	Supply	
16.28	Size 3 Black Shrouds	**50**	each	Supply	
16.29	Size 3 Glands	**50**	each	Supply	
16.30	Size 4 Black Shrouds	**50**	each	Supply	
16.31	Size 4 Glands	**50**	each	Supply	
16.32	WTR 4SL Spring Loaded Terminal	**500**	each	Supply	
16.33	Terminal numbers for WTR 4SL Spring Loaded Terminal		each	Supply	
16.34	Terminal Strip Marker	**100**	each	Supply	
16.35	PVC Coated Galvanised Steel, Black, 25 meters, 20mm Flexible Conduit TSP20/BL/25M	**500**	meters	Supply	
16.36	PVC Coated Galvanised Steel, Black, 25 meters, 32mm Flexible Conduit TSP32/BL/25M	**500**	meters	Supply	
16.37	Straight Fitting 20mm T/SP20/M20/A M20	**100**	each	Supply	
16.38	Straight Fitting 32mm T/SP32/M32/A M32	**100**	each	Supply	

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
16.39	Smooth Entry Bush 20mm T/SP20/20/C	**100**	each	Supply	
16.40	Smooth Entry Bush 32mm T/SP32/32/C	**100**	each	Supply	
16.41	Conduit Terminator 20mm T/SP20/E	**100**	each	Supply	
16.42	Conduit Terminator 32mm T/SP32/E	**100**	each	Supply	
16.43	Brass Female Couplers Metric Thread 20mm T/B/M20/C	**100**	each	Supply	
16.44	Brass Female Couplers Metric Thread 32mm T/B/M32/C	**100**	each	Supply	
16.45	Straight Fitting Swivel External Male Thread 20mm T/SP20/M20/B	**100**	each	Supply	
16.46	Straight Fitting Swivel External Male Thread 32mm T/SP32/M32/B	**100**	each	Supply	
16.47	Nickel Plated Brass - 45° Elbow T/SPL20/M20/C45	**100**	each	Supply	
16.48	Nickel Plated Brass - 90° Elbow T/SPL20/M20/C90	**100**	each	Supply	
16.49	Nickel Plated Brass - 90° Elbow T/SPL32/M32/C90	**100**	each	Supply	
16.50	2-piece P1000 Clamp (with bolt and nylock nut) for TSP20 (Unistrut Channel Clamps 20mm) T15/20	**1500**	each	Supply	
16.51	2-piece P1000 Clamp (with bolt and nylock nut) for TSP20 (Unistrut Channel Clamps 32mm) T25/30	**1500**	each	Supply	
16.52	EX Thread Convertors 25mm to 20mm T/EXN/M25-M20/R	**100**	each	Supply	
16.53	Pre-insulated Ring Lugs (Red). Size: 0.25-1.65mm². Product ID: 1R3	**200**	100/PKT	Supply	
16.54	Pre-insulated Ring Lugs (Blue). Size: 1.04-2.63mm² Product ID: 2R35	**200**	100/PKT	Supply	
16.55	Pre-insulated Hook Blade Lugs (Red). Size: 0.25-1.65mm². Product ID: 1HB3	**200**	100/PKT	Supply	
16.56	Pre-insulated Hook Blade Lugs (Blue). Size: 1.04-2.63mm². Product ID: 2HB3	**200**	100/PKT	Supply	
16.57	Insulated Bootlace Ferrules (Red). Size: 1.00mm². Product ID: E1010RD	**200**	100/PKT	Supply	
16.58	Insulated Bootlace Ferrules (Black). Size: 1.50mm². Product ID: E1010BK	**200**	100/PKT	Supply	
16.59	Insulated Bootlace Ferrules (Grey). Size: 2.50mm². Product ID: E1010GY	**40**	100/PKT	Supply	
16.60	Harting plugs: Han A Hood Coupler 1 Lever M20, Category: Hoods/Housing, Series: Han A, Type: Housing, Part number 19 20 003 1750	**200**	each	Supply	
16.61	Harting plugs: Han A Hood Top Entry 2 Pegs M20, Category: Hoods/Housing, Series: Han A, Type: Hood, Part number 19 20 003 1440	**200**	each	Supply	

Item	Description (refer to Works Information for works details)	Quantity	unit of measure	Contract Scope of Work	Reference information drawings/ Schedules
16.62	Harting plugs: Han 4A-STI-S, Category: Inserts, Series: Han A, Termination method: Screw termination, Number of contacts: 4, Part number 09 20 004 2611	**200**	each	Supply	
16.63	Harting plugs: Han A 04 Pos. F Insert Screw, Category: Inserts, Series: Han A, Termination method: Screw termination, Number of contacts: 4, Part number 09 20 004 2711	**200**	each	Supply	
16.64	Harting plugs: Han CGM-M M20x1,5 D.5-9mm, Category: Accessories, Series: Han CGM-M, Type: Cable Gland, Part number 19 00 000 5080	**200**	each	Supply	
16.65	Harting plugs: Screw teethed M3x6 (PU 100pcs), Category: Accessories, Series: Han 3 A, Type: Fixing screws, Part number 09 20 000 9995	**200**	each	Supply	
17	**Transportation**				
17.1	Phase 1 Control Panels from Cape Town (Acacia Power Station) to Vanderkloof Power Station	**826**	km	Transport	
17.2	Phase 2 Control Panels from Cape Town (Acacia Power Station) to Vanderkloof Power Station	**826**	km	Transport	
18	**Sample of Labour Activities to be considered**				
18.1	Wiring and fitting of harting plugs		each		
18.2	Configuration and Bench Testing of instruments (Pre-Outage)		each		
18.3	Cold commissioning (loop checks)		each		
18.4	Hot Commissioning (Instrument Function Checks)		each		
18.5	Provide support during commissioning		each		

APPENDIX C: spare list

Item#	Type & Accessories	Quantity
1	Temperature probes TR10-H (Pt100, 600mm probe length for Bearing systems)	4
2	Temperature probes TR10-H (Pt100, 675mm probe length with 150mm flexible rod for Bearing systems)	4
3	Temperature probes (Pt100, 100mm probe length with embedded steel braided cable)	8
4	Temperature probes (Pt100, 130mm probe length with embedded steel braided cable)	8
5	Temperature probes (Pt100, 240mm probe length with embedded steel braided cable)	8
6	Pressure transmitter EJX530A-EBS8N-019EF	10
7	Pressure transmitter EJX530A-ECS8N-019EF	10
8	Pressure transmitter EJX530A-EDS8N-019EF	5
9	Differential Pressure transmitter EJX110A-EHS4G-919EB	5
10	Bourdon Tube Pressure Gauges	4
11	2 Way Valve-Manifolds	10
12	3 Way Valve-Manifolds	10
13	Isolation valves	5
14	Isolation valves	5
15	DWM2000 Electromagnetic Flow Meter with LCD indicator	5
16	Flow Switch - Flowphant T_DTT32-A1111AEX1AB, with connecting plug 510063	2
17	Reed Level Transmitter MPJ5-M280	2
18	Reed Level Transmitter MPJ5-M505	2
19	Reed Level Transmitter MPJ5-M350	2
20	Reed Sensor for Bypass Level Indicators MPJ5-M1500	4
21	BMD-SA Magnetic Display for Bypass Level Indicator	1
22	BGU Magnetic Switch for Bypass Level Indicator	10
23	Point level detector 11375Z	5
24	FTW325 Transmitter	5
25	Limit Switch	10
26	Direct Acting Valve	2
27	Directional Valve	2
28	2-wire level transmitter PR 5343A	20
29	Level Chamber with sight glass	1
30	200B3DASSR2MXI Electromagnetic Flow Meter	1

APPENDIX D: CABLE RACKING DIAGRAM

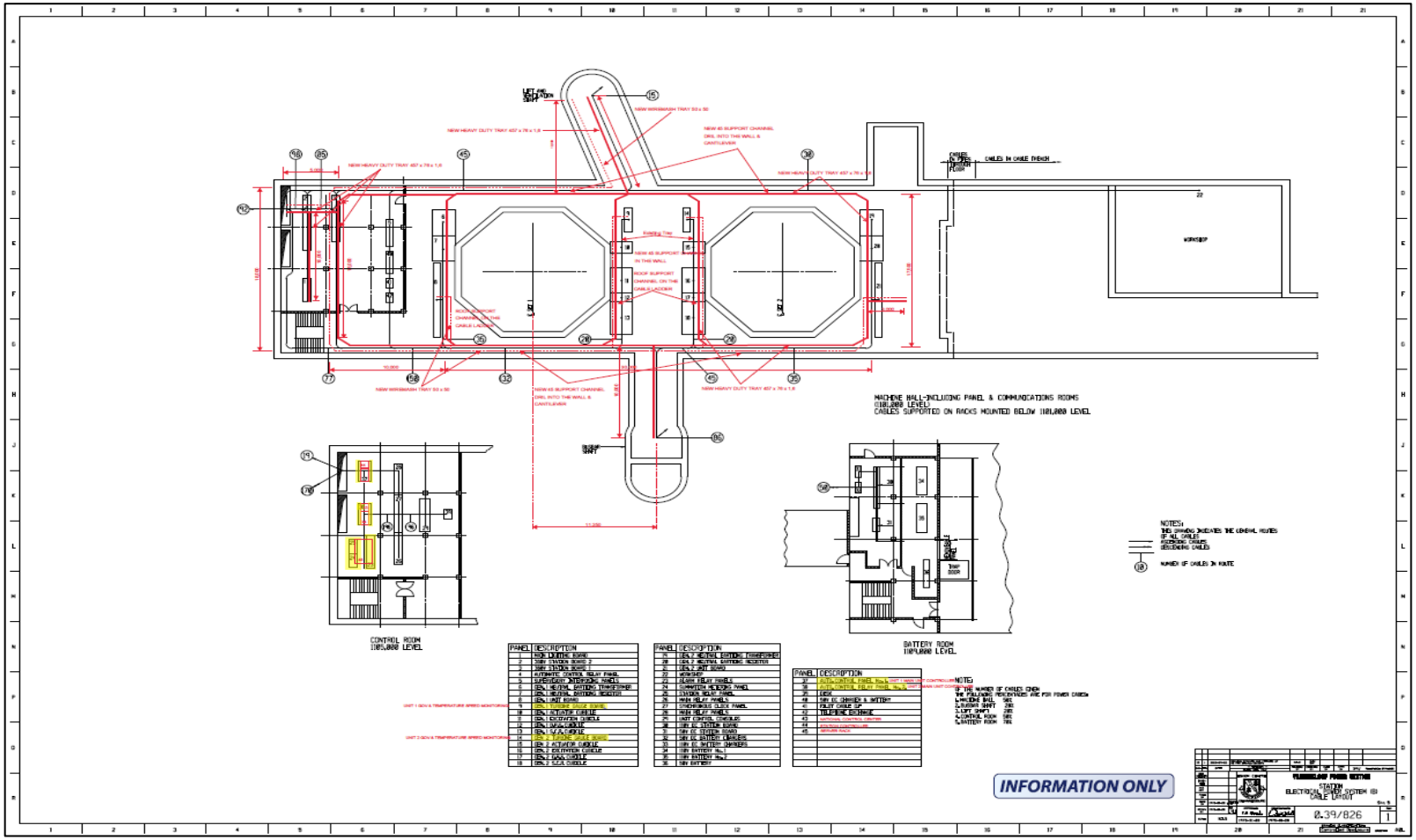


Figure 4: Station Cable Racking Layout

APPENDIX E: LOOP CIRCUIT DIAGRAMS

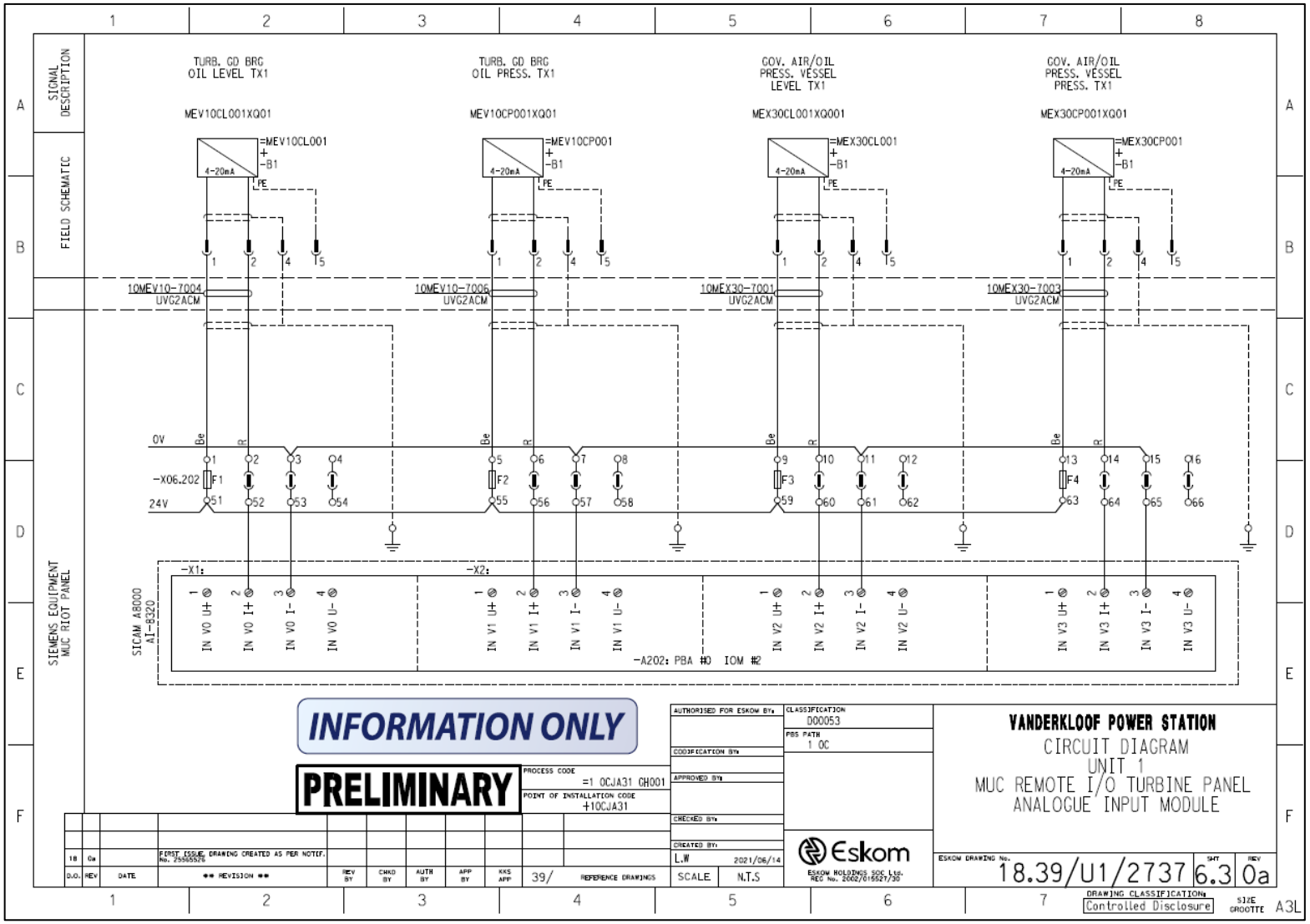


Figure 5: Circuit Diagram Analogue Input Module

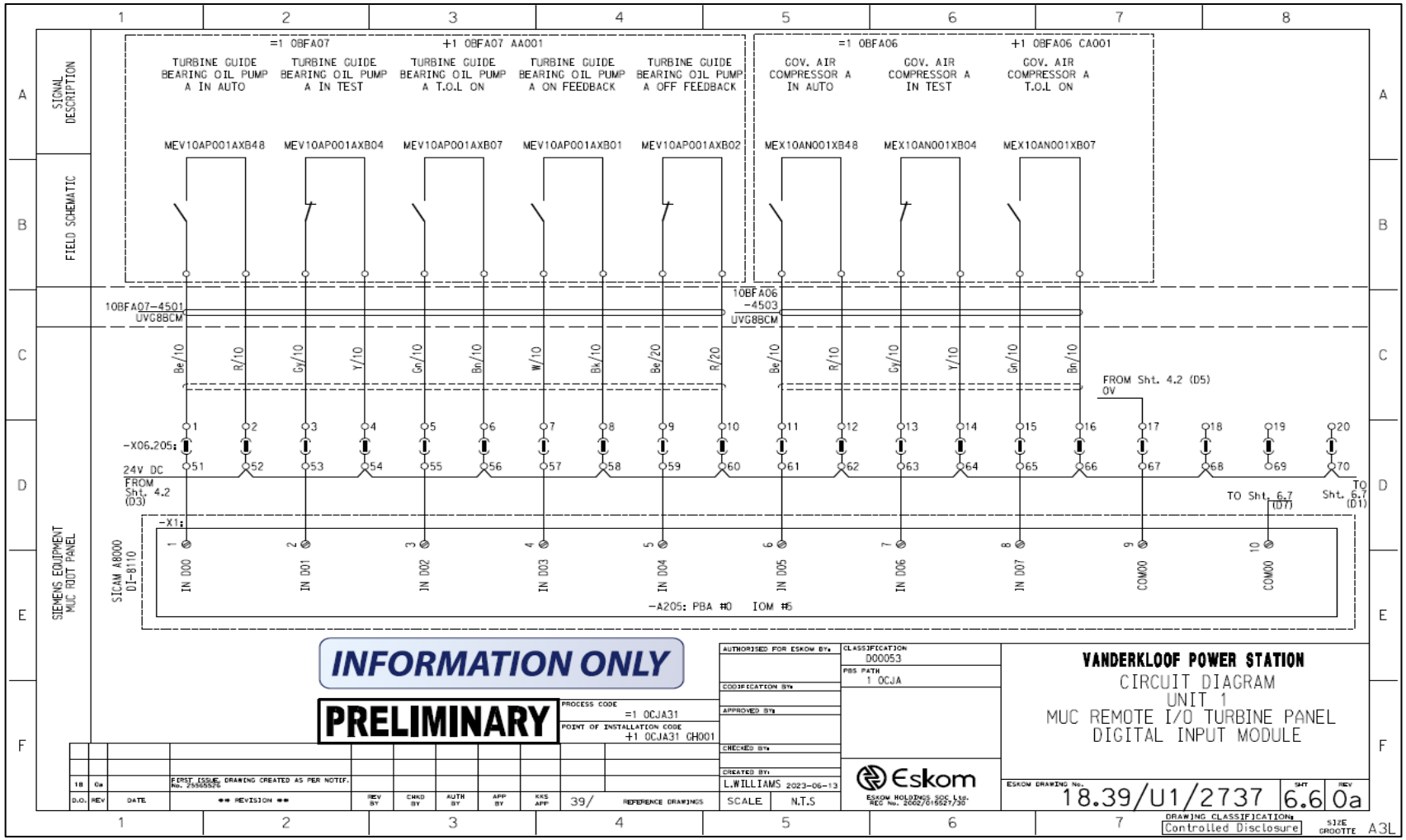


Figure 6: Circuit Diagram Digital Input Module 1st Section

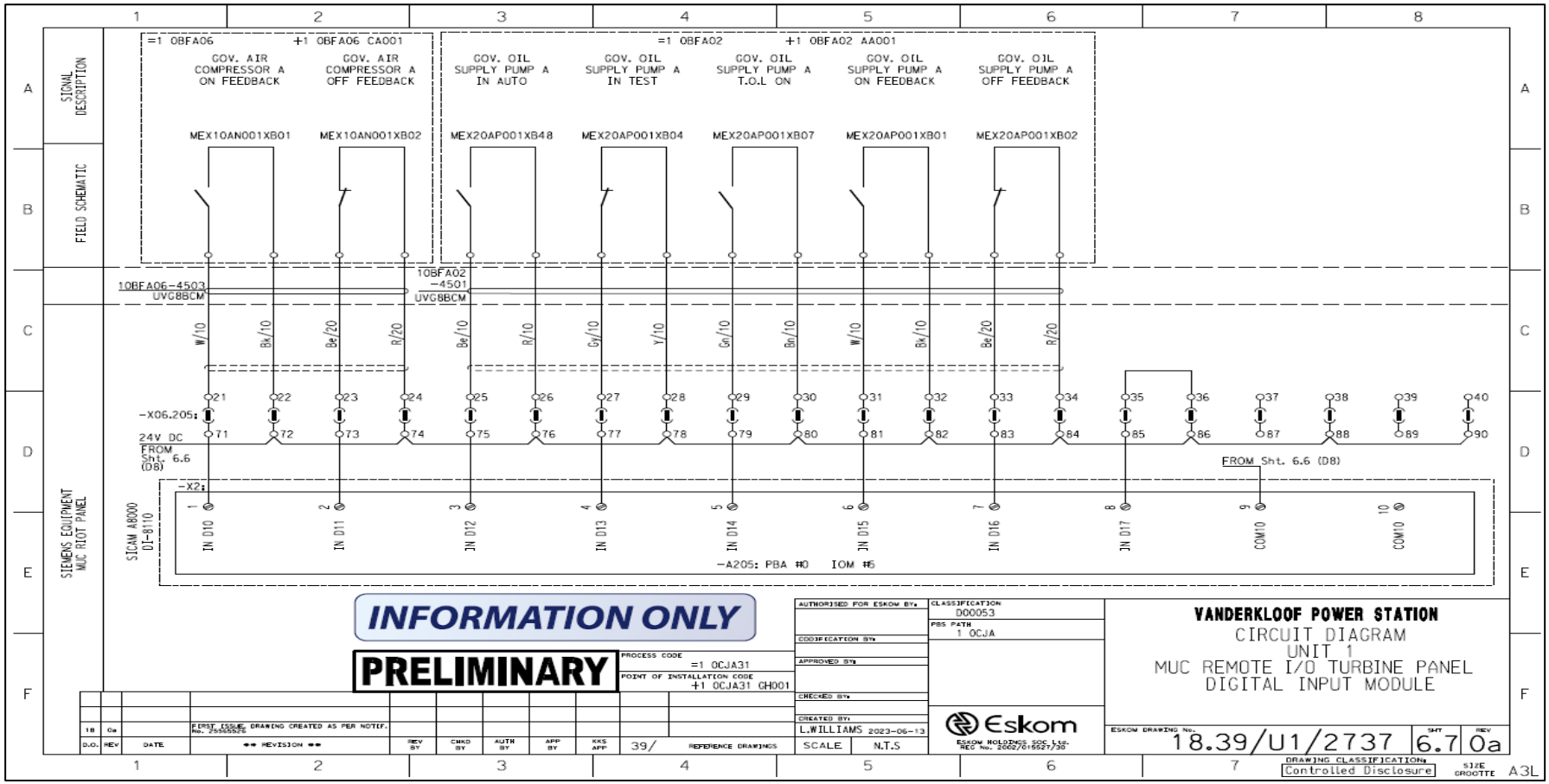


Figure 7: Circuit Diagram Digital Input 2nd Section

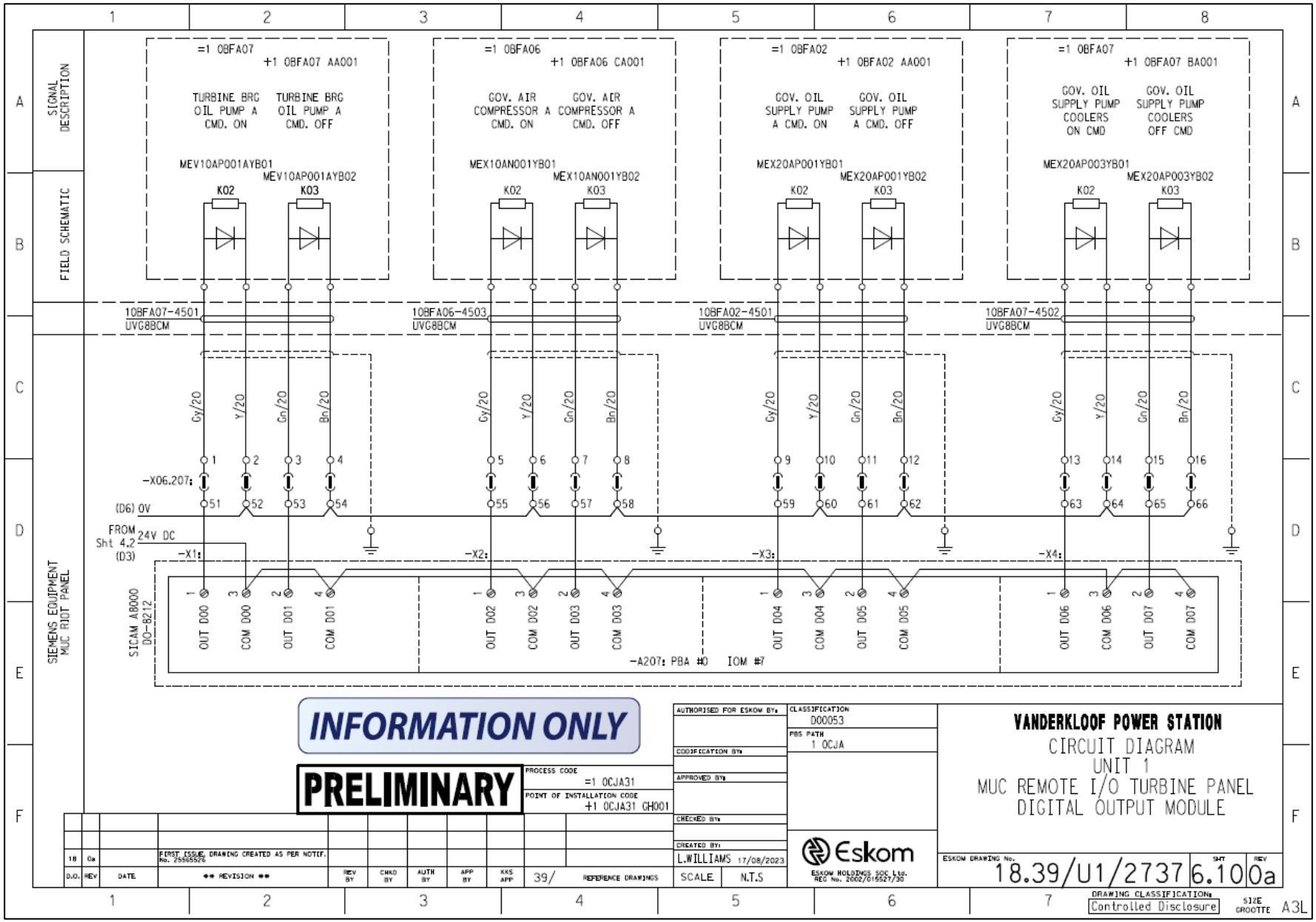
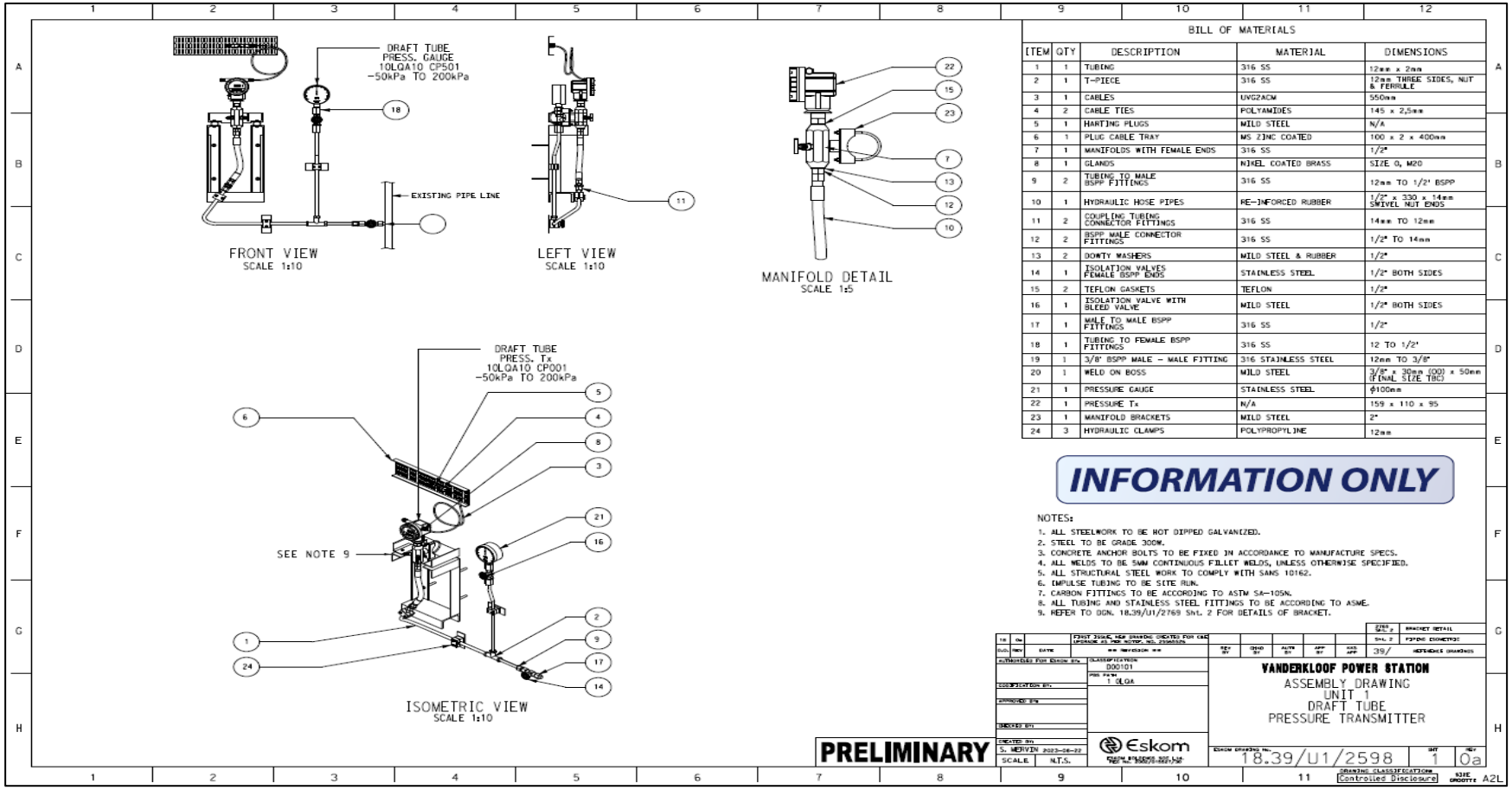


Figure 8: Circuit Diagram Digital Output Module



BILL OF MATERIALS

ITEM	QTY	DESCRIPTION	MATERIAL	DIMENSIONS
1	1	TUBING	316 SS	12mm x 2mm
2	1	T-PIECE	316 SS	12mm THREE SIDES, NUT & FERRULE
3	1	CABLES	UVG2ACM	550mm
4	2	CABLE TIES	POLYAMIDES	145 x 2,5mm
5	1	HARTING PLUGS	MILD STEEL	N/A
6	1	PLUC CABLE TRAY	MS ZINC COATED	100 x 2 x 400mm
7	1	MANIFOLDS WITH FEMALE ENDS	316 SS	1/2"
8	1	GLANDS	NIKEL COATED BRASS	SIZE 0, M20
9	2	TUBING TO MALE BSPP FITTINGS	316 SS	12mm TO 1/2" BSPP
10	1	HYDRAULIC HOSE PIPES	RE-INFORCED RUBBER	1/2" x 330 x 14mm SWIVEL NUT ENDS
11	2	COUPLING TUBING CONNECTOR FITTINGS	316 SS	14mm TO 12mm
12	2	BSPP MALE CONNECTOR FITTINGS	316 SS	1/2" TO 14mm
13	2	DOWTY WASHERS	MILD STEEL & RUBBER	1/2"
14	1	ISOLATION VALVES FEMALE BSPP ENDS	STAINLESS STEEL	1/2" BOTH SIDES
15	2	TEFLON GASKETS	TEFLON	1/2"
16	1	ISOLATION VALVE WITH BLEED VALVE	MILD STEEL	1/2" BOTH SIDES
17	1	MALE TO MALE BSPP FITTINGS	316 SS	1/2"
18	1	TUBING TO FEMALE BSPP FITTINGS	316 SS	12 TO 1/2"
19	1	3/8" BSPP MALE - MALE FITTING	316 STAINLESS STEEL	12mm TO 3/8"
20	1	WELD ON BOSS	MILD STEEL	3/8" x 30mm (OD) x 50mm (FINAL SIZE TBC)
21	1	PRESSURE GAUGE	STAINLESS STEEL	ϕ100mm
22	1	PRESSURE Tx	N/A	159 x 110 x 95
23	1	MANIFOLD BRACKETS	MILD STEEL	2"
24	3	HYDRAULIC CLAMPS	POLYPROPYLINE	12mm

Figure 9: Assembly Drawing Single Pressure Transmitter and Gauge

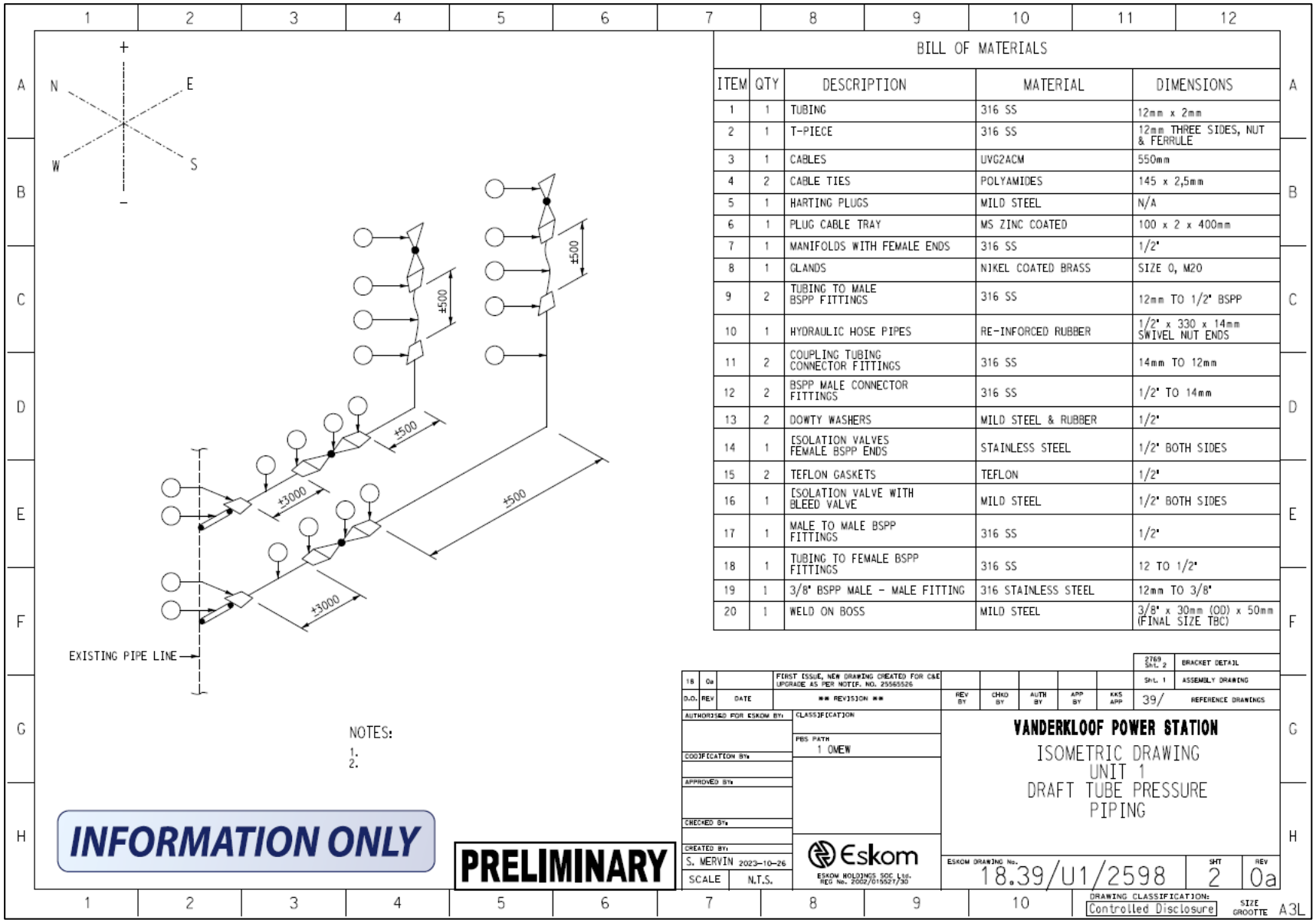


Figure 10: Isometric Drawing Single Pressure Transmitter and Gauge piping

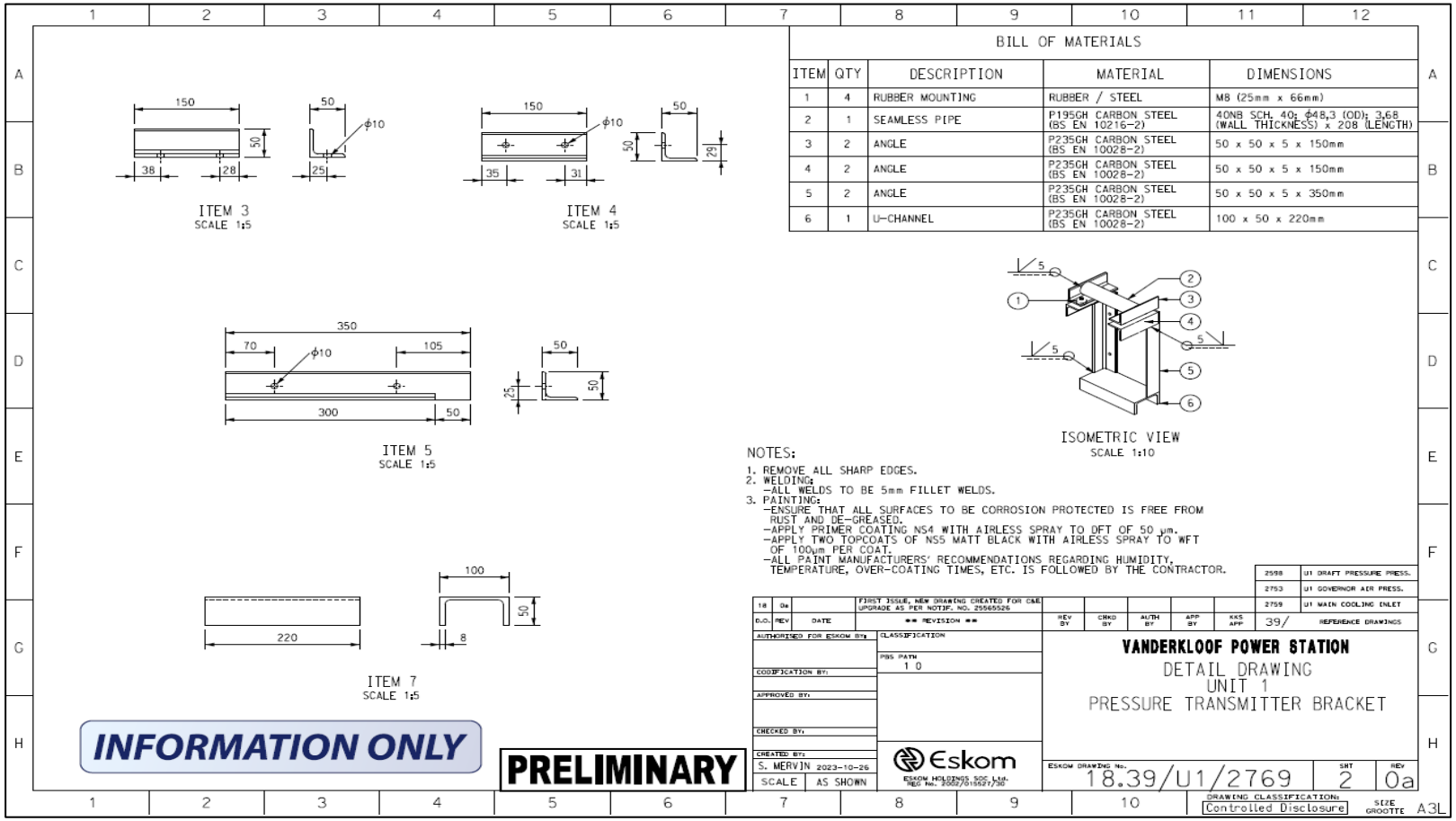
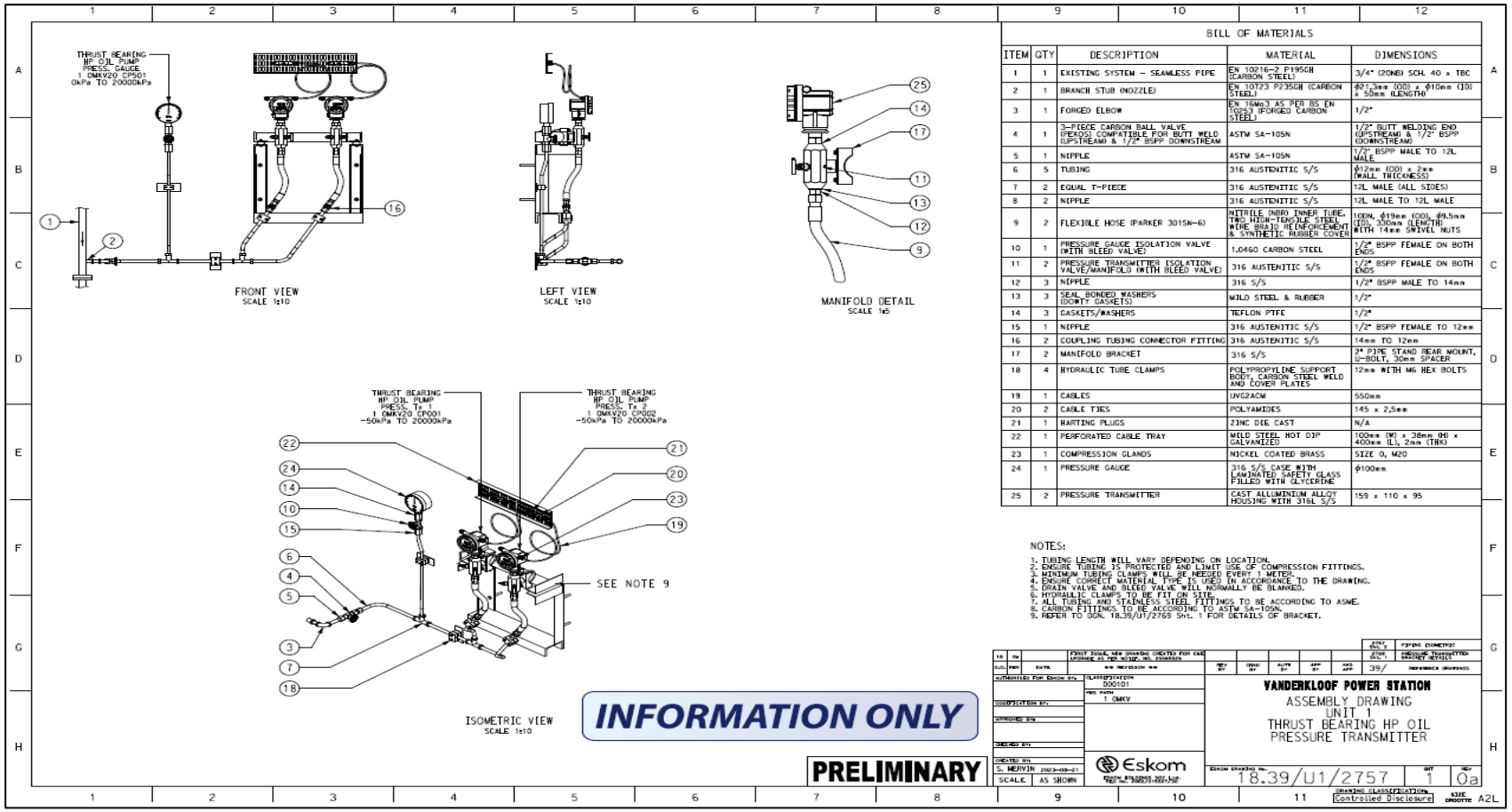


Figure 11: Detail Drawing Single Pressure Transmitter Bracket



BILL OF MATERIALS

ITEM	QTY	DESCRIPTION	MATERIAL	DIMENSIONS
1	1	EXISTING SYSTEM – SEAMLESS PIPE	EN 10216-2 P195GH (CARBON STEEL)	3/4" (20NB) SCH. 40 x TBC
2	1	BRANCH STUB (NOZZLE)	EN 10723 P235GH (CARBON STEEL)	ϕ21.3mm (OD) x ϕ10mm (ID) x 50mm (LENGTH)
3	1	FORGED ELBOW	EN 1694-3 AS PER BS EN 10253 (FORGED CARBON STEEL)	1/2"
4	1	3-PIECE CARBON BALL VALVE (PEKOS) COMPATIBLE FOR BUTT WELD (UPSTREAM) & 1/2" BSPP DOWNSTREAM	ASTM SA-105N	1/2" BUTT WELDING END (UPSTREAM) & 1/2" BSPP (DOWNSTREAM)
5	1	NIPPLE	ASTM SA-105N	1/2" BSPP MALE TO 12L MALE
6	5	TUBING	316 AUSTENITIC S/S	ϕ12mm (OD) x 2mm (WALL THICKNESS)
7	2	EQUAL T-PIECE	316 AUSTENITIC S/S	12L MALE (ALL SIDES)
8	2	NIPPLE	316 AUSTENITIC S/S	12L MALE TO 12L MALE
9	2	FLEXIBLE HOSE (PARKER 301SN-6)	NITRILE (NBR) INNER TUBE, TWO HIGH-TENSILE STEEL WIRE BRAID REINFORCEMENT & SYNTHETIC RUBBER COVER	100N, ϕ19mm (OD), ϕ9.5mm (ID), 330mm (LENGTH) WITH 14mm SWIVEL NUTS
10	1	PRESSURE GAUGE ISOLATION VALVE (WITH BLEED VALVE)	1.0460 CARBON STEEL	1/2" BSPP FEMALE ON BOTH ENDS
11	2	PRESSURE TRANSMITTER (ISOLATION VALVE/MANIFOLD (WITH BLEED VALVE)	316 AUSTENITIC S/S	1/2" BSPP FEMALE ON BOTH ENDS
12	3	NIPPLE	316 S/S	1/2" BSPP MALE TO 14mm
13	3	SEAL BONDED WASHERS (DOWTY GASKETS)	MILD STEEL & RUBBER	1/2"
14	3	GASKETS/WASHERS	TEFLON PTFE	1/2"
15	1	NIPPLE	316 AUSTENITIC S/S	1/2" BSPP FEMALE TO 12mm
16	2	COUPLING TUBING CONNECTOR FITTING	316 AUSTENITIC S/S	14mm TO 12mm
17	2	MANIFOLD BRACKET	316 S/S	2" PIPE STAND BEAR MOUNT, U-BOLT, 30mm SPACER
18	4	HYDRAULIC TUBE CLAMPS	POLYPROPYLENE SUPPORT BODY, CARBON STEEL WELD AND COVER PLATES	12mm WITH M6 HEX BOLTS
19	1	CABLES	UVG2ACM	550mm
20	2	CABLE TIES	POLYAMIDES	145 x 2,5mm
21	1	HARTING PLUGS	ZINC DIE CAST	N/A
22	1	PERFORATED CABLE TRAY	MILD STEEL HOT DIP GALVANIZED	100mm (W) x 38mm (H) x 400mm (L), 2mm (THK)
23	1	COMPRESSION GLANDS	NICKEL COATED BRASS	SIZE 0, M20
24	1	PRESSURE GAUGE	316 S/S CASE WITH LAMINATED SAFETY GLASS FILLED WITH GLYCERINE	ϕ100mm
25	2	PRESSURE TRANSMITTER	CAST ALUMINIUM ALLOY HOUSING WITH 316L S/S	159 x 110 x 95

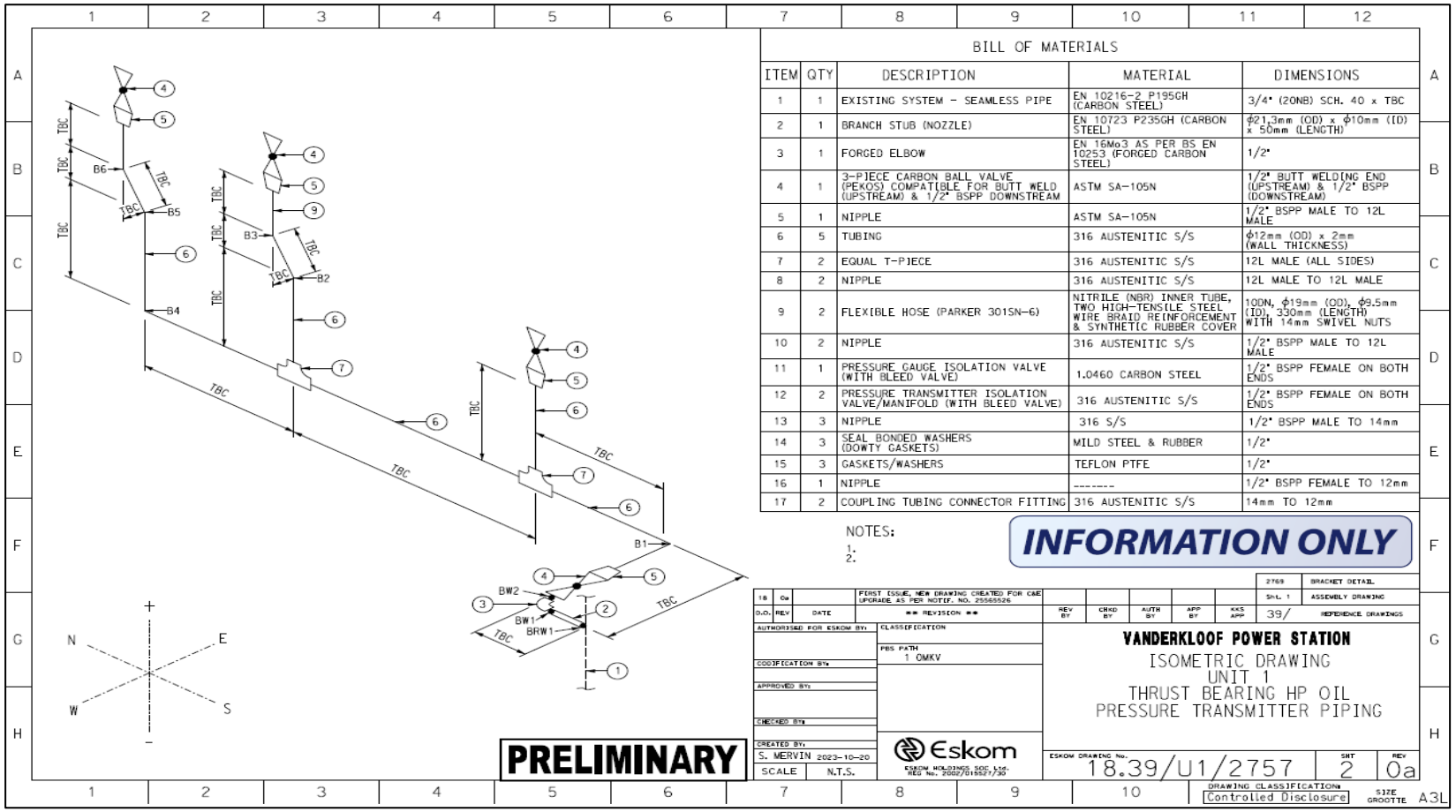
NOTES:
1. TUBING LENGTH WILL VARY DEPENDING ON LOCATION.
2. ENSURE TUBING IS PROTECTED AND LIMIT USE OF COMPRESSION FITTINGS.
3. MINIMUM TUBING CLAMPS WILL BE NEEDED EVERY 1 METER.
4. ENSURE CORRECT MATERIAL TYPE IS USED IN ACCORDANCE TO THE DRAWING.
5. DRAIN VALVE AND BLEED VALVE WILL NORMALLY BE BLANKED.
6. HYDRAULIC CLAMPS TO BE FIT ON SITE.
7. ALL TUBING AND STAINLESS STEEL FITTINGS TO BE ACCORDING TO ASME.
8. CARBON FITTINGS TO BE ACCORDING TO ASTM SA-105N.
9. REFER TO DGN. 18.39/UT/2769 Sht. 1 FOR DETAILS OF BRACKET.

CLASSIFICATION: 000101
PROJ. PATH: 1 OMKV
CREATED BY: S. MERVIN 2023-09-21
SCALE: AS SHOWN

VANDERKLOOF POWER STATION
ASSEMBLY DRAWING
UNIT 1
THRUST BEARING HP OIL
PRESSURE TRANSMITTER

Eskom drawing no. 18.39/U1/2757 | UNIT 1 | REV 0a
DRAWING CLASSIFICATION: Controlled Disclosure
SIZE A2L

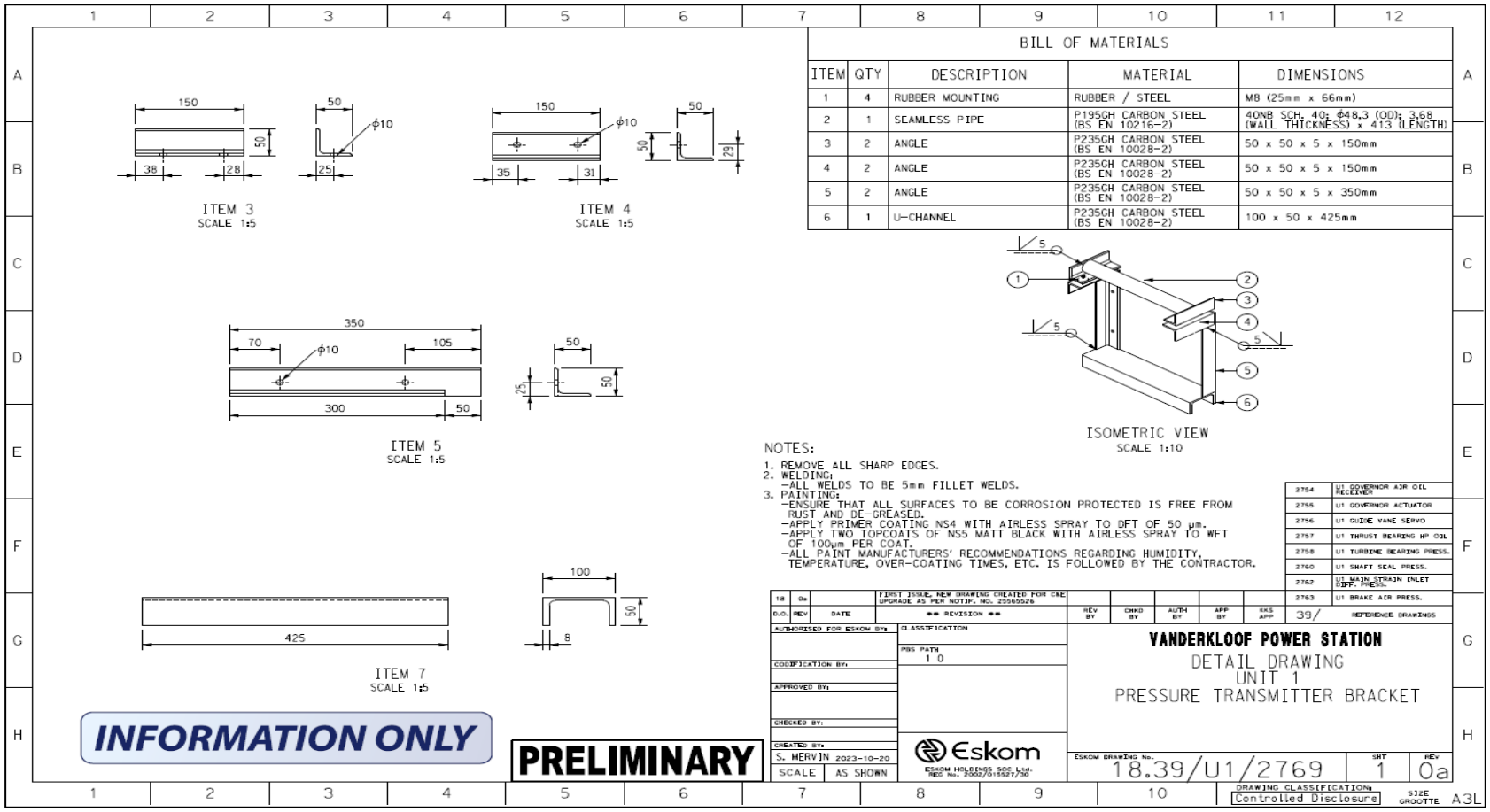
Figure 12: Assembly Drawing Redundant Pressure Transmitter and Gauge



BILL OF MATERIALS

ITEM	QTY	DESCRIPTION	MATERIAL	DIMENSIONS
1	1	EXISTING SYSTEM – SEAMLESS PIPE	EN 10216-2 P195GH (CARBON STEEL)	3/4" (20NB) SCH. 40 x TBC
2	1	BRANCH STUB (NOZZLE)	EN 10723 P235GH (CARBON STEEL)	ϕ21,3mm (OD) x ϕ10mm (ID) x 50mm (LENGTH)
3	1	FORGED ELBOW	EN 16Mo3 AS PER BS EN 10253 (FORGED CARBON STEEL)	1/2"
4	1	3-PIECE CARBON BALL VALVE (PEKOS) COMPATIBLE FOR BUTT WELD (UPSTREAM) & 1/2" BSPP DOWNSTREAM	ASTM SA-105N	1/2" BUTT WELDING END (UPSTREAM) & 1/2" BSPP (DOWNSTREAM)
5	1	NIPPLE	ASTM SA-105N	1/2" BSPP MALE TO 12L MALE
6	5	TUBING	316 AUSTENITIC S/S	ϕ12mm (OD) x 2mm (WALL THICKNESS)
7	2	EQUAL T-PIECE	316 AUSTENITIC S/S	12L MALE (ALL SIDES)
8	2	NIPPLE	316 AUSTENITIC S/S	12L MALE TO 12L MALE
9	2	FLEXIBLE HOSE (PARKER 301SN-6)	NITRILE (NBR) INNER TUBE, TWO HIGH-TENSILE STEEL WIRE BRAID REINFORCEMENT & SYNTHETIC RUBBER COVER	10DN, ϕ19mm (OD), ϕ9.5mm (ID), 330mm (LENGTH) WITH 14mm SWIVEL NUTS
10	2	NIPPLE	316 AUSTENITIC S/S	1/2" BSPP MALE TO 12L MALE
11	1	PRESSURE GAUGE ISOLATION VALVE (WITH BLEED VALVE)	1.0460 CARBON STEEL	1/2" BSPP FEMALE ON BOTH ENDS
12	2	PRESSURE TRANSMITTER ISOLATION VALVE/MANIFOLD (WITH BLEED VALVE)	316 AUSTENITIC S/S	1/2" BSPP FEMALE ON BOTH ENDS
13	3	NIPPLE	316 S/S	1/2" BSPP MALE TO 14mm
14	3	SEAL BONDED WASHERS (DOWTY GASKETS)	MILD STEEL & RUBBER	1/2"
15	3	GASKETS/WASHERS	TEFLON PTFE	1/2"
16	1	NIPPLE	-------	1/2" BSPP FEMALE TO 12mm
17	2	COUPLING TUBING CONNECTOR FITTING	316 AUSTENITIC S/S	14mm TO 12mm

Figure 13: Isometric Drawing Redundant Pressure Transmitter and Gauge piping



ITEM	QTY	DESCRIPTION	MATERIAL	DIMENSIONS
1	4	RUBBER MOUNTING	RUBBER / STEEL	M8 (25mm x 66mm)
2	1	SEAMLESS PIPE	P195GH CARBON STEEL (BS EN 10216-2)	40NB SCH. 40; Φ48,3 (OD); 3,68 (WALL THICKNESS) x 413 (LENGTH)
3	2	ANGLE	P235GH CARBON STEEL (BS EN 10028-2)	50 x 50 x 5 x 150mm
4	2	ANGLE	P235GH CARBON STEEL (BS EN 10028-2)	50 x 50 x 5 x 150mm
5	2	ANGLE	P235GH CARBON STEEL (BS EN 10028-2)	50 x 50 x 5 x 350mm
6	1	U-CHANNEL	P235GH CARBON STEEL (BS EN 10028-2)	100 x 50 x 425mm

2754	U1 GOVERNOR AIR OIL RECEIVER
2755	U1 GOVERNOR ACTUATOR
2756	U1 GUIDE VANE SERVO
2757	U1 THRUST BEARING HP OIL
2758	U1 TURBINE BEARING PRESS.
2760	U1 SHAFT SEAL PRESS.
2762	U1 MAIN STRAIN INLET DIFF. PRESS.
2763	U1 BRAKE AIR PRESS.

Figure 14: Detail Drawing Redundant Pressure Transmitter Bracket

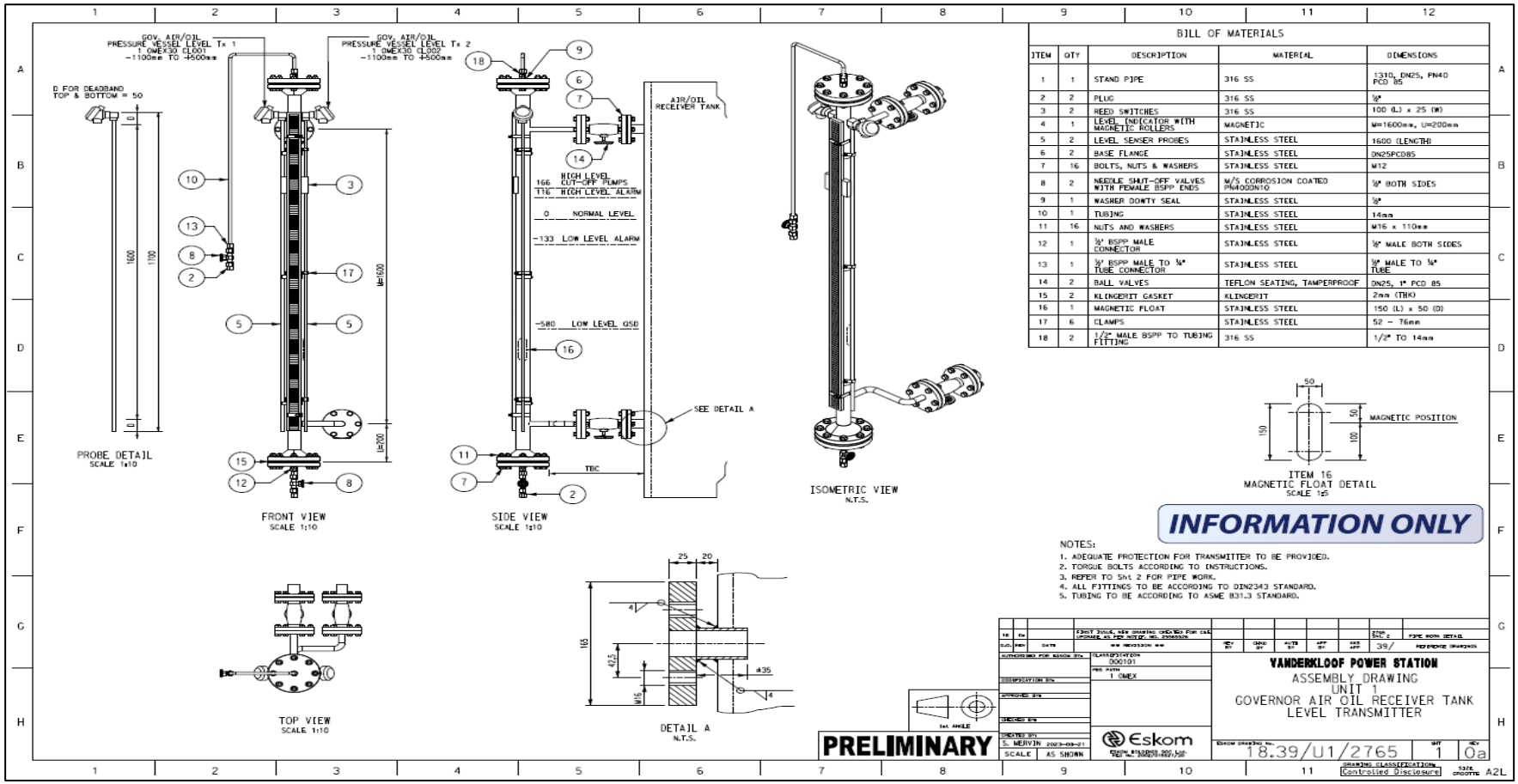


Figure 15: Assembly Drawing Stand-pipe Level Transmitter for Pressurised Air Oil Receiver

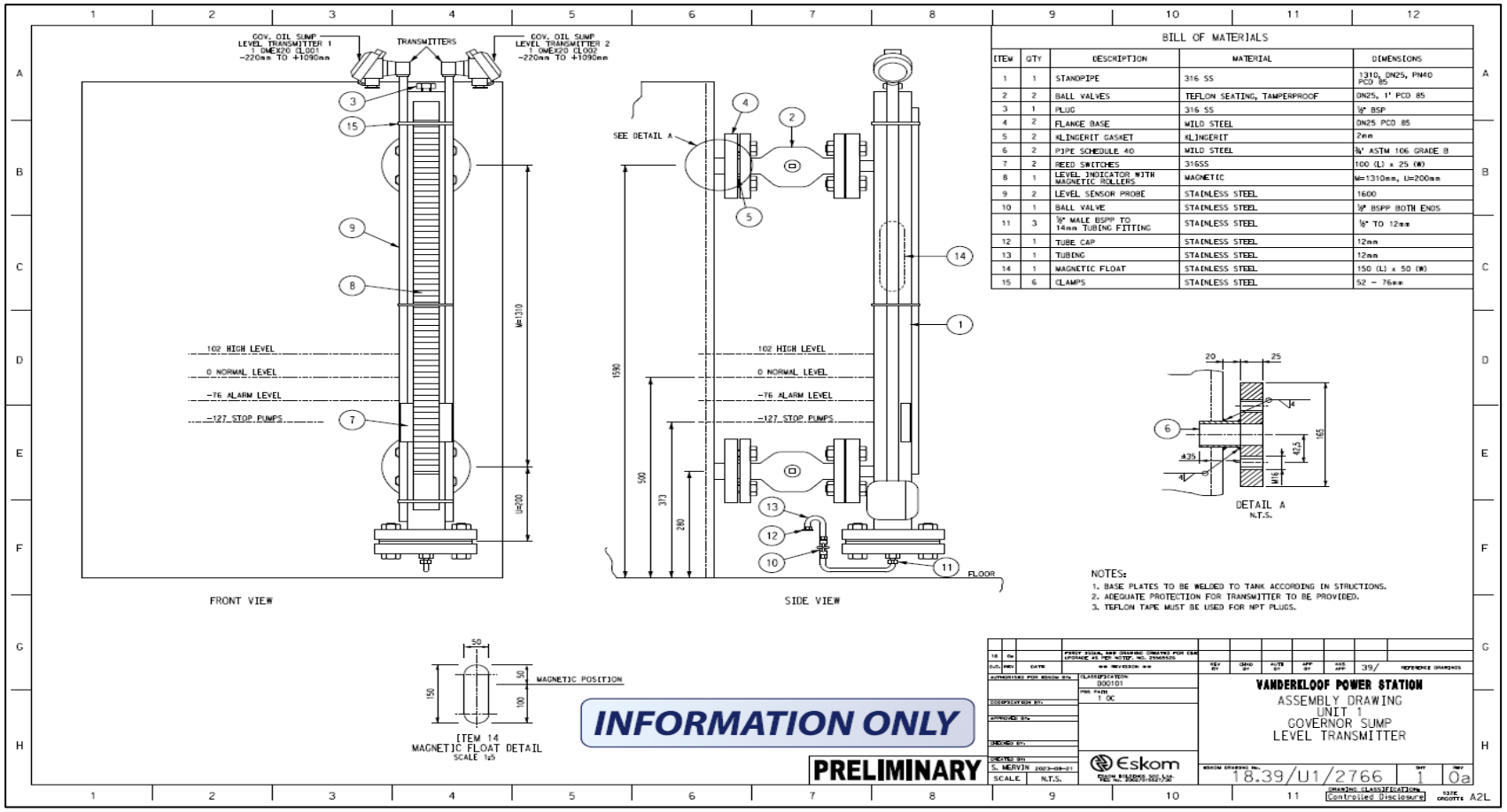


Figure 16: Assembly Drawing Stand-pipe Level Transmitter for Oil Sump

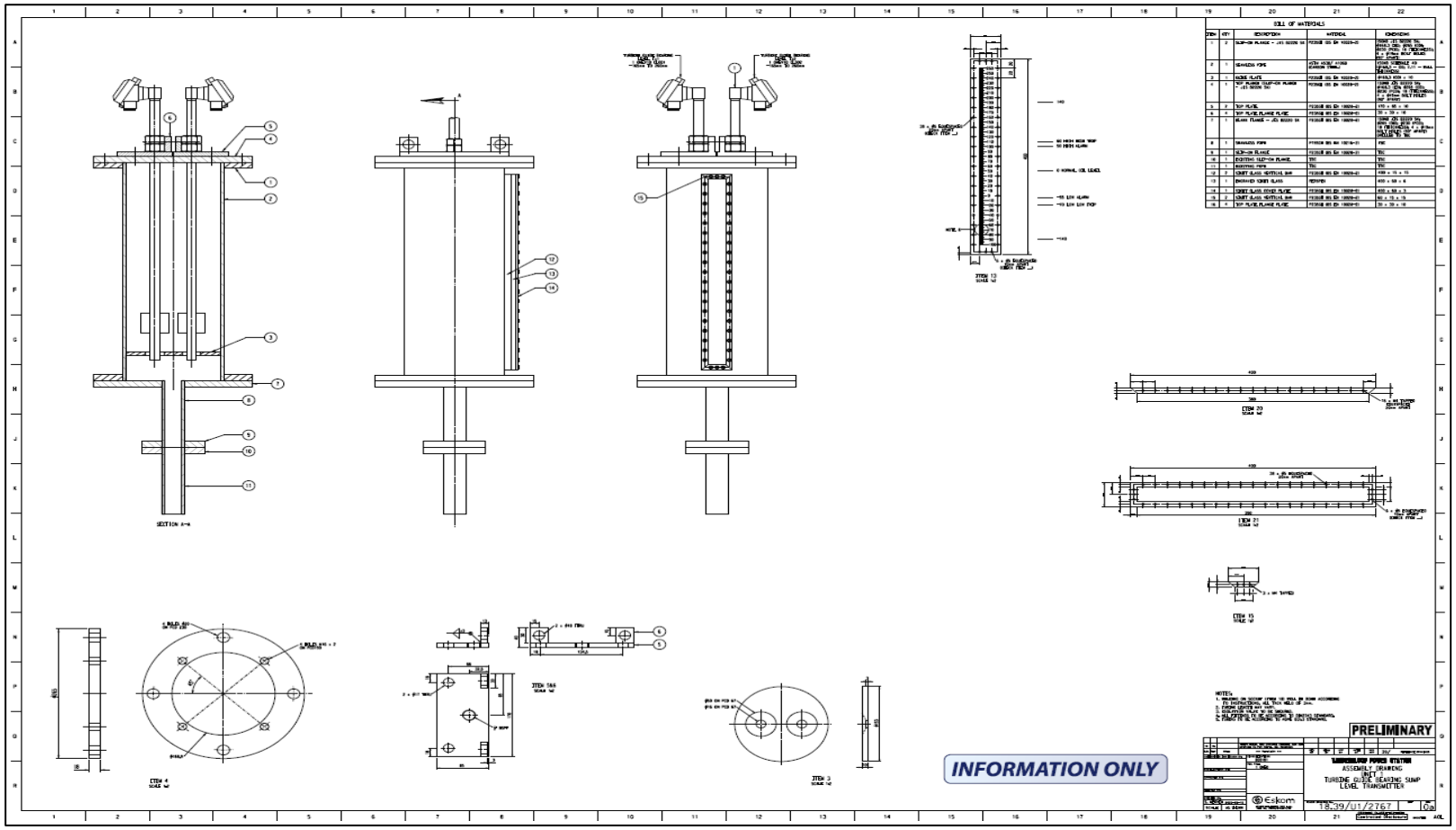


Figure 17: Assembly Drawing Level Transmitter Chamber for Oil Sump