

### **PART 3: SCOPE OF WORK**

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	Total number of pages	165

## **C3.1: EMPLOYER'S WORKS INFORMATION**

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## **1. Description of the works**

### **1.1 Executive Overview**

Majuba Power Station is a six (6) unit coal fired power plant that produces a total of 4 110 MW of electricity. The units consist of three (3) dry cooled units which each produce 665 MW and three (3) wet cooled units which each produce 716 MW. Construction of the power station started in 1983 and the first unit was connected to the national grid in 1996, it is planned to operate the power station up until 2061.

The last unit was commissioned in 2001. Majuba is Eskom's only power station that is not linked to a specific mine. The power station receives its coal from various sources.

The Ash Disposal Facility (ADF) stores ash which is primarily conveyed by conveyor belts from the fly ash storage and conditioning facility. There are two (2) crawler mounted ash stackers on the Ash Disposal Facility for stacking the ash in a two-tier system which is known as the piggy-back system. The current ash Disposal Facility foot print was determined before the construction of the power station. The designs did not include a lining system for the Ash Disposal Facility as ash was not classified as a waste at the time. There are channels and pollution control dams around the Ash Disposal Facility to effectively manage storm water runoff from the Ash Disposal Facility. The Ash Disposal Facility was designed for the 40 year life of the station (plus 5 year contingency) with a capacity of 150 million m<sup>3</sup>. The station life has since been extended to 60 years, requiring additional ashing capacity to be provided.

The original 45 year Ash Disposal Facility on the land, which Eskom had purchased, had a wetland area in the centre of the footprint. This was not regarded as a problem at the time, as there was no legislation governing wetland protection. There is a large wetland area adjacent to the Ash Disposal Facility in the stream valley.

Eskom's methodology for ash facility operations is to divide the facility into 15 year intervals so that infrastructure is only constructed when required. The infrastructure required for the following 15 years is therefore designed and constructed when the ash stack is nearing the end of the initial 15 year capacity. Majuba therefore fenced off the first 15 years ashing area and only constructed the pollution control infrastructure in this area. The area beyond the 15 year ashing area was leased for farming.

The Ash Disposal Facility was approaching the end of the 15 year area in 2010 and it was intended to extend the pollution control infrastructure and fence to the 30 year position. The EIA was initiated as the disposal of ash is now a listed activity. At that time the Majuba environmental officer initiated concern over the now protected wetland area and commissioned environmental studies to establish the impacts of continuous ashing.

The EIA therefore pursued the option of approaching the environmental authorities to obtain permission to ash over the wetland. In August 2015, Eskom received authorisation to ash over the wetland by extending the current facility. This was further confirmed when Eskom received their amended Water Use Licence in February 2016, allowing the ash facility to proceed southwards as well as the authorisation exemption to ash without a liner until June 2020.

## **1.2 Employer's Objectives and Purpose of the works**

Due to the fact that the life of the power station was extended from 40 to 60 years plus a 5 year contingency, the current Ash Disposal Facility design does not have sufficient ashing capacity. The objective of this project is to extend the volume capacity of the ash facility while meeting all environmental requirements.

The Employer has gone through the process of licensing the extension of the ash facility in terms of environmental authorisation (waste licence) and usage and storage of water (water use licence). The requirements of the authorisations are that the ash facility, as well as the associated Pollution Control Dams (PCDs), needs to be lined according to the current regulations.

The structure of the design of the Majuba ADF Extension is split into the following two phases:

- Phase 1: Initial works, exemption area works, and initial lined area and associated infrastructure.
- Phase 2: Four (4) year liner packages to the end of the 65 year life of the ADF.

The initial works, exemption area works and initial lined area works of Phase 1 were subdivided into design and construction packages. The purpose of this subdivision was in order to compartmentalise the various works into smaller packages with the potential for construction to be handled independently of one another. These consisted of the following three packages:

Package 1: Initial Works and Exemption Area works

Package 2: Initial Lined Area (Area 2A) and associated Pollution Control Dams

### Package 3: Lining of Area 2B

The above works is not part of this contract and was executed by others.

### **1.3 Scope of the works**

This scope of work detailed in this Works Information is for Phase 1, Package 2 – Ash Dam 1 & Rehab Dam 1.

The scope of work includes:

#### **1.3.1 Civil: Construction of Ash Dam 1 & Rehab Dam 1**

##### **Package 2**

- Excavation, lining and construction of Ash Dams 1 and associated infrastructure including spillways and valve chambers.
- Construction and lining of the new Rehabilitation Dams 1 and associated infrastructure including spillways.
- Stripping of topsoil.
- Construction of liner terrace including cut to fill of the basin and construction of embankments.
- Installation of subsoil herringbone drainage network which will drain to an external manhole.
- Construction of the liner system.
- Construction of inlet structures.
- Construction of temporary Cofferdam within the footprint of Ash Dam 1.

#### **Pollution Control Dams**

The liner system in the pollution control and rehabilitation dams includes the following layers from excavation level upwards:

Substrate preparation layer: The substrate will be ripped and re-compacted to 95% MOD AASHTO with a moisture content of -2 to +2% of optimum moisture content.

Subsoil Drainage Layer: A drainage layer is installed below the barrier system to relieve pressure that may be caused by shallow ground water. It also collects any leakage that may penetrate the barrier system.

Primary impermeable layer: 2 x 150 mm layers of clay compacted to 98% Standard Proctor with a moisture content of +1 to +3% of optimum moisture content in order to have a permeability coefficient (k) of less than  $1 \times 10^{-6}$  cm/s.

Primary geomembrane layer: 1.5 mm HDPE double textured geomembrane layer.

A liner protection layer.

Additional information is provided in Section 3.

## 1.4 Interpretation and Terminology

### 1.4.1 List of Definitions

Terms and/or abbreviations used in this Works Information are defined as follows:

**Table 1: Definitions**

<i>Employer</i>	The person named as the <i>Employer</i> in the Appendix to Tender and the legal successors in title to this person.
<i>Contractor</i>	The person(s) named as <i>Contractor</i> in the Letter of Tender accepted by the <i>Employer</i> and the legal successors in title to this person(s).
<i>Project Manager</i>	The person appointed by the <i>Employer</i> to act as the <i>Project Manager</i> for the purposes of the Contract and named in the Appendix to Tender, or other person appointed from time to time by the <i>Employer</i> and notified to the <i>Contractor</i> as per NEC procedures.
NEC	New Engineering Contract.
Drives	Drives are all mechanical or electrical prime movers, e.g. actuators, pumps, etc.
Major plant	Machinery e.g. Conveyors, Feeders, etc.
Works Information	The document/s forming part of the contract in which are described the methods of executing the various items of work to be done, and the nature and quality of the materials to be supplied and includes technical schedules and drawings attached thereto as well as all samples and patterns.
Competent Person	A person who is qualified by virtue of his education, training, experience and contextual knowledge to make a determination regarding the performance of a building or part thereof in relation to a functional regulation or to undertake such duties as may be assigned to him in terms of these regulations.
Fire Protection System	Any fire alarm device or system or fire-extinguishing device or system, or combination thereof, that is designed and installed for detecting, controlling, or extinguishing a fire or otherwise alerting

	occupants, or the fire department, or both, that a fire has occurred.
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#### 1.4.2 List of Abbreviations

**Table 2: Abbreviation**

Abbreviation	Meaning given to the abbreviation
ADF	Ash Disposal Facility
AP	Appointed Person
AD	Ash Dam
B-BBEE	Broad Based Black Economic Empowerment
BMH	Bulk Materials Handling
BPLwD	Black People Living with Disability
BWO	Black Woman Owned
BYO	Black Youth Owned
C&I	Control and Instrumentation
CA	Contract Award
CD	Compact Disk
CoE	Centre of Excellence
CPA	Cost Price Adjustment
CPM	Critical Path Method
CQP	Contract Quality Plan
CR	Construction Regulations
CSI	Coporate Social Investment
CV	Curriculum Vitae
DB	Distribution Board
DC	Direct Current
DCS	Distributed Control System
DE	Drive End
DIR	Department of Internal Revenue
DOL	Department of Labour
ECSA	Engineering Council of South Africa
EIA	Environmental Impact Assessment

<b>Abbreviation</b>	<b>Meaning given to the abbreviation</b>
FAT	Factory Acceptance Test
FMEA	Failure Mode and Effect Analysis
FRI	Forecast Rate of Invoice
FSS	Finance Shared Services
Gx	Generation
HAZOP	Hazard and Operability
HDPE	High Density Polyethylene
HECU	Head End Control Unit
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
ITP	Inspection and Test Plan
KKS	Kraftwerk Kennzeichen System (Numbering System used at Majuba) Power Station
kPa	kilopascal
LAR	Limited Access Register
LOSS	Limits Of Supply and Services
LPS	Low Pressure Services
LV	Low Voltage
MDL	Master Document List
MS	Mild Steel
MV	Medium Voltage
NCR	Non Conformance Report
NEC	New Engineering Contract
NEMA	National Environmental Management Act
NFPA	National Fire Protection Association
OD	Outside Diameter
OEM	Original Equipment Manufacturer
OHSA	Occupational Health and Safety Act
OPCR	Outside Plant Control Room
OR	Operation Regulation
P&ID	Piping and Instrumentation Diagram

<b>Abbreviation</b>	<b>Meaning given to the abbreviation</b>
PFD	Process Flow Diagram
PPE	Personal Protective Equipment
PS	Power Station
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
QM	Quality Management
QM	Quality Management
QMS	Quality Management System
RBO	Reliability Based Optimisation
RD	Rehabilitation Dam
SABS	South African bureau standards
SANS	South African National Standards
SAT	Site Acceptance Test
SBE	Small Black Enterprises
SD&L	Supplier Development and Localisation
SHE	Safety, Health and Environment
SIT	Site Integration Test
SOC	State Owned Company
TH	Transfer House
TP	Terminal Point
tph	Metric Tonnes per hour
UHMWPE	Ultra High Molecular Weight Polyethylene
VAT	Value Added Tax
VDSS	Vendor Document Submittal Schedule
VSD	Variable Speed Drive
VT	Voltage Transformer
WBS	Work Breakdown Structure

## 2. Management and Start Up

### 2.1 Management Meetings

Meetings will be held monthly between the *Project Manager* and the *Contractor* (and any other co-opted members). The *Contractor* is represented at each meeting by the appropriate members of the staff.

The venue for these meetings is as determined by the *Project Manager*. The *Project Manager* writes the minutes of meetings.

Any action of the *Project Manager*, *Supervisor*, *Contractor* and *Adjudicator* implied in the minutes of meetings with contractual implications is confirmed by a separate communication given in accordance with this Works Information and NEC

The *Contractor* reports the overall progress and as a minimum requirement, the following is addressed:

- a) *Contractor's* current activity progress and planned finish dates;
- b) *Contractor's* to report on all items listed in the NEC core clause, 31.
- c) *Contractor's* and *Project Manager's* programme agenda compared for delays and milestone targets
- d) Current and projected manpower by class;
- e) Health, safety and quality Management;
- f) The progress of any other relevant activities;
- g) To discuss any technical or commercial issues;
- h) Skills Development and Localisation
- i) CSI and Infrastructure Project Implementation Plan
- j) Procurement progress
- k) Problem areas or concerns.

Regular meetings of a general nature may be convened and chaired by the *Project Manager* as follows:

**Table 3: Meetings Schedule**

Title and purpose	Approximate time & interval	Location	Attendance by:
Risk reduction meeting	as and when required	Venue determined by the <i>Project Manager</i>	Relevant appointed members of a Risk or

<b>Title and purpose</b>	<b>Approximate time &amp; interval</b>	<b>Location</b>	<b>Attendance by:</b>
			and Compensation event committee
Overall contract progress, technical and feedback (from contract date to execution commencement)	Weekly	Venue determined by the <i>Project Manager</i>	<i>Employer, Contractor, Supervisor, and Others as determined by the Project Manager</i>
Planning Meetings (including integration meetings with Others)	Weekly	Venue determined by the <i>Project Manager</i>	<i>Employer, Contractor, Supervisor, Planners and Others as determined by the Project Manager</i>
Safety Meetings	Weekly	Venue determined by the <i>Project Manager</i>	<i>Employer, Contractor, Supervisor, Safety Officers and Others as determined by the Project Manager</i>
Payment Assessment Meeting	Monthly – 20 <sup>th</sup> of every month	Venue determined by the <i>Project Manager</i>	<i>Employer, Contractor, Supervisor, Quantity Supervisors and Others as determined by the Project Manager</i>
Quality and Engineering Meeting	Monthly or as determined by Project Manager	Venue determined by the <i>Project Manager</i>	<i>Employer, Contractor, Supervisor Safety Officers and Others as determined by the Project Manager</i>

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*. Such meetings should not prejudice the Employer in terms of cost, quality

and schedule. Records of these meetings shall be submitted to the *Project Manager* by the person convening the meeting within five days of the meeting. People attending meetings must have authority to make decisions and execute the decision.

## **2.2 Documentation Control**

### **2.2.1 Documentation Management**

#### **2.2.1.1 Document identification**

The documentation requirements cover the various engineering stages, from the design stage through fabrication, installation, testing and commissioning and most importantly for the operating, maintenance and training stage of the project.

The Contractor is responsible for the compilation and the supply of the documentation during the various project stages and to provide the documentation programme to link with the milestone dates. Documentation and drawings are programmed for delivery to meet the milestone dates and in accordance with the agreed VDSS supplied *Employer*.

#### **2.2.1.2 Documents Submission**

All documents and records must be submitted according to Technical Document and Record Management Work Instruction (240-76992014) and Gx Projects Documentation Deliverable Requirements Specification (240-65459834) and the *Employer* ensures that the *Contractor* is provided with latest revisions of all these documents. In order to portray a consistent image it is important that all documents used within the project follow the same standards of layout, style and formatting as described in the documents above. The *Contractor* is required to submit documents as electronic in .pdf format in a CD and hard copies and must be delivered to the *Project Manager* with a transmittal note.

The *Contractor* submits the Master Document List to the *Employer* on a monthly basis for tracking purposes irrespective of whether there are updates or not. The MDL includes list of drawings and documents and contains the following minimum information for each document:

- Date of submission
- Transmittal number
- Transmittal title
- Document description
- Document number

- Document Type
- Revision number
- Document Approval Status
- Document Authorisation Status (i.e. Accepted With Comments, Not Accepted with Comments, Accepted)

### **2.2.1.3 Documentation Review and Turn-around**

The *Employer* has a minimum 14 calendar days to review and consolidate review comments for documentation submitted by the *Contractor*. This is specifically dealing with the *Contractor's* designs and any other proposals made by the *Contractor*.

### **2.2.2 Drawings Format and Layout**

The creation, issuing and control of all Engineering Drawings will be in accordance to the latest revision of 36-943 (Engineering Drawing Office and Engineering Documentation Standard) and 36-945 and 36-946 (associated Work Instructions) to be supplied as part of the enquiry documents. Drawings issued to the *Employer* will be a minimum of one hardcopy and an electronic copy. All *Contractors* are required to submit electronic drawings in Micro Station (DGN) format, and scanned drawings in pdf format. No drawings in TIFF, AUTOCAD or any other electronic format will be accepted. Drawings issued to Eskom may not be "Right Protected" or encrypted. (240-86973501) The Employer reserves the right to use these drawings to meets it other contractual obligations.

### **2.2.3 Plant Identification**

#### **2.2.3.1 Plant Coding Allocation**

Coding of the design will be based on the KKS coding system and the *Employer* will undertake the coding in line with its standards. The KKS coding shall be applied during the design review stage(s) and cross referenced to all arrangement drawings, schematics, wiring diagrams, instructions and manuals and where practical to spare parts list/manuals. The *Contractor* will be required to include allocated coding to the electronic design drawings. Coding standard we want them to apply?

#### **2.2.3.1 Plant Labelling**

The *Contractor* will also manufacture and install KKS labels to identified plant items as per list supplied by the *Employer*. Labels will be manufactured and installed according to the *Employer's* KKS Plant Labelling and Equipment Descriptions Standard. The labeling standard will be supplied as part of the enquiry documents. Mention no. of standard.

## **2.2.4 Configuration change control**

Any changes to the design baselines will be formally managed according to the Eskom Project Engineering Change Procedure (240-53114026). All design reviews will be conducted according to the Design Review Procedure (240-53113685).

## **2.3 Health and Safety Risk Management**

### **2.3.1 General**

In carrying out its obligations to the *Employer* in terms of this contract, which obligations include, amongst others, providing the *works*; using Plant, Materials and Equipment; and whilst at the site for any reason, the *Contractor* is the “*Employer*” in terms of the Occupational Health and Safety Act, No. 85 of 1993, in respect of its activities and in relation to its employees, agents, Subcontractor/s and mandatories.

The *Contractor* does not consider itself under the supervision or management of the *Employer* with regard to compliance with the Safety Health and Environmental requirements.

Furthermore, the *Contractor* does not consider himself to be a subordinate or under the supervision of the *Project Manager* in respect of these matters. The *Contractor* is responsible for the supervision of its employees, agents, Subcontractors and mandatories and takes full responsibility and accountability for ensuring that they are competent, aware of the Safety Health and Environmental requirements, whilst executing the *works* in accordance with the Safety Health and Environmental requirements.

The *Contractor* ensures compliance with, amongst others:

- a) The provisions of the Occupational Health and Safety Act, No. 85 of 1993 and all applicable regulations (as amended), binding in terms thereof;
- b) The latest versions of standards, procedures, specifications, rules, systems of work and requirements of the *Employer*, copies of which will be provided to the *Contractor* on request. Refer to Section 6.
- c) The Health and Safety Plan prepared by the *Contractor* in accordance with the *Employer's* Safety Health and Environmental Specification – 240-143825536 and requirements.
- d) The provisions of the National Environmental Management Act (as amended) and all regulations in force from time to time in terms of that Act, including Environmental

Authorizations, Water Use Licences and Environmental Management Programmes for the construction of Majuba ADF Project.

(The documentation referred to in paragraphs 2.3.1 (a) (b) (c) and (d) are collectively referred to as the Safety Health and Environmental requirements and forms a part of the contract Works Information.)

The *Contractor* ensures that its employees, agents, Subcontractors and mandatories comply with the provisions of the Occupational Health and Safety Act, No. 85 of 1993, and all applicable regulations binding in terms thereof as well as the *Employer's* Safety Health and Environmental Specification whilst making use of plant, materials and equipment and whilst at the Site for any reason whatsoever.

The *Contractor* implements a comprehensive health and safety management system, based on the ISO 45001:2018 requirements for utilisation at the project.

The *Contractor* appoints a person, qualified and competent in accordance with the safety health and environmental requirements, as the liaison with the *Employer's* Project Safety, Health and Environment Manager/Officer or delegated person for all such matters as pertaining related to safety, health and the environment. The *Contractor* shall ensure that such a person is contactable 24 hours a day, and is registered with a registered professional council approved by the Principal Director of the Department of Labour, as per the requirements of the latest Construction Regulations, inclusive of all exemptions and amendments pertaining thereto.

The *Contractor* hereby indemnifies the *Employer* and holds the *Employer* harmless in respect of any and all loss, costs, claims, demands, liabilities, damage, penalties or expenses that may be made against the *Employer* and/or suffered or incurred by the *Employer* (as the case may be) as a result of, any failure of the *Contractor*, its employees, agents, Subcontractors and mandatories to comply with their obligations, and/or the failure of the *Employer* to procure the compliance by the *Contractor*, its employees, agents, Subcontractors and/or mandatories with their responsibilities and/or obligations in terms of or arising from the Occupational Health and Safety Act, No. 85 of 1993.

### **2.3.2 Mandatory Agreements**

The *Contractor* confirms that:

- a. In terms of sections 37(1) and 37(2) of the OHSA, the *Employer* is relieved of any and all of its responsibilities and liabilities pertaining to the activities performed by the

*Contractor* (and its employees, agents, Subcontractors and mandatories) relating to the *works*; the use of plant, materials and equipment; and whilst at the Site for whatsoever reason.

- b. The *Contractor* confirms that, in terms of the Construction Regulations, regulation 6, it is hereby mandated as the designer and must perform all duties required of a designer. (This will be applicable only where the *Contractor* is required to do design work as part of their Scope).

The *Contractor* confirms that he has been provided with sufficient information regarding the health and safety arrangements applicable to the *works*; the use of Plant, Materials and Equipment, as well as at the Site.

In addition, the *Contractor* shall ensure that:

- c. Prior to the *Contractor* commencing with any operations/ activities relating to the *works* and/or prior to gaining access to the Site, the *Contractor* concludes a written mandatory agreement with the *Employer* in terms of section 37(2) of the OHS Act and 5(1)(k) under the construction regulations. The aforementioned agreement constitutes a record of the written arrangements and procedures between the *Contractor* and *Employer* regarding health and safety.
- d. As far as is reasonably practicable, the safety and absence of risks to health in connection with the production, processing, use, handling, storage or transport of articles or substances is maintained;
- e. As far as is reasonably practicable, all hazards pertaining to the health and safety of persons and harm to the environment that are attached to any work which is performed, any article or substance which is produced, processed, used, handled, stored or transported and any plant or machinery which is used in its business, is clearly identified and, as far as is reasonably practicable, further establishes what precautionary measures should be taken with respect to such work, article, substance, plant or machinery in order to protect the health and safety of persons and or harm to the environment, and provides the necessary means to apply such precautionary measures;
- f. Such information, instructions, training and supervision as may be necessary to ensure, as far as is reasonably practicable, the health and safety at work of its employees, agents, Subcontractors and mandatories is provided;
- g. As far as is reasonably practicable, no employee, agent, Subcontractor and mandatory performs any work or produces, processes, uses, handles, stores or transports any article or substance or operates any plant or machinery, unless the precautionary

measures contemplated in paragraph 2.3.3, or any other precautionary measures which may be prescribed have been taken;

- h. Such measures as may be necessary in the interest of health and safety and the environment are enforced;
- i. Work is performed and that plant, materials or equipment is used under the direct supervision of a person trained to understand the hazards associated with it and who has the authority to ensure that precautionary measures required by the *Employer* are implemented; and

All employees are informed of the scope of their authority as contemplated in Occupational Health and Safety Act, No. 85 of 1993.

### **2.3.3 Health and Safety Obligations**

In addition to the mandatory agreements, the *Contractor*:

- a. Ensures that all statutory appointments (as required in terms of the Occupational Health and Safety Act, No. 85 of 1993 and all applicable regulations binding in terms thereof, as amended) and other appointments required in terms of the *Employer's* Safety Health and Environmental Specification – 240-143825536 and SHE Requirements Procedure (32–726) are in place and that all appointees are cognisant of their duties and responsibilities in terms of such appointments;
- b. Ensures that such appointees execute their duties and responsibilities as required by such an appointment.
- c. Ensures that all personnel brought by itself onto site (including employees of *Contractors* and Subcontractors) are suitably qualified and trained for the performance of the task, duties and functions, which will be allocated to them;
- d. Immediately reports any occupational or other injuries, near miss events, property damage, environmental related incidents as well as any potential threat to the health and safety of individuals at the *works* or on the site, as soon as he becomes aware thereof, to the *Project Manager*;
- e. Complies with the *Employer's* Environmental ,Occupational Health & Safety Incident Management Procedure - 32-95, relating to the reporting and investigation of incidents. The classification of incidents contained in such document are considered final and must be applied by the *Contractor* relating to any incidents/ injuries relating to its employees, agents, *Contractors*, Subcontractors and mandatories whilst on Site;
- f. Conducts a risk assessment regarding the utilisation of PPE and thereafter ensure that PPE of good quality is issued (at its own cost) to its employees, agents, *Contractors*, Subcontractors and mandatories prior to such individuals accessing the site, alternatively

performing activities related to the *works* at the site, as specified in the Eskom PPE Specification - 240-44175132.

#### **2.3.4 Radiographic Examinations**

If radiographic tests are carried out in the plant, the danger area must be evacuated with the exception only of authorised radiographic workers, and thereafter barricaded. Compliance is according to Regulatory, Eskom's Safety Health and Environmental Specification – 240-143825536 and Majuba Power Station, Site regulations number 16 for use, conveyance and storage of radioactive sources; document identifier – Site Regulations 16 No persons will be allowed gate access if the Majuba Power Station Procedure is not followed. The transportation of density tests should be fully complied with before access will be granted into Majuba Power Station.

In advance arrangements needs to be made with GCD, SHE Practitioner for the RPO of Majuba Power Station to be available for testing and authorizing entrance into Majuba Power Station.

The relevant warning signs should be visible on all the vehicles that is transporting radio-active source even density tests on and off site. The relevant warning signs at the lockout gates are bolt secured and not by wire or any other means, which could be removed while radiographic tests are in progress. The area is barricaded and access is restricted until the radiographic process is complete. The radiographic technicians ensure that all the lockout gates are opened on completion of the tests.

#### **2.3.5 Fire Protection**

The *Contractor* ensures that adequate firefighting apparatus is provided at all his work sites, and that his staff and sub-contractors are trained in the use of this apparatus.

Precautions are taken to prevent any occurrence of fires or explosions while carrying out any work near flammable gas and liquid systems.

Any tampering with the *Employer's* Fire Equipment is strictly forbidden. All exit doors, fire escape routes, walkways, stairways and stair landings are kept free of obstruction, and not be used for work or storage at any time. Firefighting equipment remains accessible at all times.

### **2.4 Environmental Constraints and Management**

The *Contractor* provides an Environmental Management Plan applicable to construction activities on site. The plan provides a guideline on the management of environment relating to the scope of works. All waste will be handled in an environmentally friendly manner. The *Contractor* conforms to the “polluter pays principle”, duty of care and other NEMA principles.

The *Contractor* conforms to all requirements dictated in the permits and licences for the construction of Majuba Ash facility project, Integrated Environmental Authorization, Integrated Water Use Licence and Environmental Management Programmes as well as other applicable Majuba ADF Environmental Management Procedures. The contractor also conforms to all applicable environmental legislation including but not limited to National Environmental Management Act (NEMA, Act No. 107 of 1998) and the National Environmental Management Waste Act (NEMWA, Act No. 59 of 2008).. This is achieved by undertaking inspections, audits, monitoring and reviews, conducted internally by the *Contractor* and externally by the *Project Manager*.

The *Contractor* ensures that all environmental authorization obligations, applicable legislative requirements and *Employer’s* specific requirements are fulfilled. This includes all national, provincial and local environmental legislation and requirements.

The *Contractor* appoints a person, qualified and competent in accordance with the Environmental management requirements, as the liaison with the *Employer’s* Project ‘s Environmental Manager/Officer or delegated person for all such matters as pertaining related to environmental management.

The *Contractor* issues on a weekly and monthly basis, Environmental Management Performance and Expenditure Reports to the *Project Manager*.

The *Contractor* conducts their environmental management based on the ISO 14001:2004 requirements and implement their environmental management practices accordingly.

The *Contractor* develops and implements as a minimum the following procedures:

- Environmental Management Plan,
- Incident management procedure
- Waste Management Procedure,
- Spill Management Procedure,
- Hazardous Chemical Substances Management and Storage Procedure,
- Stockpile and Erosion Management Procedure,

- Clear-and-Grub Procedure,
- Alien species management procedure
- Batch plant and concrete works management procedure
- Workshop and washbay
- Environmental Rehabilitation Procedure.

All environmental procedures, as listed above, shall be site-specific and shall align with Employer's procedures, licences and Management plans and shall be submitted to the *Employer* for acceptance by the *Project Manager* before the commencement of construction activities.

The *Employer* will provide a copy of the environmental authorisations, Water use licence and Environmental Management Plan to the contractor.

#### **2.4.1 Waste Management**

All waste management activities, which includes procurement of control measures, handling and disposal or processing of all waste forms generated on the *Contractor's* site, are conducted according to Majuba ADF Waste Management procedure, and all requirements of the Employer as per the Environmental Management Programme licences and permits for Majuba ADF. All costs associated with waste management are the responsibility of the *Contractor*.

All hazardous chemicals will be stored in a sealed and covered skip placed on an impermeable concrete slab.

#### **2.4.2 Spill and Incident Management**

The *Contractor*, at his cost, has available spill control measures (spill kits, drip trays, etc.), to the satisfaction of the *Employer*. All hazardous wastes generated from a spill are disposed of at a licensed disposal facility, at the cost of the *Contractor*, and safety disposal certificates are kept for record purposes. The contractor shall ensure that all hazardous waste are stored in a sealed and covered skip placed on an impermeable concrete slab.

#### **2.4.3 Dust and Storm-water Management**

The *Contractor* implements dust control measures for the project. The *Contractor* ensures that no ponding of storm water occurs on the site and shall establish good storm-water management in accordance with the *Employer's* requirements as per Environmental Management Programme and storm water management plan for Majuba ADF project.

#### **2.4.4 Environmental Rehabilitation**

The *Contractor* rehabilitates its disturbed areas at the end of the project. The rehabilitation is done in accordance with recommendations made in the Environmental Management Programmes for Majuba ADF, as provided by the *Employer*. The *Contractor* submits to the *Project Manager* a rehabilitation plan and schedule at least 2 weeks before finalisation of the *works* for approval by the *Project Manager*. All rehabilitation costs are the responsibility of the *Contractor*. The contractor monitors rehabilitation works and ensures that rehabilitation is successful.

#### **2.4.5 Alien Vegetation Control**

The Contractor controls alien invasive plants and noxious weeds. The contractor shall compile and submit to the *Employer* Alien vegetation management procedure for acceptance, the procedure shall align with Majuba ADF Alien vegetation management procedure and shall take into consideration conditions of the project permits and licences all control of alien plants and noxious weeds costs are the responsibility of the Contractor.

### **2.5 Quality Assurance Requirements**

#### **2.5.1 General**

The *Contractor* complies with the *Employer's* Quality Requirements Standards.

- a) The *Contractor* and all Subcontractors comply with the *Employer's* quality requirements including those listed in the *Employers* specification document, ( 240-105658000)
- b) Certified to ISO 9001 is a mandatory requirement for this contract. The *Contractor* uses the QMS for all phases of the Project. The *Contractor* provides evidence of a fully implemented QMS within its own organisation. The *Employer* may, at his sole discretion, carry out an audit on the *Contractor* or Subcontractor's QMS for acceptance.

#### **2.5.2 Quality Management Documents Requirements**

The *Contractor* conforms to the quality management requirements as per ISO 9001 and the *Employer's* Supplier Contract Quality Requirements Specification (240-105658000). The *Contractor* shall adhere to the following:

During the Pre-Contract Award: Quality Requirements Categories (1, 2,3 and 4)

Eskom supplier quality requirements for all existing and potential suppliers and sub-suppliers are classified into four Categories. The following is the minimum documentation for Category 1 to 4:

### **CATEGORY 1.**

- The supplier shall complete and sign Form A (Enquiry/Contract/Quality Requirements for Supplier Quality Management Specification 240-105658000/ QM 58 and ISO 9001).
  - The supplier shall submit a valid copy of ISO 9001 or any applicable certificate of a QMS (the latest applicable revision). The QMS should drive the supplier's business management processes to ensure that all of Eskom's requirements are fully met on a consistent basis.
  - The supplier shall submit the latest copy of the management system internal and external audit reports. The audit reports must include, if applicable, nonconformity identified, and the resulting remedial actions (correction and/ or corrective action reports).
  - The supplier shall submit a draft contract quality plan that is specific to the scope of work as described in the tender documents. The plan must address the minimum requirements as per ISO 10005.
  - Where applicable; the supplier shall submit a draft, or an example of an inspection and test plan (ITP) or quality control plan (QCP) on similar and/ or previous work done.
  - The supplier shall submit documented information for Control of Externally Provided Processes, Products and Services.
  - The supplier shall submit a copy of documented information for roles, responsibilities and authorities in relation to the QMS. Examples of relevant documented information are; organization charts, job descriptions, work instructions, duty statements, manuals, procedures.
  - The supplier shall submit documented information retained (records) of management review meetings that include agenda, meeting minutes, attendance registers, reports, presentations, etc.
- Note: specific requirements per tender will be selected using the List of Tender Returnable documents (240-12248652).

### **2.5.3 The Contract Quality Plan (CQP)**

The *Contractor* submits to the *Project Manager* within 30 days of Contract Date for review and acceptance prior to the commencement of work, a CQP which will detail the *Contractor's* organisation, quality assurance and quality control procedures within that organisation specific to this project. The CQP must be aligned to, and reference ISO 10005:2005 QMS, guidelines for quality plans and in compliance with the guideline in QM 240-105658000.

The CQP will make reference to the *Contractor's* QMS documents to be used in this Contract:

- a) The *Contractor's* QMS compliance with the requirements of ISO 9001
- b) *Contractor's* quality manual
- c) *Contractor's* quality procedures
- d) *Contractor's* quality forms and work instructions
- e) *Contractor's* quality system documents referenced in this Works Information
- f) *Employers* Works Information, drawings, specifications, standards and codes, etc.

#### **2.5.4 Quality Control Plan or Inspection and Test Plan**

As defined in the approved CQP the *Contractor* drafts and submits to the *Project Manager* for acceptance, prior to the commencement of any works, the requisite Inspection and Test Plan (ITP) or Quality Control Plan (QCP). The ITP/QCP shows each activity from the Works Information. The *Project Manager* inserts intervention points based on the risk profile of the equipment.

- a) The interventions points include all witness, hold, verification, surveillances and review points required by the *Project Manager*. The *Contractor's* failure to allow the intervention points will constitute a non-conformance.
- b) The intervention requirements take into consideration the criticality of the Plant and Materials.
- c) Where intervention points have been bypassed without prior written waiver from the *Project Manager*, result in the repeat performance of the activity in question and a Non-conformance (NC) is issued.

#### **2.5.5 Operational Documents**

The *Contractor* submits as a minimum the following documents, as required by the *Project Manager* during the execution of the *works*:

- a) Updated QCP register
- b) Inspection notifications accompanied by their inspection report
- c) Non-conformance and Defects registers and reports
- d) Updated Site and off site inspection schedules.
- e) Inspection and or FAT / SAT dates.
- f) Inspections, completed and outstanding.
- g) Inspection and test reports

- h) Weekly and monthly contract quality progress report
- i) Data books for the completed *works*, before commissioning can commence (refer to the data book specification)

### **2.5.6 Inspections and Tests**

All Plant and Materials is comprehensively tested in accordance with the agreed ITP/ QCPs prior to delivery. The *Employer* reserves the right to appoint others to inspect all parts during manufacturing, erection and commissioning to be present at any of the tests specified. The witnessing of tests by the *Supervisor* or Others, and if the *Supervisor* chooses to waive the witnessing of any tests, it does not relieve the *Contractor* of his responsibilities.

Tests that are required by the *Employer* are carried out by the *Contractor* during manufacturing, erection and commissioning to prove compliance with the specification independently of any test that may have been carried out at the *Contractor's* premises.

The *Supervisor* inspects parts of the Plant at his discretion during manufacturing stages and before shipment as per the agreed ITP/QCP;

- a) The *Contractor* is responsible for the inspection of all the work that is performed and the *Supervisor* only verifies that the work is conducted as per the Works Information.
- b) The *Contractor* conducts all inspections in accordance with the accepted ITP/QCP.
- c) The *Contractor* provides suitably qualified personnel to conduct on-and-offsite inspections
- d) The *Contractor* ensures that all are inspected and approved before the *Supervisor* is invited for verification.
- e) The *Contractor* provides a minimum of five (5) working days' notice for local off-site inspections, 24 hours for local on-site inspection, and 21 working days' notice for foreign inspections. The notice contains copies of the *Contractor's* inspection reports.

### **2.5.7 Quality Responsibility**

The *Contractor* responsibilities include but are not limited to the following:

- a) The *Contractor* is accountable for the quality of the output and liable for any failures.
- b) Implementation of their QMS on site
- c) Administration of their QA/QC systems on site

- d) Verification of approval status of Subcontractor's Quality programmes, that is, CQP's, QCPs, NC's, Defects and all their operational procedures and works instructions
- e) On-and-offsite inspections
- f) Weekly and monthly progress reporting on quality performance
- g) The *Contractor* is responsible for defining the level of intervention of QA/QC or inspections in line with the *Employers* requirements.
- h) The *Contractor* is responsible for defining the level of intervention of QA/QC or inspections to be imposed on his Subcontractor, suppliers and sub-suppliers and must ensure that these are in line with the *Employer's* requirements.

The *Supervisor* will be responsible for the following:

- a) Reviews of the quality submissions
- b) Verification of the *Contractor's* intervention points
- c) Reviews the *Contractor's* ITP/QCP documents (procedures, test results)
- d) Reviews the data book
- e) Issue of Defects Certificate
- f) Checks and marks off materials off site

### **2.5.8 Non Conformances and Defects**

Where Non-Conformance (NC) notifications are issued, the *Contractor* acknowledges receipt within the period of reply and proposes corrective and preventive actions to the *Supervisor*. The corrective and preventive actions will include the implementation and completion dates. Progress on all NCs notifications issued to the *Contractor* must be reported to the *Supervisor* on weekly basis.

- a) The *Contractor's* Quality Manager keeps a register of all NC notifications issued
- b) Records of NCs notifications are kept and form part of the data book records.
- c) Deviations from the Contract are treated as a non-conformance.

To ensure reduction of non-conformances, the *Employer* will implement a penalty to the value of R20 000.00 for every NCR issued during the contract period and not closed within 14 working days.

During the contract execution phase, the *Contractor* will be monitored by the *Supervisor* for performance on quality related aspects. The monitoring will be in the form of audits and assessments.

### **2.5.9 Quality Reporting**

The *Contractor* submits a monthly quality report, on the last working day of the month. The report includes but not limited to the following:

- a) A register of NCRs and defects
- b) Updated QCP / ITP register
- c) QA monthly report summary
- d) Planned and completed local and foreign inspection dates
- e) Completed and outstanding Inspections
- f) Audit findings report
- g) Risks with Mitigation plan

### **2.5.10 Preservation, shipping and transportation**

The *Contractor* ensures that all Plant and Materials are preserved in an appropriate manner as described in the product specifications or in the *Employer* preservation, shipping and transportation procedures as applicable. The *Contractor* submits the preservation, shipping and transportation procedures to the *Supervisor* for review and acceptance. The *Supervisor* may choose to witness the packaging, loading and offloading of the products depending on the equipment criticality, this will be indicated in the intervention points on the ITP/QCP.

The *Contractor* also ensures that all storage requirements for Plant and Materials are properly implemented to preserve the products against adverse conditions, deterioration, damages, etc. Storage and preservation procedures for the different equipment must be submitted to the *Project Manager* for review and acceptance. The *Project Manager* may request to inspect the stored Plant and Materials at any given point during the storage period of the product.

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

Plant and Materials for this contract is not shipped by the *Contractor* until all the documents stated in the Particular Specification have been submitted to the *Supervisor*.

The *Contractor* shall be responsible for the preparation, maintenance during the execution of the *works* and submission of Data Packs to the *Supervisor* for acceptance at least thirty (30) days before

the Completion Certificate is issued. The Data Packs shall be in accordance with the Data Packs Specification as contained in the Annexures Part C3.2.7

## **2.6 Programming Constraints**

### **2.6.1 General**

The *Contractor* submits a single integrated Level 3 programme that incorporates all the work to be performed including that of his Subcontractors. The interfaces between Subcontractors as well as the interfaces between Subcontractors and the *Contractor* are clearly identified. Project key dates are incorporated into the programme.

Project Key Milestones (Refer to C1.2 Contract Data Part 1 of Engineering and Construction Contract) as supplied by the Project Manager, are incorporated into the programme as per the NEC Core Clause 31.2.

#### **Details of the Employer and Others Who Will Be Occupying the Working Areas at the Same Time**

Other Contractors are working in the same area as the work of this contract. In this regard, the Contractor co-ordinates his work with the Project Manager to maintain harmonious working conditions on Site. During the progress of the works the Contractor provides access to Others who also execute work in the same area, on an as and when required basis.

The Contractor makes his own assessment of the problems and difficulties which may be encountered for providing access to and interfacing with Others (this includes access difficulties experienced during construction or commissioning phase).

No extra payment or claim of any kind on account of providing reasonable access is allowed.

### **2.6.2 Computerised Planning and Reporting**

The Project Manager does not intend duplicating the Contractor's programming and planning, however, portions or high level extractions of the Accepted Programme may be used in the Employer's internal master project programme for control purposes. The Contractor submits updated computer files on a monthly basis, or at any other time as required by the Contractor or as instructed by the Project Manager.

The updated computer file shows the logic and all filters and layouts used in the programme. The accepted programme will be in Primavera XER file (latest version) or MS Project has been adopted by the Employer for all planning, progress monitoring and reporting.

The Project Manager requires one project programme to be used and updated during the installation process, which will remain with Eskom. This ensures that any changes, deviations to the Programme can be carried out on the agreed programme and monitored. The initial programme supplied to Eskom after Contract award must be fully resource loaded.

Any changes that are required to be made to the Project/ Programme i.e. scope changes, delays and the, will be recorded through the Eskom change process and documentation, where all parties agree to the changes and sign.

The Contractor and Project Manager shall agree on the format of how the updates will be done i.e. PDF, XER, and the frequency of the updates i.e. such as on a weekly basis, or at any other time as required by the Contractor, or as instructed by the Project Manager.

The Contractor obtains this software and applies it for the planning and control of the works in line with the accepted Work Breakdown Structure which will be agreed upon contract award.

### **2.6.3 Planning and Scheduling Levels**

All planning and scheduling is done based on the Critical Path Method (CPM). The *Contractor* uses activity codes to define interfaces to be agreed upon between project manager and contractor. The *Contractor's* programme shows the actual critical path clearly.

The preparation of the programme contains a programme basis document (Basis of Schedule). This basis document describes the programme and planning methodology, format, project execution philosophy, resource assumptions, qualifications and any other items that may have a substantive impact on the schedule.

The schedule layout takes into account the approved WBS, reflecting the manner the *works* are to be performed as per the *Contractor's* Method Statement and how activities are to be summarised, reported and monitored.

The minimum requirements of the WBS for Majuba Power Station Continuous Ash Disposal Facility Project – Phase 1 Package 2 – Ash Dam1 & Rehab Dam1 are as per the Works Information.

The following levels of programmes are to be used for this project for integrated project control:

- (a) Management programme (Level 1)
- b) Project programme (Level 2)
- c) Control programme (Level 3 – Sub-system level)
- d) Discipline specialty programme (Level 4)

### **2.6.3.1 Management Programme (Level 1) – Project Master Programme**

The management programme Level 1 is the project master programme and is used to show the overall time frames for the *works*. It is a statement of project objectives recorded in graphic form. The management level programme defines:

- Established goals or major milestones key dates,
- The duration of major operations and their relationship to one another,
- Identified Long Lead material items,
- Responsibility assignments for accomplishing project objectives.

### **2.6.3.2 Project Programme (Level 2)**

A "rolled up" programme from the control level 3 programme is produced. It will be separated by unit, plant area and by phase (engineering, procurement, construction and commissioning).

### **2.6.3.3 Control Programme (Level 3 – Sub-system level)**

The project programme is prepared representing the significant work activities and deliverables associated with the *works*. The end product is a time scaled bar-chart schedule developed through use of a logic network. This programme is separated by Unit, by plant area, by Phase, by WBS.

The programme includes:

- a) Major milestones, interface dates, access dates and key dates (for the new plant, existing plant and between Subcontractors)
- b) The duration of major activities and their relationship to one another.
- c) Identified long-lead material items.

d) Responsibility assignments for accomplishing project objectives end product is a time scaled bar-chart programme developed using logic network.

This programme is separated by unit, by plant area, by phase, by WBS. The work within each plant area is broken down by engineering discipline, procurement, delivery, construction by the *Contractor*, start-up and commissioning. The programme is resource-loaded and it forms the basis for progress measurement, progress curves and histograms for each discipline within a plant area. This is used for Evaluations and for the accepted programme after contract award. This will be saved and used as the original.

The *Contractor* submits a Level 3 Programme to the *Project Manager* which breaks the Works Information down to a sub-system level as per the Activity Schedules. This programme is in alignment with the *Contractor's* Method Statement. The *Contractor's* Forecasted Rate of Invoicing (FRI) should also align with the resource loading on the programme.

#### **2.6.3.3 Discipline Programme (Level 4)**

The need for supplemental or discipline speciality programme is dependent upon the requirements and/or circumstances of the contract.

The discipline specialty programme is developed and maintained by the *Contractor* and generated for tracking and control of various activities and deliverables for all phases of the project. This programme is formatted as a spreadsheet or database report utilizing the WBS breakdown. This programme represents the day-to-day activities which are work-unit based and are summarized in the level 3 activities.

Resource information for manpower, plant, material and equipment and reflected in resource histograms is provided by the *Contractor*. Staffing histograms are required to be submitted based on "equivalent personnel".

#### **2.6.4 Planning Programmes**

The *Contractor* develops a contract programme which will include a bar chart conforming to the project master programme dates included and sufficient detail to indicate the *Contractor's* intention for executing the *works*. This programme covers major items relating to design, procurement, manufacture, delivery, erection, start-up and commissioning. The critical path is clearly shown.

Key milestones, access dates, interface dates and commissioning key dates are clearly identified in the contract programme, including access dates and release of terminal points that involve the *Employer* or *Others*.

The programme makes provision for site related preparation such as site establishment, safety induction and medical clearance of the entire *Contractor's* staff that will be working on site.

### **Submission of Revised Programmes and Progress Reporting**

The Contractor submits a PDF and one electronic copy in Primavera or MS Projects as well as a two weeks lookahead Dash board in excel, of each revised programme and progress report to the Project Manager for acceptance. All formally issued reports are to follow the progress reporting requirements as stated below;

- **Weekly Status Reports**

A weekly status report is submitted by the Contractor to the Project Manager. This report is less formal than the monthly report and is used as a tool for the day-to-day management of the project. Contents of a weekly report may include the following items:

- The updated Primavera programme
- Programme summary narrative
- Progress and performance summaries
- Schedule rolling horizon
- Sectional Completion and Key Milestone status

- **Monthly Progress Report**

The contents of the report may vary from month to month depending upon the phase of the project and/or the items of management focus. However, the basic framework of the report consists of the following:

- Executive summary (narrative identifying major movement within the reporting period).
- Revised Programme indicating, actual progress of work against last Accepted Programme.
- A one-month look ahead work window.

- Activities completed during current reporting period per discipline, including the activities of the Employer and Others.
- Activities in progress during current reporting period per discipline, including the activities of the Employer and Others.
- Activities undertaken during next reporting period per discipline, including the activities of the Employer and Others.
- Status overview by unit, by plant area, by phase.
- Key issues / Items of concern and corrective actions.
- Progress curves and tabular progress reports.
- Cost and Cash flow.
- Cost curve 'S-curve'.
- Early warning log.
- Compensation event log.
- General planning report (computer generated).
- Critical activities report.
- Key event report (computer generated).
- Report selecting all of the activities of the Employer and Others - (computer- generated).
- Updated bar charts.
- Updated resource schedule and histogram (If changed).
- Updated activity schedule (If changed and if applicable, Option A).
- Forecast rate of payment schedule updated with actual progress.
- Statement and report on works ahead and behind progress.
- The monthly progress reporting cycle is based on a month end "cut-off".

#### **2.6.4.1 Design Programme**

The design programme contains a full list of documents and drawings, their submission dates and duration for review as specified by the *Contractor* in the VDSS. The programme also illustrates the sequence of work for the project and the submission of drawings, studies and reports.

The design programme meets the requirements of the *Contractor* and Others engaged on the project. The *Contractor* is required to submit the programme for review by the *Project Manager*.

The programme should include all the design reviews to be conducted as per the *Employer's* Design Review Procedure. The *Contractor* is responsible for conducting the following design reviews:

- a) Detail Design Freeze Review

- b) Integrated Design Review
- c) Construction Completion Review
- d) Acceptance Testing Review

#### **2.6.4.2 Procurement and Manufacturing Programme**

The *Contractor* is required to submit a procurement and manufacturing programme for review by the *Project Manager* which identifies as a minimum:

- a) Details of orders and target dates for placing subcontracts
- b) Any detailed design required within the manufacturing period
- c) Long-lead delivery items
- d) Hold-points and witness-points for inspection and tests for acceptance and release.
- e) CSI roll out plan to be incorporated.

This programme is in sufficient detail to enable the work to be adequately tracked and progressed.

#### **2.6.4.3 Construction Programme**

The *Contractor* is required to submit a construction programme that is resource loaded for review by the *Project Manager*. This programme includes the following criteria:

- a) Full details of all civil/mechanical/electrical/C&I/Low Pressure Services terminal point release requirements
- b) Identify any erection or commissioning activities that may affect other construction activities
- c) Identify when services are required for commissioning purposes

This programme meets the requirements of the *Contractor* and Others engaged on the project.

The programme shall be based on the following working hours: Where applicable

- a) Twenty four (24) hours per day
- b) Seven (7) days per week
- c) Holidays included as working days
- d) Pay weekends to be negotiated (if working 7 day work week)
- e) The Contractor is to factor in the duration of the inclement weather provided by the Employer on Annexure A of the Contract Data when estimating the activity durations. For the determination of the

project calendar no conversion of working days to non-working days shall be allowed to represent time risk allowance for inclement weather.

**2.6.4.4 Commissioning Programme**

During the progress of the *works*, the *Contractor* develops a detailed commissioning programme with sufficient detail to enable the work to be adequately progressed and tracked to meet the commissioning key dates.

Training programme to be incorporated into the commissioning programme.

The commissioning programme is detailed to sub-system level and is fully integrated with the Construction Programme.

**2.6.4.5 Reporting and Data Requirements for Contractors Document number 240-83561037**

This specification is included as an Annexure to the Works Information. This specification lists all the data and reporting that must be submitted by the *Contractor* on a weekly / monthly basis to the *Project Manager*. The purpose of this information is to implement proper project controls on this project.

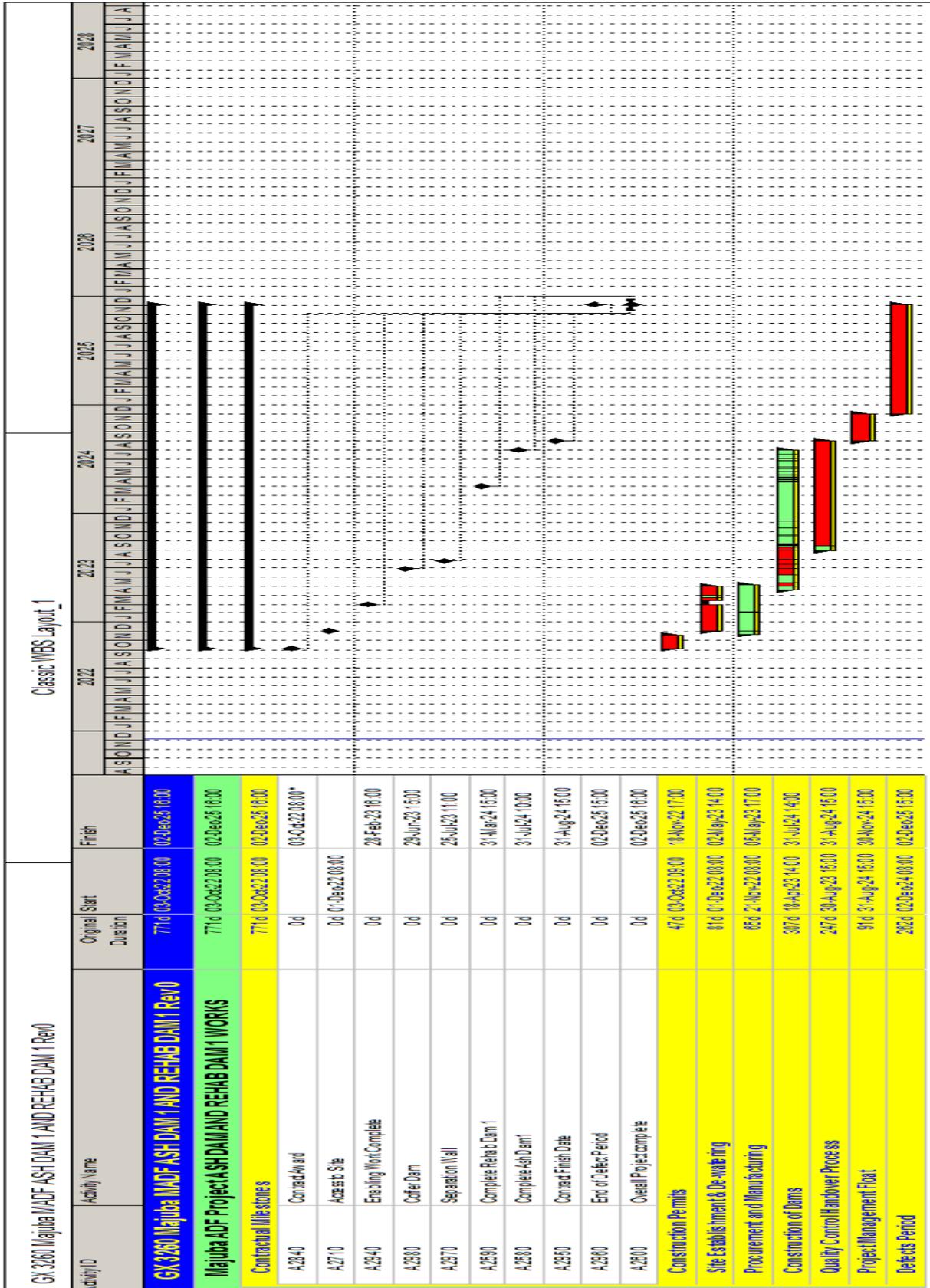
**2.6.4.6 Project Work Breakdown Structure**

Activity durations should not be longer than 10 days, activities longer than 10 days should be split into sub tasks.

<b>WORK BREAKDOWN STRUCTURE (WBS)</b>		
<b>1</b>	<b>PLANNING PROGRAMME</b>	
<b>2</b>	<b>CIVIL AND STRUCTURAL</b>	
		<i>Design Activities</i>
		<i>Procurement Activities</i>
		<i>Manufacturing Activities</i>
		<i>Delivery Activities</i>
		<i>Construction Activities</i>
		<i>Commissioning Activities</i>
<b>3</b>	<b>OTHER</b>	
<b>4</b>	<b>HAND-OVER</b>	

2.6.4.7 Sequencing of the Work

Refer to section 3.1 of the Works Information in conjunction with the below indicative programme.



## **2.7 Contractor's Management, Supervision and Key People**

The *Contractor* will provide the *Employer* and the *Project Manager* with an organogram showing the key people and the roles and responsibilities.

The organogram provided must show clear reporting lines between individuals, including individuals from subcontractors or joint ventures.

The *Contractor* provides the following key personnel as a minimum:

- a) Dedicated *Project Manager*
- b) Contracts Manager (NEC)
- c) Dedicated Project Planner
- d) Dedicated *Site Manager*
- e) Dedicated *Quality Manager*
- f) Dedicated *Site Safety Manager*
- g) Dedicated Environmental Manager

## **2.8 Invoicing and Payment**

There are no additional requirements to the invoicing and payment clauses in Section 5 of the core clauses.

At each *assessment interval*, the *Contractor* submits to the *Project Manager* a forecast rate of invoicing that includes all the expected payments by the *Employer* to the *Contractor* on a month-by-month basis.

The invoices from the *Contractor* contain the following information:

- a) The registered name of the *Contractor*
- b) The VAT registration number of the *Contractor*
- c) The address of the *Contractor*
- d) The *Employer's* contract number
- e) The VAT registration number of the *Employer*
- f) The amount paid to date
- g) The value of the invoice split into payments as per the *activity schedule* as indicated in the Price Lists.

- h) Any retention monies to be deducted from the invoice
- i) Any interest payable
- j) Escalation formula used where applicable
- k) Settlement discount
- l) Proof of ownership of materials supplied

The *Contractor* shall address the tax invoice to Eskom Holdings SOC Ltd and include on each invoice the following information:

All invoices in PDF format shall be emailed straight from your system to an Eskom email address (see email addresses below):

- Email addresses for invoice submission:
  - All invoices: **invoicessgrpcapitalOTH@eskom.co.za**
  - The *Project Manager* shall be copied when submitting invoices.
- All queries and follow up on invoice payments should be made by contacting the FSS Contact Centre:
  - Tel: 011 800 5060 or e-mail: [fss@eskom.co.za](mailto:fss@eskom.co.za)
- For Foreign invoices, the *Contractor* is required to physically deliver hard copies of original documents to the *Project Manager* even though the *Contractor* has e-mailed those invoices.
- The *Contractor* ensures compliance with the tax Requirement for submitting invoices electronically.
- If there is Cost Price Adjustment (CPA) on your invoice, the *Employer* recommends that the *Contractor* issue a separate invoice for CPA so that if there are any issues on the CPA the rest of the invoice can be paid while resolving CPA issues.
- The base invoice number needs to be mentioned on the CPA invoice.
- Electronic invoicing does not guarantee payment but ensures visibility of all invoices and ensures that no invoices get lost. If the Goods Receipt (GR) is not done the invoice will be parked and the system will automatically send an e-mail to the *Project Manager* to do the goods receipt. This is also tracked by the *Employer* through the parked invoice report.
- The *Contractor* can request a parked invoice report from the Finance Shared Services (FSS) Contact Centre which can then be followed up and corrected. You are welcome to forward the details of invoices corrected to the FSS Contact Centre.

## **2.9 Insurance Provided by the *Employer***

There are no additional requirements to the risk and insurance clause in Section 8 of the core clauses.

## **2.10 Contract Change Management**

There are no additional requirements to the compensation event clauses in Section 6 of the core clauses.

## **2.11 Provision of Bonds and Guarantees**

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

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.

## **2.12 Records of Defined Cost, Payments & Assessments of Compensation Events to be kept by the Contractor**

There are no additional requirements to the compensation event clauses in Section 6 of the core clauses.

### **2.12.1 Payments and Assessments**

The *Contractor* submits a detailed monthly schedule of his actual costs with all the necessary backup information at the monthly payment assessment meeting, for review by the *Project Manager*. The various schedule items as detailed in the Schedule of Cost Components, are submitted in a spreadsheet format, itemized in terms of People, Equipment, Plant and Materials, charges, and manufacture and fabrication. The schedule of items are grouped into work area activities as outlined in the Activity Schedule, with such work area activity groupings referenced against the Activity Schedule numbering.

Before each successive monthly payment assessment meeting, the *Contractor* submits to the *Supervisor* all current and or cumulative backup documentation for acceptance. Backup

documentation includes, but not limited to: all calculation sheets, citing each completed task or items corresponding to the Bill of Quantities, method of measurement, drawings, etc. The acceptance of completed work for payment purpose including confirmation of attainment of each criteria shall be as set out either in the specifications or any other document which this Works Information prescribes.

Following the monthly payment assessment meeting, the *Contractor* provides a detailed final schedule (with revisions as agreed to at the monthly measurement meeting incorporated), including the supporting documentation, to the *Supervisor* for final checking. Once accepted by the *Supervisor*, such final set is submitted to the *Project Manager* for the assessment of the amount due in terms of Clause 50 of the ECC.

The final format and layout of this monthly schedule as well as the level of detail of backup information required are to be agreed between the *Project Manager* and the *Contractor*. Clause 52 of the ECC applies in terms of accounts to be kept by the *Contractor* to verify the monthly schedule of actual costs.

## **2.13 Training Workshops and Technology Transfer**

The *Contractor* provides training on the Plant regarding operating, maintenance and engineering aspects. The *Contractor* provides training material and a separate training course for operating, maintenance and engineering personnel. For more detailed requirements on the training required refer to Section 5.2.8 of this Works Information.

## **3. Engineering and the Contractor's design**

### **3.1 Employer's Design**

A Detail design has been completed by the *Employer*. The Design is described in detail below and in the documents and drawings listed in Section 5 and 6.

#### **3.1.1 Civil**

The detailed design of the civil works was done by the *Employer*, via Jones & Wagener (Pty) Ltd & optimized by BEAL Africa (Pty) Ltd (Supervisors), covering the following items, objectives and technical deliverables as described below:

#### **Package 2**

- Excavation, lining and construction of Ash Dam 1 and associated infrastructure including spillways and valve chambers.
- Construction and lining of the new proposed Rehabilitation Dam 1 and associated infrastructure including spillways.
- Stripping of topsoil.
- Construction of liner terrace including cut to fill of the basin and construction of embankments.
- Installation of subsoil herringbone drainage network which will drain to an external manhole.
- Construction of the liner system.
- Construction of inlet structures.
- Construction of temporary Cofferdam within the footprint of Ash Dam 1.
- Construction of a canal along the extendable conveyor, which is made of geocell filled with a 30Mpa concrete.

### **Pollution Control Dams**

The liner system in the pollution control and rehabilitation dams includes the following layers from excavation level upwards:

- Substrate preparation layer: The substrate will be ripped and re-compacted to 95% MOD AASHTO with a moisture content of -2 to +2% of optimum moisture content.
- Subsoil Drainage Layer: A drainage layer is installed below the barrier system to relieve pressure that may be caused by shallow ground water. It also collects any leakage that may penetrate the barrier system.
- Primary impermeable layer: 2 x 150 mm layers of clay compacted to 98% Standard Proctor with a moisture content of +1 to +3% of optimum moisture content in order to have a permeability co-efficient (k) of less than  $1 \times 10^{-6}$  cm/s.
- Primary geomembrane layer: 1.5 mm HDPE double textured geomembrane layer.
- A liner protection layer, comprising of the Geogrid and geocell which includes stabilised ash as detail in the construction drawings.

The Contractor is required to dewater the existing Ash Dam 1 prior to commencement of construction activities of the dams. Once complete, the contractor is required to remove all ash silt or any other residue in the dam.

The 1.5mm HDPE double textured geomembrane layer, geogrid, the geocell and the geotextile material is available at Eskom UCG office area, situated approximately 20km away from the works. The Contractor is required to obtain the stated material from the Eskom UCG offices for construction of Ash Dam 1 and Rehab Dam1. The tendered rate shall be for installation of free

issued material shall include collection of the liner membrane, geogrid and geocell from the Employer's UCG office which situated approximately 20km from the Site.

### **Ash dam 1 and Rehab dam 1 and temporary storm water storage dam: construction sequence**

Once works on AD/RD 1 start all other Rehabilitation and Pollution Control dams will have been completed. All new pumping infrastructure will have been completed and will be in place.

The enabling pipe works of AD/RD 1 will have to be completed before the dam construction works on AD/RD 1 start.

All water pipelines feeding into AD1 from the station need to be changed and or rerouted as follows:

- Install temporary pump at HRS3 and lay temporary pipe line from HRS3 to AD2 to pump directly from HRS3 to AD2.
- Lay new temporary pipe form tee off with the new temporary pipe line between HRS3 and AD2, to tie into existing steel pipe between AD1 pump station and AD3. This is to allow continuous feed to Transfer House E.
- Existing pipelines from Emergency Pumps and Haul Road Sumps to be disconnected at flange connections north of the haul road, from there to discharge into existing open canal routed towards HRS3. This will be temporary until completion of the new temporary Cofferdam in AD1.
- Reroute existing pipelines from emergency dams and haul road sumps to discharge into existing Hard Stand Area Canal. This will be a permanent installation.
- Pipeline from ADP to be left unchanged as it already discharges into the Hard Stand Area Canal.

During the construction of the temporary coffer dam, AD1 pump station will not be operational as AD1 will be empty.

Once the coffer dam is complete the pipelines from the station should have been rerouted around the works area to discharge into the existing hard stand area canal upstream of the silt trap and coffer dam. The coffer dam and temporary alterations to the penstock outlet pipe will allow the water to be pumped via the existing infrastructure. The water level in the coffer dam must be managed very strictly and the water level should be kept as low as possible to ensure sufficient capacity for storm events.

On the eastern side, of Area 2 it is proposed that the dirty water as well as associated dirty water canals at and around PCD5 be re-directed and contained for controlled discharge from PCD5 into the dirty water canal leading to AD/RD1. AD1 is to be drained and de-silted focusing on the area where a division wall is to be constructed in AD1 as per the proposed division wall between AD1 and the proposed RD1. Following which the de-silting operation is to focus on the area where the temporary storm water storage dam (coffer dam) is to be constructed. The division wall is to be constructed as soon as said area has been de-silted followed by the temporary storm water storage dam (coffer dam) and its associated pen stock extension. Only the spillway of the coffer dam is to be lined. RD 1 should then be excavated to its design capacity and lined, while the coffer dam within AD1 is used to collect storm water runoff from the ADF. Once RD1 is constructed, stormwater can be redirected to RD1, the temporary storm water storage dam (coffer dam) removed, following which AD1 is excavated to its designed capacity and lined. Majuba ADF Ash/Rehab Dam No.1: Temporary Storm Water Storage Dam Sizing.

**The enabling pipe works of AD/RD 1 will have to be completed before the dam construction works on AD/RD 1 start.**

During the construction of the temporary coffer dam, AD1 pump station will not be operational as AD1 will be empty.

Once the coffer dam is complete the pipelines from the station should have been rerouted around the works area to discharge into the existing hard stand area canal upstream of the silt trap and coffer dam.

The water level in the coffer dam must be managed very strictly and the water level should be kept as low as possible to ensure sufficient capacity for storm events.

The Temporary Storm Water Storage Dam only caters for the 1:10 year flood run-off from the north and north eastern portion of the existing ADF.

The Jones and Wagener SWMP (Storm Water Management Plan) as well as WUL (Water Use License) remains as approved.

Upon completion of construction of AD 1 (Ash Dam 1) and RD 1 (Rehab Dam 1) the Temporary Storm Water Storage Dam i.e. coffer dam, within the footprint of AD 1 (Ash Dam 1) will have been removed. Also refer to the attached Annexures for the complete report of Ash Dam 1, Rehab Dam 1 and Temporary Storm Water Storage Dam: Construction Sequence.

The *Contractor* is required to provide a proposed dam measuring equipment for both dams, for acceptance by the Project Manager, which he will be required to install, once accepted is granted.

In addition, along the extendable conveyor route, the Contractor is required to excavate, prepare and construct a concrete lined canal filled in geocells.

- Concrete to be filled in the geocell lined canal shall be 30Mpa, without the 1.5mm HDPE, as detailed in the construction drawings.
- The length of the concrete lined geocell canal is approximately 400m.
- The Contractor shall ensure that the access route to and from the concrete lined geocell canal is maintained all times during construction, to avoid any delays as a results of access.
- The cost for maintaining the access route to and from the concrete lined geocell canal shall be included in the Contractor's prizes.
- Setting out coordinates for the canal are not available, therefore the Contractor shall liaise with the Supervisor, in time, to agree about the setting out points of the canal, prior to construction.

A complete list of drawings for the detailed design is included in Section 7.1.

### **3.2 Procedure for Submission and Acceptance of Contractor's design**

All the Designs shall be passed on to the *Project Manager* for review and approval prior to placement of any order or procurement of the designs.

#### **3.2.1 Design Review Procedure**

Where the *Contractor* has design work in their scope, the *Contractor* is the Design Authority as defined in the Design Review Procedure (240-53113685). The *Contractor* is responsible for following this design procedure and conducting all the design reviews as specified in this procedure. The *Contractor* is responsible for conducting the following design reviews:

- a) Detail Design Freeze Review
- b) Integrated Design Review
- c) Construction Completion Review
- d) Acceptance Testing Review

#### **3.2.2 Project Engineering Change Procedure**

The *Contractor* takes note of the *Employer's* Project Engineering Change Procedure (240-53114026). An engineering change includes any proposed change originating from engineering, *Contractors*, project management or construction management.

The Project Engineering Change Procedure applies to the *Employer's* personnel or *Contractors* performing engineering or engineering related work where the quality of the engineering work performed is the direct responsibility of the *Project Manager*.

### **3.2.3 Process for Submission of Documents**

The *Contractor* submits all documents according to the accepted VDSS. The process for the submission of documents is described below:

- a) The *Contractor* submits the documents/drawings to the *Project Manager*.
- b) The *Project Manager's* Document Controller registers the documents.
- c) The *Project Manager's* Document Controller will supply the documents/drawings to all relevant parties within the *Project Manager's* project team.
- d) The *Project Manager's* team reviews the documents/drawings and will submit all comments or inputs to the *Project Manager* and the *Project Manager* submits to the *Contractor* for consideration.
- e) If the *Project Manager* finds major deficiencies in the submitted documents/drawings, the *Contractor* revises the documents/drawings and resubmits to the *Project Manager*.
- f) The *Project Manager* reviews the documents/drawings and if no major deficiencies are found, the *Contractor* organises a Design Review session.
- g) The *Project Manager* and the *Contractor* conduct a Design Review.
- h) If any fundamental errors were found in the designs or further actions are required, the *Contractor* record all concerns raised and revises the designs.
- i) The *Contractor* organises a Design Review session once all designs were revised according to the concerns raised by the *Project Manager*.
- j) If no fundamental errors were found in the designs during the Design Review session, the *Contractor* compiles the Design Review minutes or report and submits it to the *Project Manager*.
- k) The *Project Manager's* Document Controller registers the report.
- l) The *Project Manager's* 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*.
- m) The *Project Manager* will accept the *Contractor's* design once the report/minutes are accepted by the *Project Manager's* team.

### **3.2.4 Time Required for Acceptance of Design**

The *Project Manager* will return 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. Every revision shows by number, date and subject in the revision block on the drawing.

### **3.3 Other Requirements of the Contractor's design**

#### **3.3.1 Technical Risk Assessments**

##### **3.3.1.1 HAZOP Studies**

- a. The *Contractor* carries out formal HAZOP Studies on all systems in their supply. These studies are done in accordance with the requirements as laid down in the Eskom HAZOP Guideline: 240-49230111.
- b. All recommendations are included in the *Contractors* designs. This is submitted to the *Project Manager* for acceptance

##### **3.3.1.2 FMEA (FAILURE MODE AND EFFECT ANALYSIS)**

The *Contractor* carries out formal Failure Mode and Effect Analysis (FMEA) Studies on all systems in their supply. These studies are done in accordance with the requirements as laid down in the Eskom FMEA Guideline: 240-49230046.

#### **3.3.2 System Interface**

The *Contractor* is responsible for all system interfaces which forms part of the works. The *Employer* will provide the relevant information defining the system interfaces. The *Contractor* caters for all the identified interfaces.

### **3.4 Use of Contractor's design**

All *Contractor* designs shall be used only and once review & approval of the designs has occurred by the *Employer*. The approval shall be submitted to the *Project Manager* in writing.

### **3.5 Design of Equipment**

All designs of equipment by the *Contractor* shall be used only and once review & approval of the designs has occurred. The review & approval shall be submitted to the *Project Manager*.

- The *Contractor* shall provide to the *Project Manager* and relevant Construction Management personnel the documentation for the warranties from manufacturers or suppliers of all equipment required in execution of the structures to be built within the ADF area.
- The *Employer* (Construction Health and Safety Agent) is obliged to ensure that proof to the effect that the designers comply with their obligations as stipulated in the Construction Regulations, section 6 is submitted during the application for a construction work permit
- All the required documentation will be made available by relevant Construction Management personnel to the *Contractor* regarding the codification of equipment as well as the freight, storage and delivery requirements within the Eskom sites prior to the procurement of any equipment required for the execution of the structures to be built within the ADF area.
- The Contractor is solely responsible for providing the protection of the equipment from damage or loss due to weather, fire, theft, unexplained disappearance or similar during the execution of the works
- The Contractor shall bear the cost of the replacement of any equipment or part thereof damaged or requiring replacement and all such costs shall be covered as per the required construction insurance taken out by Contractor for the construction of the works at the ADF area
- The liability of the use of such equipment in the execution of the works shall remain that of the *Contractor* (i.e. this includes the design and transport, storage, maintenance, use of the equipment).

### **3.6 Equipment required to be included in the Works**

No specialised equipment is identified as being required, however if any is required, the designs shall be provided by the Contractor and reviewed as per Sections 3.3 above.

### **3.7 As-built Drawings, Operating Manuals and Maintenance Schedules**

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

The technical, training, operating and maintenance manuals are provided for each type of a functional unit. Technical manuals include all technical data as well as the technical data and leaflets of each individual component provided. Where generic manuals are provided, an addendum is provided indicating the applicable project specific components.

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

- a) Technical descriptions of the equipment and component parts
- b) General arrangement drawings
- c) Installation instructions with drawings or pictures
- d) Operating and maintenance instructions for all components
- e) Detailed parts lists (accompanied by exploded view type drawings clearly detailing the part and uniquely identifying it)
- f) Spare part ordering instructions

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

This section is read in conjunction with Section 2.2: Documentation Control and the VDSS in Appendix 10

#### **3.7.1 Drawing Requirements**

The *Contractor* supplies reproducible drawings according to the Vendor Document Submittal Schedule (VDSS). The *Contractor* develops the following minimum requirements for the drawings:

### **3.7.1.1 Drawing Numbering System**

The *Employer* supplies the proposed *Project Manager* drawing numbering system. The *Contractor* may assign his own drawing number as required to meet his document control system requirements.

### **3.7.1.2 As-Built Drawings**

The *Contractor's* Staff will maintain a master set of red-lined as-built drawings. The *Contractor* will provide drawing mark-ups as work is completed. The *Project Manager* and the *Contractor* will ensure that all appropriate information is transferred to the field record copy of drawings. The *Project Manager* and the *Contractor* will check the "as-builds" for completeness and accuracy.

The following types of drawings will be updated to as-built status:

- P&IDs
- Underground utilities drawings
- Plant arrangements
- Civil & Structural drawings
- Piping layouts

### **3.7.2 Operating and Maintenance Manual**

The *Contractor* provides operating and maintenance manuals, as well as an Operating Technical Specification for the new Plant. The *Contractor* provides four (4) hard copies and an electronic copy. The procedures are provided by the original equipment manufacturer detailing descriptions of operating and the maintenance work. The procedure covers the requirements for maintenance of the equipment over the design life.

### **3.7.3 Maintenance Schedule**

The *Contractor* provides a maintenance strategy for the life expectancy of the new Plant with a summary schedule. The *Contractor* provides the life expectancy of the equipment. The *Contractor* lists maintenance spares (with detailed specifications) for the life expectancy of the equipment. Maintenance strategy updates to be in accordance with the Reliability Based Optimisation (RBO) standard for all disciplines (electrical, civil, mechanical, fire, C&I).

### **3.7.4 Data Books**

The *Contractor* shall compile Data Books progressively for all manufacturing and construction/erection inspections, operating manuals and test records and documents for every piece of plant required in producing the Works. The *Contractor* shall submit data books to the *Supervisor* and *Project Manager* for their review for all Plant and Materials and work undertaken with the applicable requirements and specifications.

## **4. Procurement**

### **4.1 B-BBEE and Preferencing Scheme**

The *Employer* requires the *Contractor* to achieve a Broad Based Black Economic Empowerment Recognition Level (B-BBEE Recognition Level) of 4 (the "Required B-BBEE Recognition Level") within six months from date of Contract Award in terms of Eskom's Directive "Implementation of Eskom's Black Economic Empowerment Strategy " and Standard "Application of the Broad Based Black Economic Empowerment Codes of Good Practice within Eskom (32-1034)".

Eskom's policy is to maximise purchases from Black or Black Empowering Enterprises (BEE's) whether Black Woman-owned, small or Large Black or Black empowering suppliers. The purpose is to promote entrepreneurship in black communities and give black business access to the mainstream of business opportunity.

### **4.2 Supplier Development Localisation and Industrialization (SDL&I)**

Eskom Holding SOC Limited as a state Owned Enterprise is supportive of the South African Government's growth, poverty eradication and job creation strategy, Supplier Development Localisation and Industrialization (SDL & I ) as well as the New Growth Path as announced by the State President.

Eskom's contribution to this initiative is to set Local Content, Local Content to Site, Black Economic Empowerment targets to Large Black Suppliers, Small Black Enterprises (SBE) Black Woman Owned (BWO), and Black Youth Owned Enterprises (BYO), Enterprises owned by Black People Living with Disability (BPLwD) as well as Skills Development targets as key evaluation criteria in awarding of all formal tenders.

The *Contractor* complies with and fulfils the *Contractor's* obligations in respect of the Supplier Development and Localisation (SD&L) in accordance with and as provided for in the *Contractor's*

SD&L Compliance Schedule IT 1.2 SD&L requirements. Moreover, the Contractor complies with the CIDB skills development goals and setting as contained on the annexures to this Works Information.

Eskom is committed to Supplier Development and Localisation and its prime objectives of economic growth, skills development, job creation and poverty eradication. This commitment shall be achieved through leveraging Eskom’s procurement spend in a manner that allows flexibility within the business in order to accommodate government local development initiatives and policies.

The *Contractor* keeps accurate records and provide the *Project Manager* with reports on the *Contractor’s* actual delivery against the above stated Supplier Development and Localisation criteria.

The *Contractor’s* failure to comply with his SD&L obligations constitutes substantial failure on the part of the *Contractor* to comply with his obligations under this contract.

**4.2.1 Contract Skills Development Goals (CSDG):**

The Standard for Developing Skills through Infrastructure Contracts published by the Construction Industry Development Board on 03 July 2020 (Board Notice 363 of 2020, Government Gazette 43495) (“the CIDB Skills Standard”) will apply to this contract. In terms of the classification system of engineering and construction works contracts the works is classified as Civil Engineering works (CE). As such for the purposes of the CIDB Skills Standard the Contract Skills Development Goal (CSDG) for this contract is 0.25% of the Accepted Contract Amount.

The *Contractor* shall spend 0.25% of the Contract Amount on Skills Development in accordance with the *Contractor’s* Skills Development Goals. The *Contractor* also committed to comply with Eskom’s proposed Skill types as a minimum.

<b>Skills Category</b>	<b>Number</b>	<b>Entry requirements</b>	<b>Exit requirements</b>
Concrete Hand	10	N1/Grade 10	Concrete Hand Level 1
Shutter Hand	10	N1/Grade 10	Shutter Hand Level 1
Safety Officer	5	N6/Diploma/Degree	SACPCMP
Civil Technician	5	National Diploma	B-TECH/Civil Technician/ SACPCMP Registration
<b>Total</b>	<b>30</b>		

#### **4.2.2 Enterprise Development through Construction works Contracts**

The *Contractor* shall comply with the Assessment of Compliance with the Standard for Indirect Targeting for Enterprise Development through construction works contracts is 01 April 2021, as published in Government Notice No. 43726, which requires that a minimum of 5% will be subcontracted to the CIDB registered *Contractor* s.

The *Contractor* must perform a needs analysis on all targeted enterprises and provide internal mentorship, which improves the targeted enterprises performance in at least two developmental areas, such developmental areas should be guided by the requirements of the CIDB Best Practice *Contractor* Recognition Scheme as well as the NCDP exit requirements for accreditation of *Contractor* s. The developmental areas are listed in the GN.

The *Contractor* must appoint an Enterprise Development Co-Ordinator who must:

- Develop a project specific enterprise development plan to improve the targeted enterprise’s performance in the identified developmental areas which allocate resources and monitors progress in relation to improved performance; and
- Submits to the *Employer’s* representative a monthly ED report which documents all mentoring activities that have taken place during that month and progress made in improving the targeted enterprise’s performance in the development area, countersigned by the targeted enterprise.

If the *Contractor* fails to substantiate that any failure to achieve the CPG was due to reason beyond the *Contractor’s* control which may be acceptable to the Employer, the sanctions (financial penalties) provided for in the contract must apply.

#### **4.2.3 Local Production and Content**

The *Contractor* committed to compliance with the stipulated Local Content threshold for the applicable Designated Sector threshold as follows:

<b>Commodity</b>	<b>Components</b>	<b>Local Content Threshold</b>
Steel products and components for construction	Reinforcement steel, re-bar, etc.	100%
Piping	HDPE Piping	100%

Textiles, clothing, leather, and footwear - PPE	Reflector vests, jackets, safety boots, hard hats, etc.	100%
Bagged and Bulk Cement	Cem I, Cem II, Cem III, Cem IV, Cem IV, and masonry cement	100%

The Skills Development beneficiaries would be recruited from within the local District Municipalities.

#### 4.2.4 Reporting and Monitoring

The *Contractor* keeps accurate records and provide the *Project Manager* with reports on the *Contractor* 's actual delivery against the above stated Supplier Development and Localisation obligations.

The *Contractor must* submit the SDL&I Implementation Schedule, inclusive of CIDB Skills Development Goal, which must be completed by the suppliers and returned to SDL&I representative for acceptance within 28 days after contract award.

This SDL&I Implementation Schedule will be used as a reference document for monitoring, measuring, and reporting on the supplier's progress in delivering on their stated SDL&I commitments.

The *Contractor must*, on a quarterly basis, submit a report to Eskom in accordance with Data Collection Template on their compliance with the SDL&I obligations described above.

Eskom must review the SDL&I reports submitted by the *Contractor* within 30 (thirty) days of receipt of the reports and notify the *Contractor* in writing if their SDL&I obligations have been met or not. Upon notification by Eskom that the *Contractor* has not met their SDL&I obligations, the *Contractor must* be required to implement corrective measures to meet those SDL&I obligations before the commencement and submission of the next SDL&I report.

The *Contractor* 's failure to comply with his SD&L obligations constitutes substantial failure on the part of the *Contractor* to comply with his obligations under this contract.

The proforma documents shall be completed by the *Contractors* after award of the contract within the stipulated period. (i.e., Form A1 List of Recognised Skills Development Agencies, Form A2

Baseline Training Plan, Form A3 Project Interim Report, Form A4 Supervisor Agreement, Form A5 Project Completion Report).

The proforma documents shall be completed by the *Contractors* after award of the contract within the stipulated period. (i.e., Project Interim Report, Project Completion Report and Declaration).

#### **4.2.5 Supplier Development, Localisation and Industrialisation (SDL&I) Bond**

The *Contractor* must submit a bond equivalent to 2.5% of the Contract Value and must only be released to the *Contractor* upon fulfilment of all SDL&I Obligations, this may be released in tranches if requested and approved by the Project Manager.

### **4.3 Subcontracting**

#### **4.3.1 Subcontracting**

The *Contractor* must sub-contract to Designated Group(s) as amplified during negotiations.

#### **4.3.2 Preferred Subcontractors**

The *Contractor* makes use of any supplier for sourcing of equipment, tools and material which the *Contractor* will use to execute *works*.

2nd and 3rd Tier Companies (Sub-Contractors) should be submitted to Eskom for vetting and approval (That is, to be evaluated for LBS/BWO/SBE/BYO BPLwD classification in terms of the requirements of 32-1034).

- The *Contractor* subcontracts CT Systems to design, supply and commission the conveyor long line protection systems equipment as the current systems are CT-Systems. The current are not being replaced but merely extended.
- The *Contractor* subcontracts ABB to design, supply, install and commission all DCS related hardware, software and interfaces in the interest of maintaining any existing warranties and guarantees

#### **4.3.3 Subcontract Documentation, and Assessment of Subcontract Tenders**

a) The *Contractor* submits the proposed contract data for each subcontracting for acceptance to the *Project Manager*.

b) The *Contractor* prepares s subcontracting document as according to the NEC Contract.

- c) The *Contractor* must inform the *Project Manager* when intending to subcontract some of the works from the contract scope.
- d) The *Contractor* takes note that their Subcontractors Safety Files will be accepted by the *Contractor* Safety Manager before it will be handed to the GCD SHE practitioner/Officers for verification of compliance before any work commence. Proof of acceptance by the Contractor Safety Manager needs to be in the Safety file when handed over to GCD SHE Practitioners for verification.
- e) The *Contractor* only employs qualified sub-contractors

#### **4.3.4** Limitations on Subcontracting

Not Applicable to this type of project.

### **4.4 Plant and Materials**

#### 4.4.1 Quality

All Plant and Materials are either new or used. All New Plant and Materials will be free from defects. No Reconditioned Plant and/or Materials are regarded as new under any circumstances.

It will be the responsibility of the *Contractor* to ascertain the condition of any used equipment or materials, transport to site, corrosion protection, as well as any spares compatibility issues that may present itself in the future.

The *Contractor* will not use Plant or Materials which are generally recognised as being unsuitable or otherwise to be avoided for the purpose for which they are intended.

Only components of high reliability will be utilised, with a proven operating history, to enable the Plant to achieve required reliability and availability. Plant and Material design, engineering and manufacture will accord with the best modern practice applicable to high-grade products of the type to be furnished, so as to ensure the efficiency and reliability of the *works* and the strength and suitability of the various parts for the *works*.

Plant and Materials withstands ambient conditions and the variations of temperature arising under working conditions without distortion, deterioration or undue strains in any part.

All parts are made accurately, and where practicable, to standard gauges so as to facilitate replacement and repairs. Like parts are interchangeable.

No repair of defective Plant and/or Materials will be permitted without the *Project Manager's* approval and any such repair, if approved, will be carried out to the satisfaction of the *Employer*.

The *Contractor* ensures that co-ordinated and formally documented management system is in place for the assurance of quality as specified in ISO 9001, Quality management Systems – Requirements.

The *Project Manager* is free to specify hold and witness points during the installation and on site testing stages of the project. The *Contractor* issues preliminary notification of such hold and witness points by fifteen working days advance notice to the *Project Manager*, and confirms such hold and witness points at least seven days prior to the activity.

Typical holding points are listed below:

- a) Design Review
- b) FAT
- c) Delivery to Site
- d) Erection
- e) SAT
- f) All manuals and drawings (in the specified format)
- g) Commissioning

In addition to maintaining appropriate inspection and test records to substantiate conformance to requirements, the following records are safely stored for a minimum period of seven years following the final completion of the *works*:

- a) Construction, layout and component approvals
- b) Routine test certificates
- c) Construction drawings and approvals

After this period, the *Contractor* offers these records to the *Employer* (in writing) and obtains a disposal instruction.

Documentation regarding quality procedures is submitted within thirty days of Contract Award. The *Employer* will review and comment on the acceptability of these documents in a time frame as per

the requirements of the contract for contractual correspondence. If controlled copies of these documents have been submitted to the *Employer*, then the controlled copy numbers may be quoted in the submission.

#### **4.4.2 Plant & Materials provided “free issue” by the *Employer***

The *Employer's* design incorporates the use of the coarse ash fraction in the drainage layer. This will be free issue material supplied by the *Employer*.

The *Employer* does reserve the opportunity to negotiate with the *Contractor* that different plant and materials be used of another origin for whatever purpose that may become apparent at the time.

#### **4.4.3 *Contractor's* Procurement of Plant and Materials**

- The *Contractor* shall supply and use suitable and sufficient construction plant, tools and equipment and materials as may be required to carry out the works efficiently.
- The *Contractor* at all times provides protection for all plant and materials from damage or loss due to weather, fire, theft, unexplained disappearance or similar.
- The *Contractor* at all times protects from damage, due to the *Contractor's* service to provide the works, all plant and materials and equipment and all items on the site that are the property of the *Employer* or Others.
- The *Contractor* provides or manages, as part of *Works* everything necessary for the receiving, inspection, safe keeping and storage, issuing, handling, management and administration of all plant and materials purchased by the *Contractor*.
- The *Contractor* shall provide through the *Project Manager* and relevant Construction Management personnel the documentation for the warranties from suppliers of all any relevant plant and material used in the structures built within the ADF area, as well as the vendor data of the suppliers.
- The *Contractor* will ensure to provide all guarantees and warranties of the plant & materials used in the *Works* to the *Project Manager* and *Employer* when construction is completed.
- The *Contractor* supplies the labelling for the Plant that forms part of the *works*. The *Contractor* provides labels for the Plant according to the Majuba label specification. The *Contractor* makes use of the KKS codes and descriptions provided by the *Employer*.
- The labels are affixed in such a way that they are easily legible and not obstructed by the wiring or by other components.

- Clamping methods applied to the labels ensures that removal of the labels requires force. The *Project Manager* will approve the proposed method of clamping prior to use.
- The *Contractor* supplies the *Project Manager*, for verification and acceptance purposes, with a label list showing the text only. The *Project Manager* will approve the positioning and designation of labels.
- The KKS codes are used accordingly on documentation (e.g. drawings, manuals, equipment lists, cable schedules etc.) as a unique identification means. References to plant are accompanied by the relevant KKS code for that item of plant.
- Abbreviations to descriptions on the labels are generally not acceptable. Where abbreviations are unavoidable, due to the limited number of characters that can be engraved/etched on labels, the abbreviations are submitted to the *Project Manager* for acceptance. The *Contractor* makes use of the *Employer's* Standard Plant Related Abbreviations for Inter-System Use GGS0968.
- The *Contractor* arranges all shipments of Plant and Materials and consigns all such shipments to himself as consignee at the project shipping address, freight fully prepaid. The *Contractor* makes demurrage agreements and settlements with carriers for his shipments

#### **4.5 Tests and Inspections before Delivery**

It will be the responsibility of the *Contractor* to perform the required tests during construction and to coordinate documentation with the *Supervisor*. Test documentation generated during the commissioning phase will be filed as the work is completed. All tests and inspections are to comply with the quality management plans and requirements for the project as per Sections 2.5 and 4.4.1.

Once all *Contractor* construction activities are complete, the *Contractor* will hand over the *Works* to the *Supervisor* for testing and checkout. Completeness of the construction will be verified through a joint walk down between the *Supervisor* and *Contractor*. Any minor outstanding work items found during the construction walk down will be recorded as Defects, and dates will be established for resolution of these Defects.

Buildings with major omissions, errors, or problems found during the walk down will not be accepted for commissioning from construction. All construction documentation will be turned over to the *Supervisor* for review. This documentation will be reviewed for completeness, and will be included in the final safety clearance with the *Project Manager*.

Once the *Supervisor* has accepted a part of the *works* from construction, the responsible *Project Manager* will direct all pre-operational tests required to ready the subsystem for initial operation.

Plant and Materials contained within the *Works* will undergo testing to verify that they are in good condition and ready to be put into service.

As per Clause 41, the following equipment shall not be brought to the Working Areas before they have been tested or inspected:

- Pumps for the Dirty Water Supply System to and from the Sump
- Channel/ Sluice gates for the Silt Trap and the Sump structures
- Adjustable weirs for the Silt Trap and Sump
- Pipe fittings, equipment, etc. for the Dust Suppression System

## **5. Construction**

### **5.1 Temporary Works, Site Services & Construction Constraints**

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

##### **5.1.1.1 Access to Site**

Access to the site is controlled and it is governed by the terms and conditions lay down by Majuba Power Station security officials. All vehicles entering and exiting Majuba Power Station are subject to full inspections and searches, which could result in significant delays for which the *Contractor* must allow for in his planning and pricing.

The proposed site will be shown to the *Contractor* during the site meeting or clarification meeting by the *Employer*.

The *Contractor* liaises with the GCD SHE Practitioner/Officers for Safety Induction prior work to commence. During Safety Induction, site access permits with a copy of the medical and a certified ID copy/passport (not older than three months) should be handed to the GCD SHE Practitioner/Officer for approval.

The Contractor employees will take the signed site access documents to security reception official in order to finalize their site access.

Annual Eskom refresher induction will be done when returning to work after December holidays (January to March). No access will be granted if the re-induction is not done upon returning to work.

The *Contractor* ensures that all its employees carry their site access forms with them all the time.

The *Contractor* is subjected to alcohol testing on a daily basis.

The *Contractor* submits his application for vehicle permit to the *Project Manager*. The personnel and vehicles entering and leaving the site are subjected to routine searches.

The *Contractor* obtains a "Gate Removal Permit" from the *Project Manager* before materials and equipment can be removed from site. The "Gate Removal permit" gives itemised list of materials and equipment to be removed from site.

The *Contractor* ensures that a tool list is available on the day of arrival and that all tools are captured on the tool list. The tool list will be handed over to the Reception Security official that will stamp the tool list. The tool list will be kept safe and will be used when tools needs to be remove from site. This message should be handed over to any Subcontractor that will be working on Majuba Power Station.

#### **5.1.1.2 Site Regulations**

The *Contractor* complies with the Site Regulations as per Employer's Safety Health and Environmental Specification 240-143825536.

Any subject within the authority of the *Project Manager* may be addressed by a Site Regulation.

Before work starts on Site, a kick-off meeting is held with the *Contractor* and the *Project Manager*, to explain in detail all requirements of the Site Regulations.

#### **5.1.1.3 Permit to Work System**

The *Contractor* allocates staff to be trained and authorised as Responsible Persons according to the *Employer's* Plant Safety Regulations (36-681) and/or High Voltage Regulations. These Responsible Persons are available on Site as and when required to take out permits to work.

In this contract the *Contractor* shall appoint employees to attend and be authorised as follows:

- All Construction Managers, Assistant Managers, Supervisors and Assistant Supervisors to attend PSR and be authorised as Authorised Supervisors.
- Four(4) Supervisors to be authorised in terms of the PSR as Responsible Persons; and
- Two (2) to be authorised in terms of ORHVS as Responsible Persons.

### **5.1.2 People restrictions on Site; hours of work, conduct and records**

Restrictions and hours of work may apply at Majuba Power Station. The *Contractor* keeps records of his people on Site, including those of his Subcontractors which the *Project Manager* or *Supervisor* have access to at any time. These records may be required when assessing compensation events.

### **5.1.3 Health and safety facilities on Site**

The *Contractor* provides a First Aid service and SHE representative to his employees and Sub-*Contractors*. In the case where these prove to be inadequate, like in the event of a serious injury, the *Employer's* Medical Centre and facilities will be available. Outside the *Employer's* office hours, the *Employer's* First Aid Services are only available for serious injuries and life threatening situations. The *Employer* recovers the costs incurred, in the use of the above *Employer's* facilities, from the *Contractor*.

### **5.1.4 Environmental controls, fauna & flora, dealing with objects of historical interest**

As per "Environmental Management Programme for the Emergency Coal Handling at Silo 10 & 30; Construction of Access Roads and Conveyor Systems". Majuba Waste Management Procedure – RAENV06, National Environmental Management Act (NEMA, Act No. 107 of 1998) and the National Environmental Management Waste Act (NEMWA, Act No. 59 of 2008)..

### **5.1.5 Title to materials from demolition and excavation**

As per Clause 73.2 the *Contractor* has no title to materials from excavation and demolition (e. g. copper).

### **5.1.6 Cooperating With and Obtaining Acceptance of Others**

Other Contractors are working in the same area as the work of this contract. In this regard, the *Contractor* co-ordinates his work with the *Project Manager* to maintain harmonious working conditions on Site.

During the progress of the *works* the *Contractor* provides access to Others who also execute work in the same area, on an as and when required basis.

The *Contractor* makes his own assessment of the problems and difficulties which may be encountered for providing access to and interfacing with Others (this includes access difficulties experienced during construction or commissioning phase).

#### **5.1.7 Publicity and Progress Photographs**

The taking of photographs at Majuba Power Station including the Project *works* is restricted and subject to the approval by the *Project Manager*.

For the purpose of the Progress Reporting Requirements, the *Project Manager* may prohibit the taking of such photographs and/or require that all such photographs be taken by an official *Employer* photographer. In the latter event, the *Contractor* is required to make arrangements directly with the photographer for the taking of the photographs required by the *Contractor* for the purpose of the Progress Reporting Requirements.

#### **5.1.8 Contractor's Equipment**

- a) The *Contractor* provides all Equipment that is required to complete the *works*.
- b) The *Contractor* shall ensure that all his construction labour and equipment remains within the fenced off allocated construction area.
- c) The *Contractor* shall ensure that any staff, labour, or equipment moving outside his allocated construction site does not obstruct the normal operation of the ADF or the power station. Any additional access routes required must be coordinated with the *Project Manager*.
- d) The *Contractor* must keep daily records of his equipment used on Site and the Working Areas (distinguishing between owned and hired Equipment) with access to such daily records available for inspection by the *Project Manager* at all reasonable times.

- e) All Equipment used by the *Contractor* in providing the *Works* shall comply with the General Machinery Regulation 4 of the Occupational Health and Safety Act (Act 85 of 1993).

#### **5.1.9 Equipment provided by the *Employer***

No Equipment will be supplied by the *Employer*, however the *Employer* does reserve the right to negotiate with the *Contractor* that different equipment be used of another origin for whatever purpose that may become apparent at the time.

The *Contractor* supplies all equipment including cranes, scaffolding and other earthmoving equipment for the construction of the works.

#### **5.1.10 Site services and Facilities**

##### **5.1.10.1 Site Yard**

Site Yard for the *Contractor* shall conform to the *Employer's* Safety Health and Environmental Specification 240-143825536. It is required, for the proper co-ordination and execution of the works that the *Contractor* has an office on site for the duration of the contract.

A site will be made available to the *Contractor* for his yard within the Power Station security area. The proposed site will be shown to the *Contractor* during site meeting or clarification meeting. The yard is a raw site of approximately one hectare and will be used by the *Contractor* for the establishment of his offices, workshop and stores.

The *Contractor's* yard is subject to periodic inspection by the *Project Manager*/delegated person.

The location of the nearest sewer manhole, power distribution point, portable water connection storm water channel and road access point is indicated by the *Employer*. The *Contractor* is responsible for connection to the closest point of supply.

##### **5.1.10.2 Supply of Electricity**

Electricity will be made available for construction purposes free of charge from power points which will be indicated by the *Project Manager*. The *Contractor* is responsible for the provision of the reticulation

system from the point of supply. Both 220 (AC) Volt and 380 (AC) Volt are available on request. All points of supply requested by the *Contractor* are provided in terms of quantity and location at the discretion of the *Project Manager*.

No guarantees of power supply quality are given and power supply breaks of some duration may occur without warning. Planned outages are also a possibility. The *Contractor* makes arrangements at his own expense to improve continuity and quality of power where necessary for any reason and no claim of any nature relating to power failures is considered.

No connection is made to the permanent installation at Majuba Power Station without the prior acceptance of the *Project Manager*.

The power supply is managed in accordance with the latest revision of the Eskom safety regulations i.e.:

- a) 32-846, Operating Regulations for High-Voltage Systems
- b) 36-681, Generation Plant Safety Regulations
- c) COC for the site installation is required prior to power being switched on.

#### **5.1.10.3 Lighting**

The *Contractor* at his own expense provides temporary local lighting in accordance with the requirements of the OHS Act as amended. The *Project Manager* provides no local lighting. All construction lighting is the responsibility of the *Contractor*.

#### **5.1.10.4 Water**

Water will be made available on request free of charge from water points on site. The *Contractor* supplies at his own cost all the necessary connections, fittings, piping work, temporary plumbing and pumps necessary to lead water from the *Employer's* points of supply to the various points where it is required. The *Contractor* is responsible for maintaining this equipment and for removing it at Completion of the whole of the works.

The *Project Manager* does not guarantee continuity of supply and the *Contractor* makes his own provision for standby supplies to maintain continuity of work. Claims of any nature relating to discontinuity of water supply are not considered.

#### **5.1.10.5 Roads**

Main access roads are surfaced and complete and may be used by the *Contractor* with the necessary care. The *Employer* maintains the Site roads, described above, to a fair condition. Any costs incurred by the *Project Manager* from damage caused to underground services, structures, etc. as a result of the *Contractor* not using the prescribed routes is recovered from the *Contractor*.

The *Contractor* provides temporary access points from the prescribed routes and roads to the points where the *Contractor* is required to perform work, having first obtained permission in writing from the *Project Manager*.

#### **5.1.10.6 Setting-Out Beacons**

The *Project Manager* provides permanent beacons marking the main setting out grid lines for the works, and permanent level benchmarks.

The *Contractor* takes reasonable steps to preserve beacons and benchmarks provided by the *Project Manager* who is not to be held responsible if any existing beacons are removed as long as other beacons exist.

#### **5.1.11 Facilities provided by the *Contractor***

##### **5.1.11.1 Contractor's Yard, Offices, Workshops and Stores**

It is required, for the proper co-ordination and execution of the works that the *Contractor* has an office on Site for the duration of the contract.

The *Contractor* includes in his establishment rates for all further treatment of the yard areas that he considers necessary for his entire operation throughout his period of occupation and under all weather conditions. The *Contractor* also includes for all security fencing, security and access arrangements. The yard will be kept clean and tidy at all times, this will include all workshops and storage areas under the control of the *Contractor*. Maintenance of the yard is the *Contractors* responsibility and is for the *Project Managers* acceptance.

Outfall drainage of all surface run-off drains is constructed by the *Contractor* to the acceptance of the *Project Manager* to minimise erosion and to effect control of contaminated water. The

*Contractor's* plan for the layout of his yard area are accepted by the *Project Manager* prior to occupying the yard and the *Contractor* does not occupy any site area other than that allocated to him. The *Contractor's* plan states fully what measures are taken regarding removal and storage of topsoil, stabilisation of eroded areas and further loss of topsoil.

The *Contractor* complies with the environmental policy given in the Site Regulations. The *Contractor* provides, erects and maintains for his own use adequate size office accommodation and stores together with such drainage, lighting, heating, and hot and cold water services as may be required. Provision is also made for adequate parking and a turning area adjacent to all the aforesaid structures. The *Supervisor* prior to commencement of any work on Site accepts all designs and layouts for these provisions.

The *Contractor* dismantles and clears the yard of all such temporary structures and associated foundations and infrastructure at the direction of the *Supervisor* on Completion of the whole of the *works*. No such dismantling and clearance work is carried out without prior acceptance from the *Supervisor*.

The *Contractor* shall make provision for carrying out of all quality control testing required in terms of the *works* involved. This shall include, but is not limited to, the following:

- Soil grading analysis from 0.075 mm up to 100 mm as per TMH 1 A1a) and A5;
- Soil testing for Atterberg limits as per TMH 1 A2-A4;
- Soil density testing (nuclear and sand replacement as per TMH 1 A10);
- Soil testing for moisture content;
- DCP testing.

The *Contractor* shall either provide a laboratory on site or may make use of approved external laboratories and/or laboratories of other contractors on site subject to the approval of the *Supervisor*.

Results of permeability testing will only be accepted if carried out by an accredited laboratory.

#### **5.1.11.2 Telecommunications**

Neither a network point nor a telephone is available on site. Should the *Contractor* require one, he is to make his own arrangements with relevant authorities. Arrangements may also be made to use

the telephones of the station if they are available. Calls from these will be charged for at prevailing GPO rates.

Should the *Contractor* wish to use radio communication equipment on site, he will make his own arrangements with the relevant authorities. In this case, he is requested to liaise with the head of security at the station to ensure that there is no interference with existing channels or equipment.

#### **5.1.11.3 Sanitary Facilities and Refuse**

The *Contractor* is to supply own sanitary facilities at his *Contractor's* yard. A refuse control system will be established by the *Contractor*. All waste and refuse will be collected and disposed of as directed by the *Project Manager*, at the Power Station refuse disposal site.

#### **5.1.11.4 Equipment/Appliances**

Any electrical Equipment, or appliances, used by the *Contractor* conforms to the applicable OHS Act safety standards and is maintained in a safe and proper working condition. The *Project Manager* has the right to stop the *Contractor's* use of any electrical Equipment, or appliance, which, in the opinion of *Project Manager*, does not conform to the foregoing. Inspection of equipment/appliance will be done as required by OSH Act.

The *Employer* may assist the *Contractor* with the off-loading of equipment, plant and material but the responsibility for off-loading remains with the *Contractor*.

Any special tools and equipment to be used on site for the execution of the *works* is the responsibility of the *Contractor*.

#### **5.1.12 Survey control and Setting Out of the Works**

The *Project Manager* designates the working area boundary limits and assigns for the *Contractor's* use access roads, parking areas, storage areas, existing facilities areas and construction areas. The *Contractor* does not trespass in or on areas not designated for his work.

The *Contractor* is responsible for keeping *Contractor's* personnel out of areas not designated for *Contractor's* use, except, in the case of isolated work located within such areas for which the *Contractor* is authorised to do so.

The control points will be established by the *Contractor*. Land surveys will be done by the *Contractor* before and after clear and grub, before and after topsoil strip and after final excavation before construction commences.

The *Contractor* will ensure that application for excavation permit is done well in advance before any excavation work can start in an area. The Employer will need the drawings of the work to be conducted in the area to show the Excavation authorised person of Majuba the drawings so that an excavation permit can be issued. A copy of the excavation permit with the drawings will be handed to the *Employer* for record keeping.

In addition, the survey information is to be according to the National LO co-ordinate grid system and is to be provided in digital format (either YXZ format or preferably in Model Maker file system ver. 7 or above).

The following survey information is additionally required in order to approve construction works executed. This list is intended to give an indication of some of the survey work required, and is not intended to be an exhaustive list of all the surveys that will be required.

- Detailed bottom of excavation survey, before placement of any layer works, clearly showing toe and crest lines of the basin excavation and embankment walls (for all works).
- Survey of invert level subsoil and leakage detection collection collector and outlet pipes to verify falls and length of pipes installed.
- Detailed survey of final HDPE liner surface, clearly showing toe and crest lines of the facility.
- As-built surveys of the bottom and top of primary and secondary Compacted Clay Liners to verify liner thickness, as well as of the final surface of the ballast layer, will be required.
- Inverts levels of storm water drains.
- Any extensions to stockpile areas.

Final As-Built survey information must be given to the *Supervisor* in the same format as what the setting out was given in the drawings. Final completion will not be processed before this survey information has been evaluated and verified using a DTM package.

### **5.1.13 Control of Noise, Dust, Water and Waste**

The *Contractor* maintains a high standard of cleanliness during the conduct of his activities at Majuba Power Station. This includes areas allocated for storage of materials, site offices etc. to the satisfaction of the *Project Manager*. The *Contractor* keeps these areas clean and free from accumulation of waste materials and refuse regardless of the source.

The *Contractor* ensures during sweeping and dusting, that a minimum amount of dust is liberated into the atmosphere. Cleaning by vacuum cleaners is preferred and the use of compressed air for cleaning is prohibited.

The *Contractor* is responsible for the prompt removal of all waste to a designated disposal area. The disposal area will be on or in the vicinity of the Power Station and be indicated by the *Project Manager*.

For the purpose hereof, "waste" any matter, whether liquid or solid or any combination thereof, which is a by-product, emission, residue or remainder of any process or activity carried out in connection with the *works* and which is not reused on the Site in the ordinary course of carrying out the *works* within seven days of production.

The *Contractor* provides an adequate number of marked bins and containers at offices, in yards, at workshops and on the Site for the temporary storage of waste. These bins and containers are subject to approval by the *Project Manager*. The *Contractor* is required to segregate certain items of waste by type as designated by the *Project Manager*.

Bins and containers are emptied and waste removed to the designated area at least once a week. All the waste removed to the designated area at least once a week. All the temporary storage areas for bins and containers are kept tidy and must not constitute a nuisance to others. The *Contractor* takes all required steps to avoid spillage of waste alongside the bins and containers during removal and disposal thereof.

All waste that cannot be contained in either a bin or container is placed on a temporary waste site which the *Project Manager* identifies. The waste is removed as soon as possible but in any event at least once a week. No burning of waste is allowed at the Power Station.

Hazardous waste is dealt with in accordance with the safety, health and/or environmental requirements of the *works* and the *Contractor* is solely responsible for the proper disposal thereof.

Hazardous waste will be disposed of at an authorised landfill site. Waste manifest will be kept for record keeping and hand over at the end of the Project.

Controlling water from excavations is done as required by the Environmental legislation and only after a method statement to this regard has been accepted by the *Project Manager*.

The *Contractor* must ensure that adequate pumping capacity is provided for the continual pumping of water from excavations. Water may be contaminated and should not be discharged into the environment unless tested.

#### **5.1.14 Sequences of Construction or Installation**

The *Contractor* is responsible for the construction and installation of the equipment according to the *Contractor's* construction and installation plans. Taking Section 3.1 above into consideration.

The *Contractor* complies with the *Employer's* Work Co-ordination Process.

Without derogating from the provisions of the Conditions of Contract, the Work Co-ordination Process is used by the *Project Manager* to monitor and manage activities on the Power Station and to facilitate the integration and co-ordination of the various *works* by Others.

If not included in the contract, the *Project Manager* will notify the *Contractor* of the requirements of the Work Co-ordination Process prior to the date of site establishment by the *Contractor*.

#### **5.1.15 Giving Notice of Work to be covered up**

The *Contractor* provides a notice of work to be covered up to the *Supervisor*.

#### **5.1.16 Hook ups to Existing Works**

The adjacent plant and equipment may not be modified without written permission from the *Project Manager*. The *Contractor* complies with Eskom Life Saving Rules and will report any non-conformance.

## **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 Use of the Works before Completion has been certified**

After the completion of construction of Phase 1 Package 2 works, the constructed section of ADF done in Phase 1 Package 2 will be opened for operation, while construction proceeds onto Package 3.

### **5.2.3 Materials Facilities and Samples for Tests and Inspections**

Not application to this project.

### **5.2.4 Commissioning**

Contractor to conduct Electric Leak Location Survey (ELLS) prior to filling as part of the commissioning process.

### **5.2.5 Start-Up Procedures required to put the Works into Operation**

The *Contractor* gives the Project Manager written notice that the works are ready for energisation. Such notice will suit the requirements of the Employer but will not, unless otherwise agreed, be less than 48 hours or more than fourteen (14) calendar days.

No alterations or adjustments will be made to the works after functional checks are done without the *Project Manager's* written permission.

At this stage the following must have been achieved:

- a) Installation and pre-commissioning completed.
- b) Testing report and the associated certificates received.

- c) Signed erection and safety clearance certificates.
- d) Final Draft of the Technical, Operating, Maintenance manuals delivered.
- e) All Quality Control Plan (QCP) documentation received.

### **5.2.6 Take Over Procedures**

Refer to the *Employer's Procedure, Commissioning and Completion of Power Station Projects*, 240-85416341.

### **5.2.7 Access given by the *Employer* for correction of Defects**

Clause 43.4 requires that the *Project Manager* arranges for the *Employer* to allow the *Contractor* access to and use of a part of the *works* which has been taken over if needed to correct a Defect.

### **5.2.8 Performance Tests after Completion**

The *Contractor* shall carry out necessary tests after completion to demonstrate that the performance of the Plant is in accordance with the *Employer's Works Information* requirements.

The *Contractor* will be required to provide a detailed method statement on how this verification will be achieved and any instrumentation/equipment required shall be part of the system provided by the *Contractor*.

### **5.2.9 Training and Technology Transfer**

The *Contractor* provides training on the equipment and systems included as part of the *works* to the various categories of the *Employer's* technical staff (operators, maintenance and engineering personnel) for the duration of the *works*.

Training provided by the *Contractor* is directly applicable to the actual equipment supplied for the *works*. Generalised training based on similar equipment is not acceptable. The local facilities for training provided by the *Employer* is a suitably sized air-conditioned room, as well as trainee and trainer desks, an overhead projector and flipchart or white board. The number of personnel to be trained is as per the table below.

**Table 13: Technical staff to be addressed in Training Proposal**

Department	Number of Personnel
Operators	15
Maintenance	15
Engineering	10

The *Contractor* submits to the *Project Manager* for acceptance a detailed training programme as well as a prospectus for each course. Course material is provided for the number of trainees as per the table above.

The training schedule is incorporated in the Accepted Programme.

Practical hands-on training for each individual trainee forms an integral part of each of the following courses:

#### **5.2.9.1 Training of Maintenance Personnel**

Maintenance personnel will be trained in all components and functions of the Plant i.e. Method of maintenance, fault finding, correction, routine maintenance. Training will include familiarisation with documentation (maintenance plan, procedures etc.).

#### **5.2.9.2 Training of Maintenance Operators**

Operators will be trained and declared competent on the new systems. This will include familiarisation with documentation including drawing configuration logic, as well as operator interface familiarisation e.g. operational functions, alarms etc. The *Contractor* makes provision for training of all operators, for every shift.

#### **5.2.9.3 Engineering Training**

Formal engineering training will be provided on basic Plant design, capabilities and procedures upfront, prior to design freeze. Thereafter, training will be on-job training throughout the design process. The overview design and control/interface functions will be covered by this training. The engineering team should be trained sufficiently to enable them to work as part of the implementation team on and off site.

#### **5.2.9.4 Training Documentation**

The course material is in English and includes all third party documentation. A copy of the training documentation is supplied for each trainee with an additional 3 master sets for the *Employer's* library and training department.

The training dates are included and shown in the Accepted Programme. The supply of drafts, pre-print proofs and printed copies of training documentation is planned by the *Contractor* in such a way that the required training is complete before commissioning of the Plant.

Training manuals are continuously updated by the *Contractor* up to the date of issue of the Defects Certificate for the whole of the *works*.

### 5.2.10 Operational Maintenance after Completion

It is not applicable to this *Employer's* Works Information.

## 6. List of Reference Procedures, Standards and Specifications

The *Contractor* complies with all standards, specifications and regulations as listed within this *Works* Information:

### 6.1 General

**Table 14: General National/International Standards**

SANS and other applicable Local and International Standards		
No	Document No	Description / Title
1	OHSA	Occupational Health and Safety Act South Africa No 85 and amendments
2	AWS-QC1	Standard for AWS Certification of Welding Inspectors
3	ISO 17635	Non-destructive Testing of Welds
4	ASME BPVC Section IX	Welding and Brazing Qualifications
5	ISO 12944	Paints and Varnishes - Corrosion Protection of Steel
6	SANS 1091	National Colour Standard
7	ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles
8	COLTO	Standard Specification for Roads and Bridges for State Road Authorities (1998 Edition)

**Table 15 Eskom Project Management and Project Controls Specifications**

Applicable Eskom Specifications		
No	Document No	Description / Title
1	240-83561037	Reporting Data Requirements for Contractors
2	RA/RM/WI/02	Majuba - Emergency Preparedness Response Work Instruction
3	Regulations 16	Site regulation number 16 for use, conveyance and storage of Radioactive sources
4	240-143825536	Safety, Health and Environmental Specification for Continuous Ash Disposal Facility at Majuba Power Station- Phase 1 Package 2
7	TBA Once registered	GCD, Majuba Silo 20 Recovery Project - Environmental Management Plan
9	32-365	Completion of Power Plant Projects, Commissioning, Take-over from Contractors and Hand-over to the Generation Business
10	240-76992014	Project / Plant Specific Technical Documents and Records Management Work Instruction
11	240-76992014	Technical Documents and Records Management Work Instruction
12	36-943	Engineering Drawing Office and Engineering Documentation Standard
13	240-53114026	Eskom Project Engineering Change Procedure
14	240-53113685	Design Review Procedure
15	240-44175132	Eskom PPE Specification
16	32-95	Occupational Health and Safety Incident Management Procedure
17	RA/ENV/06	Gx Majuba PS Waste Management Plan
18	240-100259162	Gx Coal Area 1 Environmental Rehabilitation Plan
19	240-49230111	Eskom HAZOP Guideline
20	240-49230046	Eskom FMEA Guideline
21	32-1034	Application of the Broad Based Black Economic Empowerment Codes of Good Practice within Eskom

## 6.2 Civil engineering and structural works

### 6.2.1 SANS Specifications

The latest revisions of the SANS codes of practice and standardized specifications at the time of contract shall apply to this contract, copies not provided by the *Employer*.

SPECIFICATIONS - SANS 1200 (applicable codes only as per the table below)

SANS 1200 TITLE	NUMBER	REV	DATE
GENERAL	A	3	30-07-2002
SITE CLEARANCE	C	1A	01-08-1982
EARTHWORKS	D	3	30-07-2002
EARTHWORKS (Pipe trenches)	DB	3	30-07-2002
SMALL EARTH DAMS	DE		
CONCRETE (STRUCTURAL)	D		
GABIONS & PITCHING	DK		
EARTHWORKS (Roads, Subgrade)	DM		
CONCRETE (SMALL WORKS)	GA	2	30-07-2002
STRUCTURAL STEELWORK	H		
MEDIUM PRESSURE PIPELINES	L		
BEDDING (Pipes)	LB	2	30-07-2002
STORMWATER DRAINAGE	LE		
ROADS (General)	M		

All references to Standard Specifications are to the latest amendment to such specifications.

A SABS 1200 series specification or other standard not listed above and referred to in the Bill of Quantities and Pricing Data, a SABS 1200 series specification and/or the Drawings shall by such reference be deemed to form part of the contract documentation.

### 6.2.2 Changes to SANS Specifications

**This section is to be read in conjunction with the SANS 1200 Standardised Specifications for Civil Engineering Construction. Should any requirements of this section conflict with any requirements of the standardised or particular specifications, the requirements of the contract shall prevail.**

In certain clauses the standard, standardized and particular specifications allow a choice to be specified in the project specifications between alternative materials or methods of construction and for additional requirements to be specified to suit a particular contract. Details of such alternative or additional requirements applicable to this contract are contained in this part of the project specifications. It also contains additional specifications required for this particular contract.

The number of each clause and each payment item in this part of the project specifications consists of the prefix PS followed by a number corresponding to the number of the relevant clause or payment item in the standard specifications. The number of a new clause or payment item, which does not form part of a clause or a payment item in the standard specifications and which is included here, is also prefixed by PS, but followed by a new number which follows on the last clause or item number used in the relevant section of the standard specifications.

#### **PSA 2 PLANT (Clause 4)**

PSA 2.1 Add the following clause:

##### "4.3 Contractor's Constructional Plant

If during the course of the Contract, the *Supervisor* considers that any item or items of constructional plant are in any way inefficient or inadequate to complete the works within the contract period, or do not meet the required safety standards, he shall have the right to call on the *Contractor* to either:

- (a) Put the constructional plant in order, or
- (b) Remove such constructional plant and replace it with other efficient and/or safe plant, or
- (c) Provide additional similar plant or plant of greater capacity.

The *Employer* shall have the right to stop all or part of the works where constructional plant not complying with required safety standards is being used until such time as the plant has been made safe or replaced with approved plant.

No additional payment will be made to the *Contractor* for expenses incurred in complying with any or all of the above."

#### PSA 2.2 Laboratory Facilities (Clause 7.2)

The following sub-clause shall be added to this clause:

Should the *Contractor* provide a laboratory on site the following shall apply.

The *Contractor* shall provide a laboratory with sufficient suitable equipment to carry out all routine tests required by the specifications and for carrying out any other tests which he may deem necessary for the proper quality control of the works.

Where specialised equipment for carrying out the tests referred to above is required, the *Contractor* may make arrangements for carrying out the tests with a commercial laboratory approved by the *Supervisor*.

The *Contractor's* laboratory shall be staffed by experienced technicians conversant with the methods to be used for carrying out the routine tests.

If in the opinion of the *Supervisor*, the *Contractor's* laboratory is inadequately equipped or the standard of expertise of the technicians is unsatisfactory, then the *Supervisor* shall have the right to order the *Contractor* to cease work until such time as the *Supervisor* is satisfied that these deficiencies have been rectified. The cost resulting from such stoppage shall be to the *Contractor's* account.

The laboratory and equipment shall be made available to the *Supervisor* for the purpose of carrying out check tests on materials and construction. The costs attendant on making the laboratory facilities available to the *Supervisor* shall be included in the *Contractor's* tendered prices.

### **PSA 3 CONSTRUCTION**

#### **PSA 3.1 Watching, Barricading, Lighting and Traffic Crossings (Clause 5.2)**

Further to the provisions of this clause, every excavation which is accessible to the public, including other contractor's or the Employer's personnel, or which is adjacent to public roads or thoroughfares, or whereby the safety of persons may be endangered shall be:

- (a) protected by a hard barrier, as directed by the *Supervisor*, or fence consisting of not less than two ropes, or wires, stretched at heights of 600 mm and 1 200 mm between poles or standards, of strength adequate to safely contain pedestrians and as close to the excavation as practicable; and
- (b) to comply with OHS act and the Construction Regulations.
- (c) The *Contractor* shall, where necessary, so arrange his work that flow of the *Employer's* vehicular and pedestrian traffic can be maintained at all times.

#### **PSA 3.2 Protection of Overhead and Underground Services (Clause 5.4)**

Further to the provisions of this sub-clause, the *Contractor* shall before commencing work, arrange with the *Supervisor* or the *Employer* to point out any underground or overhead services

which may be affected by construction activities. Where necessary the *Contractor* shall excavate trenches by hand under direction of the *Supervisor* or *Employer* to establish the exact location of services. The *Contractor* shall be solely responsible throughout the contract period for the safety and protection of services. Repair of known services damaged by the *Contractor* shall be to his account. Any deviation of services affected by construction, whether carried out by the *Contractor* or other authority will be paid for by the *Employer*.

**PSA 3.3      Pollution (Clause 5.6)**

The *Contractor* shall provide adequate containers with lids for the disposal of refuse. Containers shall be provided at the site office. The *Contractor's* refuse is their own responsibility and is to be removed from site at the *Contractor's* cost. Construction waste shall be collected and spoiled by the *Contractor* at locations approved by the *Supervisor*.

**PSA 3.4      Safety (Clause 5.7)**

If the work in connection with the contract is to be done on property subject to the OCCUPATIONAL HEALTH AND SAFETY ACT No. 85 OF 1993, the *Contractor* shall nominate a competent person (within the meaning of the Regulations under the OHS Act) who shall be appointed in writing by the *Contractor* as subordinate manager to assist in the control, management and direction of the works in terms of the provisions of the said Regulations. This appointment shall remain in force until practical completion of the works has been effected.

All equipment, constructional plant, temporary works and materials used by the *Contractor* and the work carried out by the *Contractor's* personnel are subject to the safety regulations of the *Employer* and thereby also subject to the inspection and acceptance by their officials at all times.

Cost for transport to and treatment at a hospital will be to the *Contractor's* account.

**PSC            SITE CLEARANCE**

**PSC 1 DISPOSAL OF MATERIAL (Clause 3.1)**

Material resulting from clearing site and surplus excavated material shall be removed to or stockpiled at a designated area. Under no circumstances will the burning of combustible material be permitted.

## **PSC 2 CONSERVATION OF TOPSOIL (Clause 5.6)**

Where overburden or material resulting from site clearance is acceptable for use as topsoil, it shall be stockpiled as indicated on the drawings.

The height of the topsoil stockpile will be limited to 2.0m high.

## **PSD EARTHWORKS**

### **PSD 1 CONSTRUCTION**

#### **PSD 1.1 Earth Embankments**

Areas where fill is to be placed are to be ripped and recompacted to 90% Mod. AASHTO at a moisture content of between -2% and +2% of optimum moisture content.

Cut and fill construction of earth embankment layers shall be to the lines and grades established on the drawings, or as modified in the field by the Engineer.

The fill layers shall be constructed in layers not exceeding 200mm after being compacted.

The fill shall be compacted to 95% Mod. AASHTO at a moisture content of between -2% and +2% of optimum moisture content. The compacted surface of any layer is to be scarified and wetted before any new layer is placed, if said layer is too dry or smooth to bond with the subsequent lift.

### **PSD 2 CLASSIFICATION FOR EXCAVATION PURPOSES (Clause 3.1)**

The provisions of sub-clauses 3.1.2(b), 3.1.2(d) and 3.1.2(e) shall not be applicable to this contract. Classification of material for excavation purposes shall be either "soft" or "hard rock".

Hard rock excavation shall be as defined in sub-clause 3.1.2(c) with the addition that boulders or rocks with at least a dimension of 0.3m will be classed as hard rock excavation. Soft excavation shall be excavation in all materials other than rock excavation.

Blasting will not be permitted.

### **PSD 3 MATERIAL SUITABLE FOR BACKFILL (Sub-clause 3.2.3)**

In general, material from excavation elsewhere than in rock and topsoil, or indicated by the Engineer, will be suitable for backfill.

When backfilling, material shall be returned to the excavation in the reverse order to which it was excavated.

### **PSD 4 SPECIFICATION FOR FILL**

#### **PSD 4.1 Scope**

This specification covers the minimum requirements of the compaction and testing of fill.

#### **PSD 4.2 Supervision**

The construction of fill shall at all times be under the supervision of a responsible person, approved by the Engineer, with adequate knowledge of the compaction of earthworks.

#### **PSD 4.3 Records and approval**

No material shall be placed on a previous layer before such layer has been approved by the *Supervisor*. The Contractor shall submit to the *Supervisor* a duplicate copy of all tests results. One copy shall be kept by the *Supervisor* and one copy, duly signed and approved, if acceptable, shall be returned to the *Contractor* who shall keep the same as a record.

No material shall be placed in excavations before the excavation has been approved by the *Supervisor*.

### **PSD 5 PRECAUTIONS (Clause 5.1)**

**PSD 5.1 Explosives (Sub-clause 5.1.1.3)**

The use of explosives will not be permitted unless expressly agreed to by the *Supervisor*.

**PSD 5.2 Existing Services (Sub-clause 5.1.2)**

The Contractor shall not commence any excavation until given permission to do so by the *Employer* or *Supervisor* in writing and the existence and location of services has been checked by exploratory trenching or other approved means.

(Refer PSA 3.2)

**PSD 5.3 Excavated Material not to be a Hazard (Sub-clause 5.1.4.3)**

Material excavated shall be placed in the area designated by the *Supervisor*. The material shall be spread evenly over the area as the work proceeds in such a manner that its surface remains free draining. Any dumping which occurs outside the designated area will be removed to the proper area at the *Contractor's* cost. Material suitable for backfilling where required shall be stockpiled separately for later re-use.

**PSD 6 EXCAVATION (Sub-clause 5.2.2)**

Where concrete is to be cast against the excavation face, the face shall be trimmed such that there are no projections into the excavation profile which will result in a reduction to the specified concrete cover to reinforcement.

No overbreak occurring outside the limits of the specified lateral working space or below the specified profile on the bottom of rock excavation nor re-instatement of such overbreak will be measured for payment.

**PSD 7 COMPACTED CLAY LINER**

**PSD 7.1 Clay Material**

The clay used in the liners shall conform to the following physical properties:

<b>PROPERTY</b>	<b>MAXIMUM</b>	<b>MINIMUM</b>
Liquid Limit (LL)	100	20
Plasticity Index (PI)	50	7
% Fines (75 µm)	n/a	30
% Clay (2 µm)	40	15
Particle size (mm)	4.75	n/a
Activity ( PI / % Clay)	n/a	0.35

The clay shall have a maximum permeability of  $1 \times 10^{-6}$  cm/s when compacted to a dry density of 98% Standard Proctor maximum dry density, at a water content of +1 to +3% of Proctor Optimum Moisture content.

**PSD 7.2 Construction**

The compacted liner shall consist of clay available from site, as indicated by the *Supervisor*, and be constructed to the lines and the grades shown on the drawings.

There shall be 2 x 150 mm thick layers (when compacted) in the composite liner of the facility. The layers shall be compacted to a density of 98 % of maximum dry density according to the Standard Proctor density test with a moisture content of between +1% and +3% of optimum moisture content.

Clay is to be compacted with a padfoot roller, with minimum 90mm pad height, to allow adequate kneading and remoulding of the clay. The top layer of the clay liners, which will be in contact with the geomembrane, shall be graded and compacted using a smooth drum roller where it needs to be prepared for the placing of the geomembrane and shall be finished such that no gap greater than 30mm can be measured beneath a 3m straight edge.

The permeability of clay layers is very dependent on compacting the clay wet of optimum moisture content, typically +1 to +3 % of OMC. The clay layer must also not be allowed to desiccate subsequent to compaction and prior to covering with the next clay layer or for the final clay layer with the geomembrane liner. Desiccation will result in a reduction of moisture content, and in extreme cases desiccation cracking and shrinkage, both of which have an adverse effect on the clay macro permeability. If the Contractor cannot cover the clay immediately, either with the subsequent clay layer, or for the final layer with the geomembrane liner, then allowance must be made in the rates for a sprinkler system to maintain the design moisture content specification.

The Contractor is to provide, along with his tender, a detailed method statement of maintaining clay moisture. Such system must have an application rate that doesn't result in the formation of pools on the clay layer, doesn't result in the formation of erosion gulleys and does not result in the moisture content exceeding +3% of OMC.

### PSD 7.3 Sources

The material for the liners shall be selected material obtained from the site, within 1km free haul. The *Supervisor* shall approve the material prior to it being used for construction.

## PSD 8 TESTING

### PSD 8.1 Taking and Testing of Samples (Clause 7.2)

Density control shall be either by the sand replacement method or by an approved nuclear density meter. The use of the nuclear density meter will be subject to the following provisions:

- The test will not be valid if performed within 1 m of concrete structures or in a confined space of width less than 2m.
- For each 10 nuclear density meter tests carried out on the embankments, a minimum of 1 corresponding sand replacement test shall be performed.
- For each 10 nuclear density meter tests carried out on the clay layers, a minimum of 2 corresponding sand replacement tests shall be performed.
- The accuracy of any nuclear density meter shall be proved by performing at least five comparative nuclear density and sand replacement tests on each type of soil used in the embankment and clay liner before the results of the nuclear density meter will be accepted as valid. Thereafter the correlation between the nuclear density meter and sand replacement tests shall be reviewed on a fortnightly basis.
- Each nuclear density meter shall be required to have a certificate provided by the supplier of the machine stating that the machine is in good working order. Each density meter shall be re-calibrated by the supplier at least twice a year. Certificates of proof of re-calibration will be required.

In the event of disagreement on the quality of compaction, results of sand replacement tests shall be accepted in preference to nuclear density meter test results.

The minimum testing frequency on field density and OMC that will be required from the *Contractor* shall be:

- Four tests per 500 cubic meters (4 per 500 m<sup>3</sup>) or part thereof with a minimum of 4 tests per production lot for ordinary fill.
- Four tests per 2 000 m<sup>2</sup> (4 per 2 000 m<sup>2</sup>) or part thereof with a minimum of 4 tests per production lot for the top 300mm of fill and road bed.
- Eight (8) tests per 500 cubic meters (8 per 500m<sup>3</sup>), also minimum 8 tests per production lot.

A production lot shall be taken to mean a portion of fill in a particular zone of the embankment placed and compacted in one process, using material from a single zone in the excavation. If production continues uninterrupted, a production lot will usually be taken as the product of one day's work and shall not exceed two days production. A production lot of reduced quantity will be assumed, if:

- The fill material being used shows abnormal variation in quality,
- An area is obviously of lesser quality than the rest,
- A very high production rate is maintained.

Density tests shall be carried out within twenty four (24) hours of completion of compaction on the particular layer concerned. The results thereof shall be submitted to the *Supervisor* without delay, in any case not later than 24 hours after these become available.

For control testing the following procedure will be followed for each production lot:

- a) Sample material at the centre of each of the four quadrants of the production lot area;
- b) Carry out Proctor Maximum Dry Density or Modified AASHTO Maximum Dry Density and Optimum Moisture Content tests as well as in-situ moisture content tests on all four samples and obtain average values for Proctor M.D.D. or MOD AASHTO M.D.D. and O.M.C.;

- c) Adjust field moisture of material to the required range (based on average in-situ moisture content and average O.M.C.);
- d) Compact and carry out eight in-situ density and in-situ moisture content tests;
- e) Obtain average in-situ density and average in-situ moisture content;
- f) Production lot passes if the average in-situ density is 98% of average Proctor M.D.D. and moisture content is between +1% and +3% of average O.M.C for clay liners; or  
Production lot passes if the average in-situ density is 90% - 95% of average Modified AASHTO M.D.D. (MOD AASHTO) and moisture content is between -2% and +2% of average O.M.C for fill layers as stated in table below; or  
Production lot passes if the average in-situ density is 95% of average Proctor M.D.D. and moisture content is between -4% and 0% of average O.M.C for cement stabilized liners.
- g) If production lot does not conform to the above criteria re-compact or adjust moisture content and re-compact until the above criteria are met.

The acceptance criteria for density test results for fill and in-situ compaction shall be as follows:

Specified Density % of STD	Minimum Average Density for Number of Tests						Minimum Value of any Single Test in a lot of:					
	4	5	6	7	8	9+	4	5	6	7	8	9+
90	90.1	90.4	90.6	90.7	90.9	91.0	86.4	86.2	86.0	85.9	85.8	85.7
93	93.1	93.4	93.6	93.7	93.9	94.0	89.4	89.2	89.0	88.9	88.8	88.7
95	95.1	95.4	95.6	95.7	95.9	96.0	91.4	91.2	91.0	90.9	90.8	90.7
98	98.1	98.4	98.6	98.7	98.9	99.0	94.4	94.2	94.0	93.9	93.8	93.7

A minimum of one Maximum Dry Density test, either modified AASHTO or Proctor as the case may be, per two production lots shall be carried out provided the material is obtained from one source and is uniform. The *Supervisor* may instruct that more tests be carried out if the material varies in quality.

**PSD 9 TRANSPORT FOR EARTHWORKS (Sub-clause 5.2.5)**

PSD 9.1 This sub-clause shall be replaced by the following:

"5.2.5.1 Free haul

All transport of material obtained from designated borrow pits or essential excavations for use in construction of the works or that must be disposed of as spoil shall be subject to a free haul to the *Contractor's* stockpile.

"5.2.5.2 Overhaul

Haulage of excavated material in excess of free haul will be regarded as overhaul. The overhaul distance shall be the haul distance along the shortest practicable route from the place of excavation to the place of off-loading less free haul distance. The Contractor shall not incur overhaul expenses except where authorised in writing."

PSD 9.2 Scheduled Items

Sub-clause 8.3.6 - Overhaul - shall be replaced by the following:

"Overhaul" Unit: m<sup>3</sup>km

This item shall only be applicable where the overhaul has been authorised in writing. Volumes will be calculated as specified in 8.2.1 and 8.2.2. No allowance will be made for bulking, regardless of the means of transport used; overhaul will be measured from the end of the specified free haul to the nearest 0,1 km in one direction only by the shortest practical route to the place of off-loading.

## **PSD 10 PLACEMENT SPECIFICATIONS**

PSD 10.1 Cement Stabilised Material (Clause 5)

The soil, cement and water shall be mixed until an even colour is obtained without any visible streaks of cement or wet patches.

The size of the soil cement batches mixed will be such that all the material can be placed and compacted within two hours from time when the cement comes in contact with the soil. Compaction shall start 45-60 min after the cement comes in contact with the soil.

Placement will be done early mornings and late afternoon when the membrane liners are smooth without any folds due to heat expansion as defined by the *Supervisor* on site.

The final compacted depth of the soil cement shall be measured within 4 hours of compaction to prevent break out of soil cement already set.

The compacted material will be covered immediately as placement progress and cured for at least seven days.

Directly after final compaction the moisture content and the dry density will be determined to enable water addition corrections to compensate for initial cement hydration and evaporation.

**PSD 10.2 Degree of pulverisation (Clause 5)**

The degree of pulverisation controls the size and percentage of clay lumps present in the loose soil cement immediately after mixing

The degree of pulverisation will be determined for every batch until such time as the *Supervisor* is satisfied that the mixing procedure consistently meets the required specification. Thereafter once every two (2) days.

<b>PROPERTY</b>	<b>MINIMUM VALUE</b>
% lumps passing 4.75 mm sieve	80
% lumps passing 26 mm sieve	100

**PSG CONCRETE (Structural)**

**PSG 1 SUB-CLAUSE 3.2.1**

Cement shall conform to SANS 50197-1 or EN 197-1 and have a Strength Class of 42.5. Cement extenders shall conform to SANS 1491: parts 1, 2 and 3.

The following cement extenders are allowed but limited as follows:

- Fly Ash: 30% maximum. Including
- Ground Granulated Blast furnace Slag: 50% maximum

The following cement types are acceptable

- Cem I 42,5 – Portland Cement (If available)
- Cem II 42,5/A-S, B-S, A-V, B-V or A-M – Blended Cements.

**PSG 2 SUB-CLAUSE 3.2.3 STORAGE OF CEMENT (Add)**

Cement shall not be kept in storage for longer than three months without the Engineer's permission.

**PSG 3 SUB-CLAUSE 3.4**

The maximum size of the coarse aggregate shall be 20mm unless otherwise indicated on the drawings.

The parent rock from which the coarse aggregate and crusher sand is derived from shall be approved by the *Project Manager*.

**Sub-Clause 3.4.3 Storage of Aggregates**

Modify clause to include:

- a) contamination by chemicals spilled on the ground or which may settle out of the atmosphere is prevented.
- b) the storage areas are well drained to prevent the accumulation of water.

**PSG 4 SUB-CLAUSE 3.5.1**

Admixtures will not be permitted without written approval from the *Project Manager*.

**PSG 5 SUB-CLAUSE 3.5.2**

An air entraining agent will not be permitted without written approval from the *Project Manager*.

**PSG 6 SUB-CLAUSE 3.6**

Mild steel: Type A.

High tensile reinforcement shall be type C or D class 2, grade 1. *Contractor* to confirm suitability of all reinforcing supplied

**PSG 7 SUB-CLAUSE 3.9 SEALANTS (Additional Clause)**

Where polysulphide sealants are specified, these shall be two part polysulphides complying with the requirements of SANS 110:2011

**PSG 8 SUB-CLAUSE 5.1.1 BENDING**

Clause 5.1.1.3

Replace clause with: "Bars may not be bent hot".

Clause 5.1.1.4

Delete sub-clause (no longer applicable)

**PSG 9 SUB-CLAUSE 5.1.2**

Welding shall not be permitted, unless approved by the *Project Manager* in writing, beforehand.

**PSG 10 SUB-CLAUSE 5.1.3 COVER**

No metal supports, spacers or wire ties used for holding reinforcement in position shall be in contact with formwork nor shall it have less cover to outside concrete faces than is specified for the steel reinforcement.

Exposure conditions shall be assumed as severe.

The minimum cover over the reinforcement of concrete in foundations and other structural members where the concrete is cast directly against the ground shall be 75 mm. If after the removal of the formwork, concrete surfaces are to be in contact with the ground, the cover to reinforcement shall not be less than 50 mm for bars greater than 16 mm in diameter and 40 mm for bars 16 mm or less, irrespective of the class of concrete.

Structures that require fire protection shall have a cover over reinforcement of at least 50 mm.

**PSG 11 SUB-CLAUSE 5.1.4 Splicing**

Modify clause to include: "Mechanical reinforcement couplers may only be used with prior approval from the *Project Manager*"

**PSG 12 SUB-CLAUSE 5.1.6 Handling (new clause)**

Each bundle of reinforcement bars, straight or bent, shall be metal tagged to identify the drawing number, the structure, mark number, bar size and quantity.

**PSG 13 SUB-CLAUSE 5.1.7 Corrosion protection (new clause)**

The reinforcement in structures containing chloride salts shall be corrosion protected by galvanizing or epoxy coating.

Protection of reinforcement in other corrosive environments shall be approved by the *Project Manager*.

**PSG 14 SUB-CLAUSE 5.1.8 Corrosion protection (new clause)**

The reinforcement in structures containing chloride salts shall be corrosion protected by galvanizing or epoxy coating.

Protection of reinforcement in other corrosive environments shall be approved by the *Project Manager*.

**PSG 15 SUB-CLAUSE 5.2.1**

20 x 20 mm rebates or fillets are to be provided at all corners of concrete work unless stated otherwise on the drawings.

**PSG 16 SUB-CLAUSE 5.2.5.6 CONSTRUCTION LOADS (Additional Sub-clause)**

The Contractor shall not impose any construction loads which over-stress the ground slabs, slabs or beams, allowing for the age of the concrete at the time of loading and the design loads as shown on the drawings. Where necessary, propping shall be carried through more than one floor with the props placed vertically above each other through the required floors.

**PSG 17 SUB-CLAUSES 5.5.1.5**

The minimum cement content and maximum water/cement ratio (by mass) shall be:

- 300 kg/m<sup>3</sup> and 0.66 for un-reinforced concrete;
- 375 kg/m<sup>3</sup> and 0.55 for reinforced concrete;
- 400 kg/m<sup>3</sup> and 0.5 for pre-stressed concrete and for concrete of strength greater than or equal to Grade 40 MPa.

Concrete that has an air-dry density in the range 2 000 kg/m<sup>3</sup> to 2 600 kg/m<sup>3</sup> shall contain entrained air and conform to the air-content limits given in the table below, as determined in accordance with SANS 6252

<b>Nominal maximum size of coarse aggregate</b> mm	<b>Total air content as a volume fraction</b> %
9.5	6 to 10
13.2	5 to 9
19	4 to 8
37.5	3 to 6

Where required in terms of the specification data, concrete made to have an air-dry density that does not exceed 2 000 kg/m<sup>3</sup> shall contain 6 % ± 2 % total air when the nominal maximum size

of aggregate exceeds 9,5 mm, or 7 % ± 2 % total air when the nominal maximum size is 9,5 mm or less. Proportions shall be so selected that a characteristic strength of 20 MPa or more is attained

**PSG 13 STRENGTH CONCRETE (Additional)**

The requirements for the various grades of concrete specified on the drawings are listed below:

Concrete Grade	Specified Concrete Strength MPa	Maximum Nominal Size Coarse Aggregate mm
15/19	15	19
30/19	30	19
35/19	35	19

**PSG 14 APPROVAL OF STRENGTH MIXES (Additional Sub-clause)**

Not less than two weeks before the start of any concrete work on the site, the *Contractor* shall submit to the *Supervisor*, for his information and subject to his approval, a statement of mix proportions. This statement shall provide the following information:

For each class of concrete:

- Mix proportions and types,
- Slump,
- Target strength,
- Aggregate type,
- Admixtures,
- Cement/ Binder Type
- W/C ratio

For all concrete:

Method to be adopted for adjusting the amount of water added, to compensate for variation in moisture content of the aggregate.

The statement shall be accompanied by evidence in the form of either a statement from an approved laboratory of the results of trial mixes, or an authoritative report previous use and

experience, establishing that concrete made with the materials in the proportions proposed will have the properties specified.

**PSG 15 SUB-CLAUSES 5.5.3.2 TESTING**

Test results obtained by a ready mix production facility as part of its quality control system will not be acceptable for evaluation in terms of 7.3. All concrete shall be sampled at the point of placing and test cubes made in accordance with the relevant methods.

Samples are to be obtained across various trucks in order to obtain a representative sample spread for the cast.

Slump cone tests are to be conducted at the point of placing for each batch and are to be within +/- 15 mm of the mix design target.

**PSG 16 SUB-CLAUSES 5.5.5.1**

Concrete may not be placed before the Supervisor's approval has been given in writing and a minimum written notice of 24 hours prior to pouring is required for each part of the structure.

**PSG 17 SUB-CLAUSES 5.5.7**

All kickers are to be cast monolithically with the base element. All joints are to be scabbled to remove laitance to expose stone aggregate.

Proprietary bonding compounds between old and new concrete may be used provided they are applied in accordance with the manufacturer's instructions and approved by the Project Manager.

**PSG 18 SUB-CLAUSES 5.5.8**

The method of curing and protection shall be to the Supervisor's approval.

**PSG 19 SUB-CLAUSES 5.5.9.4 Blast furnace slag in cold temperatures (new sub-clause):**

When the ambient air temperature falls below 10°C, the contractor shall immediately advise the *Project Manager* of the event and replace any blast furnace slag in the concrete mix with ordinary cement in any concrete being batched.

**PSG 20 SUB-CLAUSES 5.5.10**

Unless otherwise noted all exposed unformed surfaces are to have a wood-float finish.

**PSG SUB-CLAUSES 5.5.11 Watertight concrete**

**Include:**

The following structures shall be watertight:

- a. Sumps:
  - PCD5 outlet structure
- b. Canals:
  - Concrete canal to inlet into AD1
- c. Silt traps:
  - AD1 silt trap
  - AD3 northern silt trap
  - AD3 southern silt trap

**PSG 21 SUB-CLAUSES 5.5.13**

Unless otherwise specified, the compressive strength of 50mm mortar cubes of grout shall not be less than 30 MPa at 7 days and 40 MPa at 28 days. Grout shall be completely free of calcium chloride. It shall be used in the semi-dry state, where the water/cement ratio does not exceed 0,4.

Where the space to be filled is inaccessible and/or where directed by the *Supervisor* non-shrink liquid grout shall be used.

All approved proprietary grouts shall be used in accordance with the manufacturer's or *Supervisor's* instructions.

Unless specifically noted the grout shall not extend above the underside the base plate. Heat resistant grout shall be used where so directed on drawings.

**PSG 22 SUB-CLAUSE 6.2.3(h) TOLERANCES ON THE POSITIONING OF CAST-IN ITEMS**

The permissible deviation of any bolt or bolt sleeve in a related group of bolts relative to any other bolt in the group shall be  $\pm 2,0$  mm.

The permissible deviation of any bolt or bolt sleeve from its designated location in plan shall be  $\pm 4$ mm.

The permissible deviation of any bolt from its designated location in elevation shall be  $\pm 10$ mm.

The permissible deviation of other cast-in items from their designated locations shall be  $\pm 10$ mm, save that where the designated location is a concrete face and the item is to be cast flush with the face it shall be cast within 2mm of the face.

**PSG 23 SUB-CLAUSE 7.3**

Where more than three valid test results for a particular grade of concrete become available the average strength of all the available results for the grade shall not be less than the required average strength given below. If the average strength is less than that given below the mix design shall be adjusted to ensure compliance with the required average strength.

(Refer to clause 14.3.3 of SANS 0100 - 2)

No. of Sets (of three test cubes)	Required Average Strength
4	Specified strength + 3,0 MPa
5	Specified strength + 4,5 MPa
6	Specified strength + 5,0 MPa
10	Specified strength + 6,0 MPa
20	Specified strength + 7,0 MPa
30 or more	Specified strength + 8,0 MPa

**MEASUREMENT AND PAYMENT**

PSG 24 SUB-CLAUSE 8.1.2 Reinforcement

Sub-clause 8.1.2, Reinforcement, shall be deleted and replaced with the following:

Steel bar reinforcement shall be measured by the metric ton (or kg for small quantities) calculated from the cutting lengths shown on the drawings and using the tabulated mass per linear metre for the nominal diameter of the bar.

Bar Diameter [mm]Mass per linear metre [kg]

6 0,222

8	0,395
10	0,616
12	0,888
16	1,579
20	2,466
25	3,854
32	6,313

Welded steel mesh shall be measured in metric tons based on the nominal mass per square metre or in nett square metres for each mesh reference. Allowance to be made for laps.

Payment shall include for the supply of all material, labour and plant for fixing the reinforcement in position and shall include for cutting, bending, rolling margin, waste, cover blocks, wire ties and in the case of welded mesh for all waste due to laps and for maintaining the reinforcement in the position shown on the drawings during concreting. If the mass of steel bar reinforcement used for approved chairs (excluding those listed in the bending schedule) exceeds 1% of the total mass of reinforcement fixed, the excess will be paid for at the appropriate rates in the Bill of Quantities.

Payment shall distinguish between mild steel and high tensile steel bar reinforcement and shall where so itemised in the schedules further distinguish between bars of different diameter.

## **PSH            STRUCTURAL STEEL**

### **PSH 1 SUB-CLAUSE 3.1    Structural Steel**

Unless noted otherwise, all steelwork shall be Grade S355JR.

### **PSH 2            SUB-CLAUSE 3.3    Steel used for cold-formed sections**

Cold-rolled hollow steel section profiles shall conform to the design requirements of SANS 10162-2. The manufacturer shall supply sufficient test certificates to establish that the minimum yield strength of cold formed sections after forming is greater than 230 MPa.

### **PSH 3            SUB-CLAUSE 5.1    Fabrication**

### **PSH 4            SUB-CLAUSE 5.1.2    Contractor Provides Shop Details**

The *Contractor* shall prepare all shop drawings including marking plans. He shall provide material lists for all the work indicating part number, detailed drawing number and arrangement drawing number. Two prints of all shop drawings (including marking plans) must be submitted for approval, in principle only, by the *Supervisor*. The design drawings will be issued to the *Contractor* on commencement of the project.

PSH 5            SUB-CLAUSE 5.2    Fabrication

PSH 6            SUB-CLAUSE 5.2.3   Cutting

Where it is necessary to flame cut plates, edges of plates shall be ground smooth.

PSH 7            SUB-CLAUSE 5.2.4   Holes for Fasteners

Flame cutting of holes will in general not be permitted. Where permission is given in writing, the hole shall be burnt to a diameter at least 5mm smaller than the required diameter and then reamed to the correct size.

PSH 8            SUB-CLAUSE 5.2.6   Structural Hollow Sections

All structural hollow sections shall be sealed against the ingress of moisture. All holes through structural hollow sections shall be fitted with spacer sleeves welded into position. The minimum wall thickness of the sleeve shall be 2mm.

PSH 7            SUB-CLAUSE 5.3    Assembly

Shop connections shall be welded wherever possible.

PSH 8            SUB-CLAUSE 5.3.4   Welding

Welders must have proof of passing the appropriate tests in SABS 10044.

The following documents shall be available for inspection by the *Project Manager*.

- a) Welding procedure specifications.
- b) Welder and welding operator qualification tests.
- c) Welding release certificate.

d) Records of stress relieving of welds, when stress relieving is specified.

e) Radiographs when radio graphing is specified.

Eskom welding specification?

#### PSH 9 SUB-CLAUSE 5.3.8 Marking

Steelwork shall be marked with the item number, general arrangement drawing number and order number by both hard stamping (10 mm letter size) and by means of waterproof paint. The hard stamping shall be ringed with white paint.

Marking must be done in such a way as to not damage the steelwork.

Computer program generated numbers can be used for marking.

Elements to be hot-dipped galvanized shall be marked by hard stamping or welded lettering.

Water-based paint or an appropriate marking pen shall be used for any temporary marks on steel before galvanizing.

#### PSH 10 SUB-CLAUSE 5.3.9 Protective Treatment

Protective treatment shall comply with the requirements of SABS 1200 HC and the relevant project specification clauses.

#### PSH 11 SUB-CLAUSE 5.5.1 Procedure

Erection procedures are to be submitted for approval.

Materials shall be packed and shipped in sequence with the erection schedule.

Shipping inventory lists in a waterproof package shall accompany each shipment of structural steel. Small components, such as nuts, bolts and washers shall be placed in clearly marked containers and shipped with the first lot of structural steel.

Loose base plates and other components may be wired to large parts and shipped with the steel for which they are required.

Rail and road trucks shall be loaded and cribbed in a manner that will ensure easy off-loading.

Machined surfaces, bolt threads and bevelled plate edges exposed to corrosion shall be coated with a corrosion inhibitor.

#### PSH 12 SUB-CLAUSE 5.5.2 Storage and handling

*Add the following:*

The size of fabricated assemblies shall be subject to the limits imposed by mass, carriers, cranes, route clearances and legislation.

The *Contractor* shall make his own arrangements for loading, off-loading, handling, transporting and storing of structural steelwork and materials.

Damaged or defective materials shall be set aside for inspection by the *Project Manager* who will decide on the course of action. The *Contractor* shall bear the cost of repairing, replacing and handling defective materials.

PSH 13 SUB-CLAUSE 5.5.3 Safety during erection (new clause)

*Add the following:*

Attachments to facilitate erection may not remain as part of the permanent structure.

Add the following:

PSH 14 SUB-CLAUSE 5.5.6 Expansion Bolts

Expansion bolts and chemical anchor bolts for fixing steelwork to concrete elements shall be installed in accordance with the manufacturer's recommendations for hole diameter, depth of embedment and tightening torque.

PSH 15 SUB-CLAUSE 5.7.1 Floor Plates

*Replace clause with:*

Floor plates shall have self-draining raised patterns formed by the hot rolled process. The raised patterns shall not be considered to form part of the floor plate thickness. Drain holes 15 mm in diameter shall be provided for each 1.5 m<sup>2</sup> surface area with a minimum of one hole per floor panel. Floor plates shall be galvanized to SANS 121.

PSH 16 SUB-CLAUSE 7.2 Inspection

The *Contractor* shall advise the *Supervisor* as soon as materials and fabricated parts are ready for inspection. The *Supervisor* may require that portions of the work be reassembled at the fabricator's works to check the accuracy of the work.

PSH 17 SUB-CLAUSE 7.3 Inspection and testing of welds

The *Contractor* may be required to carry out non-destructive tests on the welds, including but not limited to the Dye Penetration test.

The Project Manager reserves the right to inspect the steel during fabrication and erection, and to employ outside inspection authorities for inspection of materials, methods and workmanship.

PSH 18 SUB-CLAUSE 8.3.1.2 Supply and Fabrication of Steelwork

The rate shall also cover the cost of supplying grade 4.6 and grade 8.8 bolts including nuts and flat and/or tapered washers, the mass of which will not be measured.

## **PSHC CORROSION PROTECTION OF STRUCTURAL STEELWORK**

PSHC 1 SUB-CLAUSE 3.2 Inspection and release (new clause)

All structural steel delivered to site shall be accompanied by an acceptable and legible painting and galvanising inspection and release certificate, clearly identifying the party and person who undertook the inspection and authorised the release from the shop. If this is not provided, the *Project Manager* may refuse to accept the delivery and not allow the steel to be offloaded

PSHC 2 SUB-CLAUSE 3.2 C5.7 Coating System

Where reference is made to “duplex” coating the following specification shall be adhered to:

- Hot dip galvanizing to conform to the requirements of the SANS 121 (ISO 1461:2009) specification. The galvanizer shall not quench the galvanized steel in a passivating solution containing sodium dichromate should painting be carried out immediately following the zinc coating process. Passivation will be required in a humid hot environment and where the top painting process is to be carried at a later date.

Once galvanized, the following painting procedure must take place:

1. Prepare all galvanized surfaces thoroughly with the aid of a galvanized iron cleaner or alternatively by means of sweep blasting. In the case of a galvanized iron cleaner, once brush applied, allow to stand for between 20 to 30 minutes. Followed by a clean water wash to remove all traces of white rust, contaminants and cleaning chemicals. This is best achieved by using a high-pressure hose and clean water.

The alternative zinc surface preparation is to use sweep blasting (not shot blasting). Sweep blasting is used to clean and provide a surface profile to key the paint primed to the galvanizing. For details of both methods of zinc surface preparation refer to specifications (HDGASA 01-Rev1:2014 and HDGASA 02-Rev1:2014).

NB. Once all the surfaces are cleaned and dried, and within 2 to 4 hours apply the zinc compatible paint primer. Do not allow the cleaned galvanized surface to be exposed to the environment for more than 4 hours without the initial paint primer.

2. Apply the 1<sup>st</sup> coat of a zinc compatible epoxy primer with a DFT of between 50 microns (µm) to 75 µm.

3. Apply intermediate MIO epoxy coating to a DFT of 100 µm.
4. Apply top coat of UV resistant polyurethane colour coat to a DFT of 60 µm.

**PSHC 2** SUB-CLAUSE 7.3 Testing by *Supervisor*

The *Contractor* shall provide, at his own expense, all samples of coatings that the *Supervisor* requires for test purposes.

**PSM** **ROADS (General)**

**PSM 1** SOURCES OF MATERIAL (Sub-clause 3.2)

Selected material for filling and all selected layers will come from designated borrow areas.

Material from the ferricrete horizon defined in the site geotechnical report will be used for the fill layers.

- Material that classifies as G5 or higher, as per TRH14 will be used in the wearing course and will be required to be sourced from a commercial source;
- Material that classifies as G7 or higher, as per TRH14 will be used in the fill layers for the roads.

**PS MJ: SEGMENTED PAVING**

**PSMJ 3** MATERIALS

Replace the whole clause with the following:

a) Interlocking precast concrete blocks

The interlocking concrete blocks shall be of the “Armoflex 165” or equally approved type which complies with the following specifications:

Each block shall be factory produced, from compressed concrete, with two horizontal cable ducts. The shape shall be such that the blocks interlock with each other transversely and be tapered to the sides to permit the system to articulate freely without disjoints.

Concrete used in the manufacture of the blocks shall have a 28 day compressive strength of not less than 25MPa. Outside dimensions in millimetres shall be 340 x 400 x 95. Each block shall have a mass of approximately 20.6kg, and have a unit mass of 165kg/m<sup>2</sup>.

## PSMJ 5 CONSTRUCTION

Replace the whole clause with the following:

“a) Site preparation, excavation, trimming & compaction

Once the bulk earthworks for the dam have been completed, the surface shall be trimmed accurately to the lines, levels and grades shown on the Drawings. Obstructions such as roots and projecting stones shall be removed. All loose material resulting from the trimming operation shall also be removed. The trimming canal surface shall be compacted to a density of not less than 90% of modified AASHTO density to minimum depth of 100mm. The final trimmed and compacted surface shall not deviate from the specified profile by more than 75mm. The completed operation shall be approved in writing by the *Supervisor* before commencement of the next stage

b) Laying of interlocking blocks

Placement of paving blocks above the primary geomembrane and protection geotextile must be done in such a way to prevent the entrapment of wrinkles/waves/folds below the final paving ballast and protection surface. To achieve this, it is important that a logical and planned method of installation of the paving blocks is adhered to. In general, the placement of paving needs to be done in unison with the installation of the geomembrane and protection layers and cannot be carried out after the geomembrane has been installed in its entirety.

The suggested method of installation of the blocks is as follows:

1. The Panel layout must be approved by all parties before the liner installation commences. The panel layout must agree with the Paving Block Installation Plan.
2. Place the day's production of geomembrane on the prepared substrate, preferably at the coolest time of day to prevent the liner from contracting below the paving blocks and possible 'trampolining'.

3. Seam deployed panels of day's production as per specification and immediately cover the geomembrane with the protection layer(s), leaving space for the following day's production weld.
4. Align the paving block grid with the centre line of the first panel placement using building lines appropriately pegged out.
5. Starting from the centre of the geomembrane deployment and working outwards, place the paving blocks to create an advancing arrow shape pointing in the direction of installation. The arrow should propagate up slopes after closure joints are completed. The anchor trenches are only to be backfilled after paving installation is complete to the crest.
6. On the following day, repeat Steps 2 to 3. The seam between the previous day's production and the new deployment must go through a 24 hour thermal cycle to be in equilibrium before the seam is carried out. Continue the propagation of the arrow after seaming is complete.
7. The method of placing the paving blocks in a triangular array (advancing arrow shape) moving from the centre up the slopes is to be continuously followed to ensure that waves are pushed outwards.
8. Paving blocks shall not be placed when there are excessive wrinkles/folds/waves in the geomembrane such that there is a risk of a wave being entombed in the installation.

## PSMJ 6 TOLERANCES

### PSMJ 6.1 GENERAL

#### PSMJ 6.1.3 Fréquence of Checks and Smoothness

This clause is amended to read:

"The *Contractor* shall carry out checks on every 100m<sup>2</sup> of paved area"

### PSMJ 6.1 PERMISSIBLE DEVIATIONS

This clause is amended to read:

"The permissible deviation will comply with a Degree of Accuracy I"

## PSMJ 8 MEASUREMENT AND PAYMENT

### PSMJ 8.2 SCHEDULED ITEMS

Replace the contents of this clause with the following:

#### PSMJ 8.2.1 Trimming and compaction of dam surface Unit: m<sup>2</sup>

The unit of measurement shall be the square metre of excavation of backfill trimmed and compacted to receive the lining.

The rate shall cover the cost of scarifying, watering, removal of obstructions, shaping and compacting the dam basin to the applicable minimum degree of compaction. The rate shall include full compensation for all supervision, labour, plant, fuel, material, control testing and other incidentals necessary to trim and compact the canal surface to the standard specified.

#### PSMJ 8.2.2 Construction of interlocking precast concrete blocks/mats Unit: m<sup>2</sup>

The area measured will be that interlocking precast concrete block/mat areas to be placed in position as shown on the drawings. The rate shall include full compensation for procuring and furnishing all materials, storage, handling, placing and for all other work necessary to complete the lining as specified.

### 6.2.3 Particular Specifications

The Particular Specifications below concerns the supply and placing/construction of:

PA: Geosynthetic Materials

PB: HDPE Piping and Fittings

PC: Corrosion

PD: Grassing

PE: Filter Material

Note:

- In the Particular Specification Engineer refers to *Project Manager* of the Contract,
- In the Particular Specification Contractor refers to *Contractor* of the Contract,

- In the Particular Specification Lining Contractor and Earthworks Contractor refers to *Contractor of the Contract*
- In the Particular Specification Engineer's Representative refers to *Supervisor*.

## **PARTICULAR SPECIFICATION PA: GEOSYNTHETIC MATERIALS**

### **GEOSNYTHETIC MATERIALS**

#### **PA 1 SCOPE**

This specification covers the supply and installation of the geomembrane liners below the ash facility and associated dams, as well as geotextiles, geogrids and geocells in the ash facility.

#### **PA 2 DEFINITIONS**

For the purpose of this specification the following definitions shall apply:

***Manufacturing Quality Control (MQC):*** Refer SANS 1526. This definition shall be applicable to all geosynthetic materials.

***Manufacturing Quality Assurance (MQA):*** Refer SANS 1526. This definition shall be applicable to all geosynthetic materials.

***Construction Quality Control (CQC):*** A planned system of inspections that is used to directly monitor and control the quality of a construction project. Construction Quality Control shall be performed by the Lining Contractor or for natural soil materials by the Earthworks Contractor, and is necessary to achieve quality in the constructed or installed system. Construction Quality Control refers to measures taken by the installer or Contractor to determine compliance with the requirements for materials and workmanship as stated in the Drawings and Project Specifications.

***Construction Quality Assurance (CQA):*** A planned system of activities that provides the Employer, Engineer and Permitting Authorities assurance that the facility was constructed as specified in the design. Construction Quality Assurance includes inspections, verifications, audits and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Construction Quality Assurance refers to measures taken by the Engineer to assess if the Lining Contractor is in compliance with the Drawings and Project Specifications.

***Lining Contractor:*** The Contractor appointed to perform the supply and the installation of the geomembrane liners required for the project

***Earthworks Contractor:*** The Contractor appointed to undertake the excavation, backfilling, compaction and surface preparation required by the Lining Contractor to allow for the installation of the geomembrane liners.

***Normal temperature:*** A temperature between 15°C and 32°C.

**Wrinkle, wave or fold:** Undulation in the liner that is caused by installation methods, temperature fluctuations or activities like cover placement taking place on the liner.

### **PA 3 APPLICABLE STANDARDS**

The following standards are applicable to this specification and can be obtained from the following sources:

**GRI Standards:** [www.geosynthetic-institute.org/specs.htm](http://www.geosynthetic-institute.org/specs.htm)

**ASTM Standards:** [www.astm.org](http://www.astm.org)

**SANS Standards:** [www.stansa.co.za](http://www.stansa.co.za)

**ASTM D 4354**, Standard practice for sampling of geosynthetics for testing

**ASTM D 4437**, Practice for determining the integrity of field seams used in joining flexible polymeric sheet geomembranes

**ASTM D 4873**, Standard Guide for Identification, Storage and Handling of Geosynthetic Rolls

**ASTM D 5641**, Standard practice for geomembrane seam evaluation by vacuum chamber

**ASTM D 5747**, Standard practice for tests to evaluate the chemical resistance of geomembranes to liquids

**ASTM, D5820**, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.

**ASTM D 6365**, Standard practice for the non-destructive testing of geomembrane seams using the spark test

**GRI Test Method GM14**, Selecting variable intervals for taking geomembrane destructive seam samples using the method of attributes.

**GRI Test Method GM19**, Seam strength and related properties of Thermally-Bonded Polyolefin Geomembranes.

**SANS 1526, Ed 2 – 2015**, Thermoplastics sheeting for use as a geomembrane.

**SANS 10409 Ed 1 - 2005**, Design, selection and installation of geomembranes

**SANS 10221 – Ed 1.2 – 2007**, Testing of geotextiles

**GRI Test Method GT12 (a)** – ASTM Version, Test method and properties for nonwoven geotextiles used as protection (or cushioning) materials

**GRI Test Method GT12 (b)** – ISO Version, Test method and properties for nonwoven geotextiles used as protection (or cushioning) materials

**GRI Test Method GT13** – ASTM Version, Test method and properties for geotextiles used as separation between subgrade soil and aggregate.

## **PA 5 MATERIALS**

The quantities set out in the schedule of quantities have been determined from data available at the time. However the liability shall rest entirely and solely with the Lining Contractor to determine before ordering, the required types and quantities of the various materials required for the completion of the Works in accordance with the specifications and the drawings issued to the Lining Contractor for construction purposes

Any reliance placed by the Lining Contractor on the estimated quantities stated in the Schedule of Quantities, or measurements made by the Lining Contractor from the drawings shall be entirely at the Lining Contractors risk and the Employer accepts no liability whatever in respect of materials ordered by the Lining Contractor on this basis.

All geosynthetic areas stated in the bill of quantities are net.

### **Material delivery and storage**

The following are applicable to all geosynthetic materials:

The area where the material is to be stored shall be free of any protrusions, rocks and other sharp objects, which could damage the material. The Main Contractor will clear an area of sufficient size for the storage of materials within 1km of the construction site next to the Main Contractor's campsite.

The Lining Contractor is to provide the necessary plant and equipment to transport the materials to the works area.

The proper storage and handling of the geosynthetic materials shall be the responsibility of the material supplier (i.e. Main Contractor in the case of geotextile separation layer or geopipes).

Materials delivered to site shall only be those as stated on the quality control sheets and lists previously disclosed to the Engineer.

All material deliveries shall be logged and a summary of this log presented to the Engineer no more than three (3) days after delivery to site for any particular material type.

The Engineer or his representative should be present, whenever possible, to observe the material delivery and unloading on Site. The Engineer or his representative will note any material received in damaged state.

### **PA 5.1 GEOMEMBRANE LINERS**

#### **Material Specification**

The high density polyethylene geomembrane liners shall be supplied and installed by the Lining Contractor as detailed on the drawings or in the bill of quantities.

All HDPE geomembranes shall be manufactured from a hexene or octene base polymer and conform to the requirements stated in the latest edition of SANS 1526 published at the date of tender/bid closure.

All HDPE geomembranes and welding rods shall be manufactured from a hexene or octene base polymer. During installation all welding rods shall have the same base polymer and additives as the Contractor supplied lining material.

The base polymer supplied, combined with the master batch additives that make up the eventual liner material and welding rods, must comply with the STD OIT **and** HP OIT specification in GRI GM13.

The geomembrane lining and welding rods provided must be capable of meeting seaming requirements specified in GRI GM19 when professionally welded with welding machines not more than three years old.

Should separation in plane (SIP) occur in any of the supplied sheets during installation, the manufacturer will be responsible for replacing the roll from which the sheet was taken, at their cost including transport. SIP in a sheet is generally believed to be a manufacturing fault, and is not viewed as acceptable by the South African regulatory authorities. Should SIP occur, the manufacturer must investigate the cause of the SIP as a matter of urgency. Although SIP is not generally seen as a welding problem, should the welding techniques involved be suspected of causing the problem, the manufacturer must work with the installer on measures to avoid SIP in the remaining project.

Rapid Tensile Tests to ASTM D 882 will be carried out to test for the possibility of SIP. The strain rate to be used in the test will be 300mm/min. No SIP should be evident from the test specimens.

Minimum panel widths for textured material is 5m to reduce on-site jointing.

Textured material to have a minimum asperity height of 0.9mm, as determined using test method ASTM D7466, and the texturing is to be applied during the extrusion process.

The Lining Contractor is to supply the following geomembrane:

- a) 1.5 mm (nominal thickness) double textured HDPE geomembrane to be used in the Ash Facility liner system and pollution control dam liner systems.

#### Deviations from GRI GM13 for Textured Material

Thickness, to be nominal, not -5%, and lowest individual for any of the 10 values is to be -10% as per ASTM D5994

Minimum Asperity Height 0.9mm as per ASTM D7466 unless otherwise shown on the drawings. If a lower asperity height is offered as an alternative, it may be accepted if laboratory

testing is submitted at tender stage to show compliance to the performance specification set out in this section.

Texturing is to be embossed unless otherwise shown on the drawings

Break elongation to be minimum 250% as per ASTM D6693 Type IV

Puncture resistance to be minimum 450 N for 1.5mm as per ASTM D4833

Oven aging requirements to be met for OIT and HP OIT following oven aging

Cover Soils

The maximum particle size D<sub>100</sub> allowed in direct contact with the geomembrane as part of a granular material that serves the purpose of a drainage medium is 5mm.

Summary of material requirements:

<b>Parameter</b>	<b>Textured Geomembrane Specification Summary</b>
Manufacture method	Flat-die, embossed
Thickness (min ave)	1.5mm
Asperity Height (min ave)	0.9mm
Density (min ave)	0.940g/cc
Tensile properties (min ave) <ul style="list-style-type: none"> <li>• Yield strength</li> <li>• Break strength</li> <li>• Yield elongation</li> <li>• Break elongation</li> </ul>	22kN/m 16kN/m 12% 250%
Rapid Tensile Tests (ASTM D882) – Strain rate 300mm/min	No SIP evident
Tear Resistance (min ave)	187N
Puncture Resistance (min ave)	450N
Stress Crack Resistance (SCR)/ Notched Constant Tensile Load	500 hours
Carbon Black Content (range)	2.0-3.0%
Carbon Black Dispersion	9 in Cat 1 or 2, and 1 in Cat 3
Standard Oxidative Induction Time (OIT)	100 minutes
High Pressure Oxidative Induction Time (HP OIT)	400 minutes
Oven aging at 85°C	

Parameter	Textured Geomembrane Specification Summary
OIT retained after 90 days, <u>and</u> HP OIT retained after 90 days	55%  80%
UV resistance • HP OIT retained after 1600 hours	50%

**Plant**

All plant shall be in good repair, adequate for its purpose and operated by persons experienced in the type of equipment used.

Welding machines may not be more than three years old. Welding machines that cause any on-going damage to geomembrane will not be permitted for further use.

**Construction**

The geomembrane liner will be installed and the quality control carried out in accordance with the latest edition of SANS 10409 published at the date of tender/bid closure. Below follows additional requirements.

Submittals Prior to Construction

The following documentation shall be submitted to the Engineer before commencement of the geomembrane installation.

- a) Proposed layout drawings of the installation, showing panel location, seams and type thereof for each layer of synthetic material to be installed. All panels and seams must be numbered in sequence of intended installation. The layouts should be drawn to scale with the design outlines in the background. The drawings shall be made submitted in electronic format. Closure joints should also be shown. In planning panel location, welding of any free-issue geomembrane to the Contractor supplied geomembrane must be minimised, i.e. the free-issue geomembrane must be used in one section as far as possible. Offcuts shorter than 10m will not be permitted to be used in the installation unless shown in the original panel layout or agreed by the Engineer.
- b) Method Statement detailing the Lining Contractor’s proposed construction procedure of the specific elements of the Works. No work related to such elements shall commence before the method statement has been submitted. Particular mention must be made of the cover placing procedure integrated with the geosynthetic

- deployment. Working hours must be specified and particular notice must be taken of the allowable folds in the liner to be placed as described under the tolerances section.
- c) Quality control documentation from the manufacturer to be submitted and approved prior to shipping of each type and gauge of geomembrane liner supplied for this project. Submittal shall include:
- dates of manufacture.
  - resin supplier/type of resin.
  - batch numbers and roll numbers, length and width.
  - documentation of the manufacturer's quality control program, which shall test data indicating the actual test values, per roll or per batch, as may be applicable.
- d) Conformance testing - each type and gauge of geomembrane liner supplied are to be tested for conformance to the specifications and approved prior to shipping by an external third party testing authority, see table further in specification for list of required conformance tests. The Lining Contractor is to include the time allowed for this testing in the material delivery schedule. This conformance testing will not supplant the conformance testing to be carried out when the material arrives at site as required.

#### Temporary Anchoring

The Lining Contractor shall supply double lined sandbags or other method approved by the Engineer to keep all material in place during the installation process. The bags are to be filled with sand of maximum particle size 5mm. A sufficient number of bags must be used to anchor the membrane on flat and sloped surfaces to prevent slippage and adequately restrain the geomembrane to prevent the formation of wrinkles, waves or folds and to secure the edges of the geomembrane liner to prevent wind uplift. The number and spacing of the bags is to be determined by the contractor.

#### Markings on Geosynthetics

All markings on the geosynthetics shall be made with a marker that will be clearly visible and that will not harm or impede the function of the geosynthetic. Only the Lining Contractor and the Engineer will be allowed to make any markings on the geosynthetics.

#### Surface Preparation

The Earthworks Contractor shall be responsible for preparing and maintaining the subgrade or supporting surface in a condition suitable for installation of the liner. The Lining Contractor

is responsible to ensure that the area to be lined is free from all protrusions, stones, roots, vegetation dry/loose soil and material and other objects that may be detrimental to the performance of the geomembrane prior to commencing installation.

In instances where the geomembrane is to be placed over a previously installed geosynthetic layer, care shall be taken that no wrinkles or folds are entrapped and that the placement of the geomembrane layer will be done such that the underlying geosynthetic is not damaged or disturbed.

A blinding layer consisting of sand and or fine gravel will only be used where specifically authorised by the Engineer.

#### Dealing with folds

The geomembranes will be installed in such a way that it lies flat on the substrate below without any tensile forces present during the coldest period of the working day. Subsequent cover layers will be placed when the geomembrane is in the condition described above. Covering of the geomembrane should therefore take place early in the morning and should be stopped once folds start to appear.

#### Cover Placement

The geomembrane will be installed in such a way that it lies flat on the substrate below without any tensile forces (i.e. trampolining) present during the coldest period of the working day. Subsequent cover layers will be placed by the Earthworks Contractor when the geomembrane is in the condition described above.

#### Acceptable Weather Conditions

Welding of the geomembrane may only occur with the limits set below:

Ambient air temperature	:	>5 °C
Ambient air temperature above dew point	:	>3 °C
Geomembrane surface temperature	:	≤75 °C

In order to achieve this, an electronic weather station must be provided that records temperature and humidity continuously. If no allowance is made in the BoQ for this item it must be included in the installation rates. Measurement of geomembrane surface temperature must be made using suitable thermometers, such as an infrared thermometer or surface thermocouple. Measurement must be undertaken hourly on an area of geomembrane that is representative of the area to be welded. Measurements must be recorded in construction quality control documentation.

After hours installation

All work carried out after normal working hours shall be assumed to be included in the installation rates. It will also be assumed that all lighting that may be required for carrying out work when dark will be included in the rates.

**Tolerances**

Verification of Permissible Deviations (PDs) are described in the table below:

1. Dimensions will be verified at normal temperature, measurements being made with a tape at normal temperature.
2. For installation, at sunrise or at such time as when, in the opinion of the Engineer, the effect of the sun is of no consequence.
3. All PDs will be rounded up to the next whole millimetre

1	2	3	4
ITEM	PERMISSIBLE DEVIATION		
	DEGREE OF ACCURACY		
	(mm)		
	III	II	I
<u>Substrate</u>			
Flatness of substrate		See Note 1 below	
<u>Anchor trenches</u>			
Anchor trench Position on plan	*	+-75	*
Anchor trench dimensions	*	-0	*
Anchor trench surface in contact with membrane	*	15	*
<u>Membranes</u>			
Refer SANS 1526 for MQC			
Waves & Folds		See Note 3below	
<u>Battens</u>			
Flatness of concrete surface		See Note 2 below	

Width of flange		+4	
Thickness of flange		-0	
Warpage of flange		Width/200	
Flatness of web		Width/120	
Location of holding down bolt centre point in plan		+3	
Thickness of Gasket		-0 to +1	

### 1. Substrate flatness

The top layer of the subgrade layer shall be graded and compacted using a smooth drum roller by the Earthworks Contractor where it needs to be prepared for the placing of the geomembrane and shall be finished such that no gap greater than 30mm can be measured beneath a 3m straight edge. No abrupt changes in falls or alignments will be allowed.

### 2. Concrete flatness

The concrete layer shall be floated with a steel float where it needs to be prepared by the Earthworks Contractor for the fixing of the geomembrane and shall be finished such that no gap greater than 1mm can be measured beneath a 200mm straight edge. No abrupt changes in the surface will be allowed.

### 3. Liner flatness

With cover: If the liner is placed with the intention of placing a cover layer over it one 20mm high x 100mm wide fold will be permitted every 10m per panel width. Propagation of folds by the placing of cover material will not be permitted. This requirement will be relaxed if it is proven on site and agreed by the Engineer that the specific liner and cover material can accommodate larger folds. This can be achieved by overlaying a fold with a heavy duty geotextile, covering the fold as per scheduled construction activities and removing the cover by lifting the geotextile

Without cover: If the liner is placed with the intention of keeping it exposed the above requirement may be relaxed as agreed by the Engineer.

Along weld: No folds or waves will be allowed along extrusion or wedge welds.

### **Material Conformance Testing**

All Manufacturing Quality Control (MQC) and Construction Quality Control (CQC) testing and reporting are described in the supporting specifications.

In addition to the above quality control testing the following independent 3<sup>rd</sup> party conformance testing will be performed.

One set of tests will be carried out for each membrane thickness, surface texturing or resin base change, per 100,000 m<sup>2</sup>, by a 3rd party accredited laboratory prior to shipping as described below. The costs for this testing are to be included in the material supply rate.

One set of ten 350mm x 350mm samples will to be cut evenly spaced across the width of a selected roll in the presence of the Engineer or his Representative once the material is delivered to site.

The samples will be cleaned and packaged and sent to TRI – Austin, Texas for testing. Information on the specific roll numbers from which the samples are cut will be recorded, these are to be different than the rolls sampled before shipping.

The cost of this testing will be for the Employer and will be paid under the allowance made in the bill.

One set of tests constitutes the items listed in the table below:

Table of Conformance Test Properties

<b>Property</b>	<b>Test method</b>
Thickness (10 spaced across a roll width)	
- Smooth	ASTM D 5199
- Textured	ASTM D 5994
Asperity height (where applicable)	ASTM D 7466
Density	ASTM D 1505
Tensile Properties	ASTM D 6693 Type IV
Rapid Tensile Test	ASTM D 882
Stress Crack Resistance	ASTM D 5397
Carbon Black Content	ASTM D 1603
Carbon Black Dispersion	ASTM D 5596
OIT – Standard Pressure	ASTM D 3895
OIT – High Pressure	ASTM D 5885
Oven Aging at 85°C Standard OIT 55% retained after 90 days	ASTM D 5721, ASTM D 3895
Oven Aging at 85°C High Pressure OIT 80% retained after 90 days	ASTM D 5721, ASTM D 5885
UV Resistance High Pressure OIT % retained after 1600 hrs	ASTM D 7238, ASTM D 5585

## **Measurement & Payment**

GM1: Supply Geomembrane

Unit: m<sup>2</sup>

Items will be provided for each membrane thickness, resin type and surface texture requirement. The area measured will be the net (i.e. exclusive of all wastage, joints and overlaps) area shown on the drawings, including area of geomembranes installed in anchor trenches. The rate shall include all costs involved in purchasing the geomembrane local or international, MQC testing, pre shipping conformance testing, transport to site, off-loading and storage as per specification. The rate is to allow for cover to protect from UV damage while in stockpile.

The quantities set out in the schedule of quantities have been determined from data available at the time of design. However the liability shall rest entirely and solely with the Lining Contractor to verify, before ordering, the required types and quantities of the various materials required for the completion of the Works in accordance with the specifications and the drawings issued to the Earthworks Contractor for construction purposes. Any reliance placed by the Lining Contractor on the estimated quantities stated in the Schedule of Quantities, or measurements made by the Lining Contractor from the drawings, shall be entirely at the Lining Contractor's risk and the Employer accepts no liability whatever in respect of materials ordered by the Lining Contractor on this basis.

The date of order shall be taken as one week after the works is awarded unless otherwise agreed in writing. The rate is subject to adjustment caused by foreign exchange and shall be fixed on the date of order. The rate shall therefore include all finance costs, forward cover costs from date of order to actual installation and subsequent payment terms of the project.

The following items will be provided:-

- The exchange rate on which the item is based
- The percentage of the rate that is subject to change
- The forward cover variation will be allowed for in the Schedule of Quantities

GM2: Install Geomembrane

Unit: m<sup>2</sup>

Items will be provided for each membrane thickness, resin type and surface texture requirement. The area measured will be the net (i.e. exclusive of all joints and overlaps) shown on the drawings including area of geomembranes installed in anchor trenches. The rate shall include the cost of preparing panel layout drawings in electronic format, transporting from stockpile, cutting, placing, overlapping, joining, temporary anchoring, repairing, terminating, fastening the membrane in position during construction, any temporary

protection works against flooding, uplift, traffic and any other adverse conditions that may exist. All work carried out after normal working hours is included in the installation rates. All lighting that may be required for carrying out work when dark should be included in the installation rates. The rate shall also include for all CQC as specified. Payment of installation will be based on approval of CQC documentation, according to SANS 10409 being up to date and approved by the Engineer. The tendered rate shall for installation of free issued material shall include collection of the liner from the Employer's UCG office which situated approximately 20km from the Site.

**GM3: Anchor trench**

Unit: m<sup>3</sup>

Items will be provided for each anchor trench configuration. The rate shall include for excavation in all materials, shaping the trench to the lines shown on the drawings, temporarily stockpiling the material adjacent to the trench, backfilling in layers not exceeding 200mm and compacting the material as specified and spoiling the excess material. If no compaction is specified the material will be compacted by two passes with a 1 ton smooth drum roller or equivalent approved. This item is the responsibility of the Earthworks Contractor.

**GM4: Batten**

Unit: Sum

Items will be provided for each batten detail configuration. The rate shall include for cleaning the surface area with a high pressure water jet if required by the Engineer, supplying all steelwork, gaskets, geotextiles and holding down bolts as shown on the drawings and installing the batten including all cutting, joining, drilling and wastage as detailed. The rate shall also include adequate liner protection over the working areas, and cleaning all metal shavings and other installation waste off the liner during installation after completion as directed by the Engineer. This item is covered under a provisional sum in the Schedule of Quantities.

**GM5: Penetration**

Unit: Sum.

Items will be provided for penetration detail configuration. The rate shall include for cleaning the surface area with a high pressure water jet if required by the Engineer, supplying all steelwork, concrete work, gaskets and geotextiles as shown on the drawings and installing the penetration as detailed including all, cutting, fixing, joining and wastage. Note that battens associated with the detail will be billed separately as above. The rate shall also include adequate liner protection over the working areas, and cleaning all metal shavings and other installation waste off the liner during installation after completion as directed by the Engineer. This item is covered under a provisional sum in the Schedule of Quantities.

GM6: 3<sup>rd</sup> party testing

Unit: Sum.

Items will be provided for conformance testing of materials delivered to site for each membrane thickness, resin type and surface texture requirement. The costs shall include the material cost of the samples, marking, cutting, packaging, dispatching, testing the samples at the laboratory and reporting thereon.

**Performance specification for alternative geomembranes with asperities height below 0.9mm**

The following performance specification is required if alternative geomembranes are offered with asperities lower than 0.9mm:

- Peak friction angle of 26.5 degrees

Critical interfaces requiring shear characterisation:

- Protection Geotextile to 1.5mm Double Textured HDPE Geomembrane
- Primary 1.5mm Double Textured HDPE Geomembrane to Site Specific Clay Material compacted to specification

The normal stress range that testing must include:

- Minimum Normal Stress of 10kPa
- Maximum Normal Stress of 800kPa

The only deviation from the PA (Particular Specification for Geomembranes) that will be accepted is a deviation from the 0.9 mm asperity height specification. Conformance testing must prove that any alternative geomembrane will have a peak friction angle of greater than or equal to the specified friction angle for the critical interfaces under the normal stress range listed above.

The conformance testing must be according to ASTM D 5321: Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

The following parameters shall be used:

- Shear rate 0.1mm/min (geomembrane / clay interface), 1.0mm/min (geomembrane / geotextile interface)
- Samples shall be tested in saturated/wet condition
- A minimum of 4 points are required to drawing the curve on the Shear Stress vs. Normal Stress graph to measure the friction angle.

Full laboratory reports showing all results and post-test photos must be submitted.

**PA 5.2 GEOTEXTILES**

The geotextiles as specified below shall be supplied and installed by either the Lining Contractor or the Main Contractor, as may be the case, as detailed in the drawings. Installation by the Main Contractor is to take place in consultation with the liner contractor where necessary.

**Geotextile for Liner Protection**

The protection geotextile shall be a minimum 1000g/m<sup>2</sup> non-woven, needle-punched, staple fibre or continuous filament, polypropylene, which complies with the specifications as set out in GRI-GT12 (a).

Extract from GRI-GT12 (a) & (b)

Property	Test Method	Unit	Value
GRI-GT12(a)			
Mass per unit area	ASTM D5261	g/m <sup>2</sup>	750
Tensile Properties			
Strength	ASTM	kN	1.80
Strain @ max load	D4632 ASTM D4632	%	50
Trapezoidal Tear Strength	ASTM D4533	kN	0.75
CBR Puncture			
Max force	ASTM	kN	4.52
Elongation @ max force	D6241 ASTM D6241	mm	38

**Geotextile for Drainage**

The drainage geotextile shall be a non-woven, needle-punched, staple fibre or continuous filament, polypropylene, with a **minimum in-plane flow rate value of 4.17×10<sup>-3</sup> l/m<sup>2</sup>/hr at a 1:4 slope and confining pressure of 200kPa**. The material shall also meet GRI-GT13 Class 2 (moderate survivability) as per Table 2 (b) extract in the section below for 'Geotextile for Separation'.

Please note that the above is only given as a guide and that it will still be the responsibility of the contractor to become familiar with the full specification.

**Geotextile for Separation**

The separation geotextile shall be a non-woven, needle-punched, staple fibre or continuous filament, polypropylene, which complies with the specifications as set out in GRI-GT13 Class 2 (moderate survivability).

Extract from GRI-GT13

Table 2 (b)-Geotextile Properties Class 2 (Moderate Survivability)

Property	ASTM Test	Unit	Elongation ≥ 50%
Grab Tensile Strength	D4632	N	700
Trapezoid Tear Strength	D4533	N	250
CBR Puncture Strength	D6241	N	1400
Permittivity	D4491	Sec <sup>-1</sup>	0.02
Apparent Opening Size	D4751	Mm	0.60
Ultraviolet Stability	D4355	% Ret. @ 500 hrs	50

Please note that the above is only given as a guide and that it will still be the responsibility of the contractor to become familiar with the full specification.

- a) The ASTM specifications for GRI GT 12 and GT13 have been included as external conformance testing will be carried out at TRI in the USA. If suppliers data sheets are compiled in ISO format then the ISO versions of the GRI GT 12 and GT 13 specifications will be used to adjudicate initial compliance, however conformance testing and compliance to the specifications will be finalized on the ASTM values.

**5.2.1 Testing**

Conformance testing on all supplied geotextiles - each type and gauge of geotextile supplied is to be tested for conformance to the specifications and approved prior to shipping or transporting by an external third party testing authority, see table further in specification for list of required conformance tests. The supplier is to include the time allowed for this testing in the material delivery schedule. This conformance testing will not supplant the conformance testing to be carried out when the material arrives at site as required.

The geotextiles shall be tested after arrival on site, or if taken from an existing stockpile, the procedure to be followed is:

Once material has been delivered to site, or identified in stockpile, the Engineer will cut samples and arrange for shipping and testing. A sample will be cut from any roll at random, but not the same roll as that tested prior to shipping.

A 300mm wide strip is to be cut along the total width of the roll. This is then to be subdivided into 300mm wide samples. Six (300mm × 300mm) samples as indicated by the Engineer will be sent to the testing facility.

The geotextiles will be tested for the properties as listed below:

Property	Test Method
Thickness (Drainage geotextile)	ASTM D-1777
In-plane permeability at 200kPa confining pressure (Drainage geotextile)	ASTM D 4491
Mass per unit area	ASTM D 5261/ ISO 09864
Tensile Properties	ASTM D 4632/ISO 10319
Trapezoidal Tear Strength	ASTM D 4533/ISO 13434

### 5.2.2 Storage and handling

All geotextiles shall be handled and stored as described in ASTM D 4873.

### 5.2.3 Installation

Geotextile fabric shall be placed as detailed on the drawings.

At the time of installation fabric shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation, or storage.

The area on which the fabric is to be placed shall be smooth and free of projections or depressions that may cause the fabric to be punctured.

Geotextile fabric shall be placed without stretching and shall lie smoothly in contact with the prepared surface. Fabric shall be placed with seams overlapping 150mm.

Edges of the material shall be sufficiently anchored during installation to prevent displacement by wind.

No geotextile shall be exposed to UV radiation for longer than 14 days without agreement from the Engineer, unless it is being used in a sacrificial application or is intended to be exposed as shown on the construction drawings.

Before handover (i.e. completion of an area of responsibility of the work) by the Lining Contractor to any other party, the Lining Contractor, the Engineer and the Third Party Controller shall conduct a detailed walk-through of the lined facility and visually check all

seams and non-seamed areas of the geotextile for defects, holes, or signs of damage during installation.

### **PA 5.3 GEOCELLS**

The geocells, as specified below, will be supplied and installed by the main contractor as detailed in the drawings where specified. Installation by the contractor is to take place in consultation with the lining contractor where necessary.

The geocells shall be a high tenacity polypropylene tape, coated with polyethylene and shall comply with the specifications shown below:

<b>Property:</b>	<b>Test Method:</b>	<b>Unit:</b>	<b>Value:</b>	<b>Note:</b>
Tensile strength	SANS 10221	kN / m	26	Minimum (Warp & Weft)
Elongation	SANS 10221	%	12	Maximum (Warp & Weft)

The geocells used are to be in a 200 x 200 mm grid and range from 100 to 250 mm high as shown on the drawings.

#### **5.3.1 Installation**

At the time of installation fabric shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation, or storage.

The area on which the fabric is to be placed shall be smooth and free of projections or depressions that may cause the fabric to be punctured.

Lay the geocells over the prepared area ensuring that the top of the cells are level with the surrounding terrain and that the highest section of the panel is secured in a lock trench at the top of the embankment or slope.

Where the geocells are underlain by earth material, anchor the geocells to the prepared surface with inverted shepherd's crook shaped steel stakes made from 10 mm to 12 mm reinforcing rod, or similar. Every alternate cell should be staked along the edge of each section to ensure that the system is well secured.

Join and align the alternate cells of each section of geocells using cable ties to create a continuous cover over the site. Tension the cover from the highest to the lowest point of the slope by staking the bottom edge of the corner to ensure that the individual cells are fully open to receive the fill.

Fill the cells of the entire geocell cover with the selected material to give the required finish to the installation e.g. a filter sand to promote drainage or concrete which provides a smooth water resistant finish.

In the case where concrete is used as fill, the surface should be raked flush to the top of the cells.

Before handover (i.e. completion of an area of responsibility of the work) by the Lining Contractor to any other party, the Lining Contractor, the Engineer and the Third Party Controller shall conduct a detailed walk-through of the lined facility and visually check all seams and non-seamed areas of the geotextile for defects, holes, or signs of damage during installation.

**PA 5.6 SILT FENCES**

The silt fences, as specified below, will be supplied and installed by the *Contractor* as detailed in the drawings where specified.

The silt fences shall be a woven polypropylene slit film geotextile, and shall comply with the specifications shown below:

<b>Property:</b>	<b>Test Method:</b>	<b>Unit:</b>	<b>Value:</b>
Mass	SANS 10221	g/m <sup>2</sup>	200
Thickness	SANS 10221	Mm (under 2 kPa)	1.0
Through flow	SANS 10221	l/s/m <sup>2</sup>	130
Tensile strength	SANS 10221	kN / m	“Warp” 26
Elongation	SANS 10221	%	“Warp” 12

The silt fences are to be supported by creosote soaked wooden pegs, 65mm in diameter (minimum), spaced at 1.5m intervals.

**PA 5.5 VERTICAL DRAINS**

The vertical drains shall consist of a polymer drainage core with a geotextile jacket wrapping and shall comply to the latest version of GRI GC16 – Standard Specification for Prefabricated Vertical Drains.

The vertical drains will need to be installed by a specialist sub-contractor using specialist rigs.

**PA 5.6 EROSION CONTROL MATS**

**5.6.1 Material**

The geosynthetic erosion control blanket shall comply with the specifications shown below:

<b>Physical Properties:</b>	<b>Units</b>	<b>Value</b>
Mass	g/m <sup>2</sup>	≥ 290
Composition	-	100% Jute Fibre
Aperture Size	mm	10 x 10
Open Area	%	≥ 65

**5.6.2 Installation**

The geosynthetic erosion control blanket will be supplied and installed by the Earthworks Contractor as detailed in the drawings and in accordance with manufacturer’s installation guidelines.

At the time of installation, the fabric shall be rejected if it has defects, tears, flaws, deterioration or damage incurred during manufacture, transportation, handling or storage.

The area on which the blanket is to be placed shall be smooth and free of projections or depressions that may cause the blanket to lose contact with the soil. Geosynthetic erosion control blanket shall be placed without stretching and shall lie smoothly in contact with the prepared vegetated surface. Fabric shall be placed with minimum overlaps and anchored in line with manufacturer’s recommendations.

Edges of the material shall be sufficiently anchored during installation to prevent displacement by wind.

The geosynthetic erosion control blanket shall be held down with manufacturer approved stakes at 1m, centre to centre intervals or as per manufactures guidelines.

Before handover (i.e. completion of an area of responsibility of the work) by the Contractor to any other party, the Contractor, the Engineer and the Third Party Controller shall conduct a detailed walk-through of the lined facility and visually check all seams and non-seamed areas of the geosynthetic erosion control blanket for defects, holes, or signs of damage during installation.

**PA 6 PLANT**

All plant shall be in good repair, adequate for its purpose and operated by persons experienced in the type of equipment used.

### PA 6.1 Material Delivery and Plant

The products shall be packaged, transported, unloaded and stored in accordance with the manufacturer's instructions, subject to the engineer's approval, and generally in accordance with ASTM Standard D 4873, "Standard Guide for Identification, Storage and handling of Geosynthetic Rolls"

The following are applicable to all geosynthetic materials:

- a) The area where the material is to be stored shall be free of any protrusions, rocks and other sharp objects, which could damage the material. The Contractor will clear an area of sufficient size for the storage of materials within 2km of the construction site close to the Contractor's campsite.
- b) The Contractor is to provide the necessary plant and equipment to transport the materials to the *works* area.
- c) Materials delivered to site shall only be those as stated on the quality control sheets and lists previously disclosed to the Engineer.
- d) All material deliveries shall be logged and a summary of this log presented to the Engineer no more than three (3) days after delivery to site for any particular material type.

## PA 7 MEASUREMENT & PAYMENT

### PA 7.1 GEOSYNTHETIC SUPPLY AND INSTALLATION

UNIT: m<sup>2</sup>

Items will be provided for each geosynthetic type required. The area measured will be the net (i.e. exclusive of all wastage, joints and overlaps) area shown on the drawings; material in the anchor trench is included in the quantities.

The quantities set out in the schedule of quantities have been determined from data available at the time. However the liability shall rest entirely and solely with the Contractor to determine before ordering, the required types and quantities of the various materials required for the completion of the *works* in accordance with the specifications and the drawings issued. Any reliance placed by the Contractor on the estimated quantities stated in the Schedule of Quantities, or measurements made by the Contractor from the drawings shall be entirely at the Contractor's risk and the *Employer* accepts no liability whatever in respect of materials ordered by Contractor on this basis.

The supply rate shall include all costs involved in purchasing the geosynthetic local or international, MQC testing, transport to site, off-loading and storage as per specification.

The installation rate shall include the cost of cutting, placing, overlapping, joining, repairing, terminating, and fastening the geosynthetics in position during construction, any temporary protection works against flooding, upliftment, traffic and any other adverse conditions that may exist. The rate shall also include for all CQC testing as specified.

## **PA 8 ALTERNATIVES**

The original design and specified product is to be priced. Alternatives will be considered and must be fully detailed on a covering letter covering all aspects including, but not limited to, technical specifications, prices and delivery dates.

### **PARTICULAR SPECIFICATION PB : HDPE PIPING AND FITTINGS**

#### **PB 1 SCOPE**

This specification covers the materials and components used, the fusion jointing procedure and equipment and the quality assessment of the completed joints for HDPE piping.

#### **PB 2 INTERPRETATIONS**

##### **PB 2.1 SUPPORTING SPECIFICATIONS**

- SANS/ISO 4427-1:2008: Plastics piping systems -- Polyethylene (PE) pipes and fittings for water supply -- Part 1: General
- SANS/ISO 4427-2:2008: Plastics piping systems -- Polyethylene (PE) pipes and fittings for water supply -- Part 2: Pipes
- SANS/ISO 4427-3:2008: Plastics piping systems -- Polyethylene (PE) pipes and fittings for water supply -- Part 3: Fittings
- SANS/ISO 4427-5:2008: Plastics piping systems -- Polyethylene (PE) pipes and fittings for water supply -- Part 5: Fitness for purpose of the system
- ISO 21307: Edition 2 (2011) : Butt fusion jointing procedures for PE pipes and fittings used in the construction of gas and water distribution systems
- SANS 10268-10:2009: Welding of thermoplastics - Welding processes Part 10: Weld defects

- SANS 2001 – DP2:2008: Construction works part 2: Medium pressure pipelines

## PB 2.2 DEFINITIONS

Refer supporting definitions.

## PB 3 SUBMITTALS

### PB 3.1 PRIOR TO CONSTRUCTION

The following documentation shall be submitted by the Contractor to the Engineer for approval prior to construction.

- a) Certificates of Compliance (COC) in terms of ISO 4427 part 1, 2 and 3 on raw materials used and extruded pipe to be supplied by the Manufacturer.
- b) All piping and fabricated fittings shall be manufactured from a PE 100 granule compound complying with table 1 as specified in ISO 4427 part 1
- c) No recycled material, even internal, is allowed to be used in the pipes manufacture. Manufacturers are to certify this as part of the COC.
- d) The Manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, and inspection of pipe and appurtenances shall be furnished.
- e) The pipe and fittings manufacturer shall have an established quality assurance program responsible for inspecting incoming and outgoing materials. The pipe manufacturer should preferably be a member of the South African Plastic Pipe Manufacturers Association (SAPPMA) or a similar international accreditation body.
- f) As a minimum, incoming polyethylene raw materials shall have a Certificate of Analysis (COA) and be tested for density, melt flow index, oxidative induction time, carbon black content and carbon black dispersion as per the relevant test methods and values stated in **P.S.C 4.1**. All incoming polyethylene materials shall be certified by the supplier who must run internal testing to verify the raw material properties. Certification shall be verified by a Manufacturing Quality Assurance programme. Incoming materials shall be approved before processing into finished goods.
- g) The pipe and fittings manufacturer shall have an established quality assurance program responsible for assuring the long term performance of materials and

products. Representative samples of polyethylene materials shall be tested against the physical property requirements of this specification.

- h) Each extrusion line and moulding machine shall be qualified to produce pressure rated products by taking representative production samples and performing sustained pressure tests in accordance with ISO 4427-2, Table 3.
- i) Quality assurance test for representative pipe and fitting samples shall include:

Test	Standard	Pipe	Fittings
Slow crack growth	ISO 13479	Yes	Not Applicable
Hydrostatic strength at 80 °C	ISO 1167-1&2	Yes	Yes
Hydrostatic strength at 20 °C	ISO 1167-1&2	Yes	Yes

- j) All outgoing materials shall be inspected for diameter, wall thickness, length, straightness, out-of-roundness, concentricity, toe-in, inside and outside surface finish, markings, and end cut. Manufacturing Quality Control shall perform tests of melt flow index, oxidative induction time, carbon black content and carbon black dispersion as per the relevant test methods and values stated in **P.S.C 4.1** on the manufactured pipe. Moulded fittings shall be subject to x-ray inspection for voids, and tests for knit line strength. All fabricated fittings shall be inspected for fusion quality and alignment. The pipe and fitting manufacturer shall maintain permanent QC and QA records.
- k) The pipe and fitting manufacturer shall package products for shipment in a manner suitable for safe loading, transport and off-loading by a commercial carrier. When delivered, a receiving inspection shall be performed, and any shipping damage reported to the pipe and fittings manufacturer. Pipe and fittings shall be handled, installed, and tested in accordance with manufacturer's recommendation, and the requirements of this specification.
- l) Once delivered to site the *Supervisor* will take a sample of the pipe and perform tests of melt flow index, oxidative induction time, carbon black content and carbon black dispersion as per the relevant test methods and values stated in P.S.C 4.1 on the delivered pipe. An allowance in the Schedule of Quantities will be made for these tests.

**PB 4 MATERIALS**

**PB 4.1 CHARACTERISTICS/PHYSICAL PROPERTIES**

The Materials used for the manufacturer of polyethylene pipe and fittings shall meet the following minimum characteristics for polyethylene compound in granule and pipe form, and shall comply to the physical property requirements for **PE100**:

<b>Physical Properties – Granule</b>	<b>Test Method</b>	<b>Values</b>	<b>Unit</b>
Density	ISO 1183-2	≥ 930	Kg/m <sup>3</sup>
Carbon Black Content	ISO 6964	2.0 – 2.5	% by mass
Carbon Black Dispersion	ISO 18553	≤ Grade 3	
Volatile Content	EN 12099	≤ 350	mg/Kg
Water Content	ISO 15512	≤ 300	mg/Kg
Oxidative Induction Time	ISO 11357-6	≥ 50	minutes
Melt flow index (190°C/5Kg)	ISO 1133:2005	0.2 – 1.4	g/10 min
Note: Water content is only applicable if the measured volatile content is not in conformity with its specified measurement.			

<b>Physical Properties Pipe</b>	<b>Test Method</b>	<b>Mode</b>
Tensile strength for butt fusion	ISO 13953	Ductile-pass, brittle - fail
Slow crack growth	ISO 13479	No failure during test
Hydrostatic strength	According to ISO 4427-2 Table 3	
Elongation at break	According to ISO 4427-2 Table 5	

**PB 4.2 PIPE AND FITTINGS**

a) Dimensions (PE100):

1. Pipe diameter and Class to be used shown in table below

Type	Diameter	Class	SDR
Collector	200 OD	10	17

2. Pipe Dimensions: The nominal inside diameter of the pipe shall be true to the specified pipe size in accordance with ISO 4427-2 Part 2 Table 1 & 2. Standard laying lengths shall be 6 m or 12 m, as may be specified by the Engineer.
  3. All piping shall be black with or without a blue identification stripe. No other colour identification stripe shall be accepted.
  4. Fitting Dimensions: Fittings such as coupling, wyes, tees, adaptors, etc. for use in laying pipe shall have standard dimensions that conform to ISO 4427-3 Part 3.
- b) Where possible, pipe and fittings should be produced by the same manufacturer from identical materials meeting the requirements the ISO 4427 Part 3 specification.
- c) Pipe and fittings shall be pressure rated to meet the service pressure requirements specified by the Engineer. Whether moulded or fabricated, fittings shall be fully pressure rated to at least the same service pressure rating as the pipe to which joining is intended.
- d) Moulded fittings shall meet the requirements this specification. At the point of fusion, the outside diameter and minimum wall thickness of fitting butt fusion outlets shall meet the diameter and wall thickness specifications of the mating system pipe. Fitting markings shall include a production code from which the location and date of manufacture can be determined. Upon request, the manufacturer shall provide an explanation of this production code.
- e) Markings:
1. All piping and fabricated fittings shall be clearly marked as per ISO 4427 Part 2 and 3 section 11, thus enabling full traceability at all times.
  2. Typically this must display as a minimum the: Standard to which this is produced, The Manufacturer ID, pipe dimensions, SDR, material spec, Pressure rating and unique identification mark.
  3. The info as per item 2 must be displayed once/ meter pipe and at least once on the fitting.

### **PB 4.3 SOURCE QUALITY CONTROL**

#### a) Inspection requirements:

1. Notification - If inspection is specified by the purchaser, the manufacturer shall notify the purchaser in advance of the date, time and place of testing of the pipe in order that the purchaser may be represented at the test.
2. Access - The *Employer's* representative shall have free access to the inspection area of the manufacturer's plant. The manufacturer shall make available to the *Employer's* representative, without charge, all reasonable facilities for determining whether the pipe meets the requirements of this specification.
3. Certification - As the basis of the acceptance of the material, the manufacturer will furnish a certificate of conformance of these specifications upon request. When prior agreement is being made in writing between the purchaser and the manufacturer, the manufacturer will furnish other conformance certification in the form of affidavit of conformance, test results, or copies of test reports

#### b) Physical Test Requirements

1. Sampling - The selection of the sample of pipe shall be as agreed upon by the purchaser and the manufacturer. In case of no prior agreement, any sample selected by the manufacturer shall be deemed adequate
2. Conditioning - Conditioning of samples prior to and during test shall be as per the specified national or international standard. In case of no applicable standard, conditioning shall be for a minimum time of 24 hrs at a temperature of  $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ .

## **PB 5 EXECUTION**

### **PB 5.1 FIELD QUALITY CONTROL**

#### a) Pipe may be rejected for failure to conform to specifications or following:

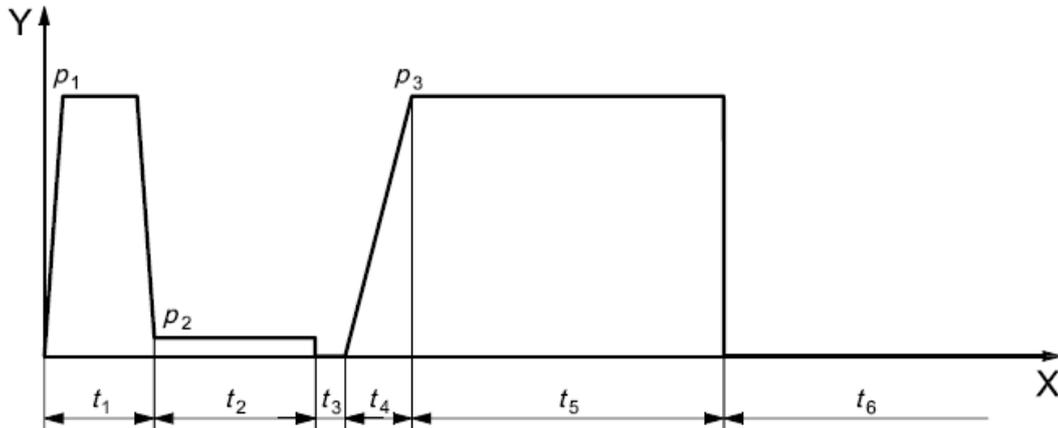
1. Fractures or cracks passing through the pipe wall.
2. Scratches, mechanical damage sufficient to impair strength, durability or serviceability of pipe.

3. Defects indicating improper proportioning, mixing, and moulding.
  4. Damaged ends, where such damage prevents making satisfactory joint.
  5. Pipe ends shall be cut cleanly and square to the axis of the pipe.
  6. Pipe internal and external surface appearance shall be smooth, clean and free from scoring, cavities and other surface defects such as pinholes.
- b) Acceptance of fittings, stubs or other specifically fabricated pipe sections shall be based on visual inspection at job site and documentation of conformance to these Specifications and ISO 4427 Part 3.
- c) Notify Engineer prior to backfilling trench. Contractor is to obtain as-built top of pipe coordinates and elevations at 20m intervals along the pipe prior to backfilling. **Also see PSC 6 Testing.**

**PB 5.2 INSTALLATION**

- a) Heat fusion of pipe to be single pressure with high fusion jointing pressure in accordance with ISO 21307 and SANS 10268 as specified in the table below:

<b>Parameter</b>	<b>Unit</b>	<b>Value</b>
Heater plate temperature	°C	200 – 230
Initial bead-up fusion jointing pressure	MPa	0.52 +/- 0.1
Min heat soak time	sec	(11 +/- 1) x e <sub>n</sub>
Min bead size after heating	mm	0.15 e <sub>n</sub> + 1
Heat soak pressure	MPa	0 to drag pressure
Max heater plate removal time	s	0.1 e <sub>n</sub> + 8
Fusion jointing pressure	MPa	0.52 +/- 0.1
Min cooling time in the machine under pressure	min	0.43 e <sub>n</sub>
Min cooling time out the machine	min	<sup>a</sup>
<sup>a</sup> = A cooling time out of the machine and before rough handling may be recommended but in most cases is not necessary with these cooling times		



**Key**

- X time
- Y pressure
- $t_1$  initial bead-up time
- $t_2$  heat soak time
- $t_3$  heater plate removal time
- $t_4$  time to achieve fusion jointing pressure
- $t_5$  cooling time in the machine under pressure
- $t_6$  cooling time out of the machine
- $p_1$  initial bead-up pressure
- $p_2$  heat soak pressure
- $p_3$  fusion jointing pressure

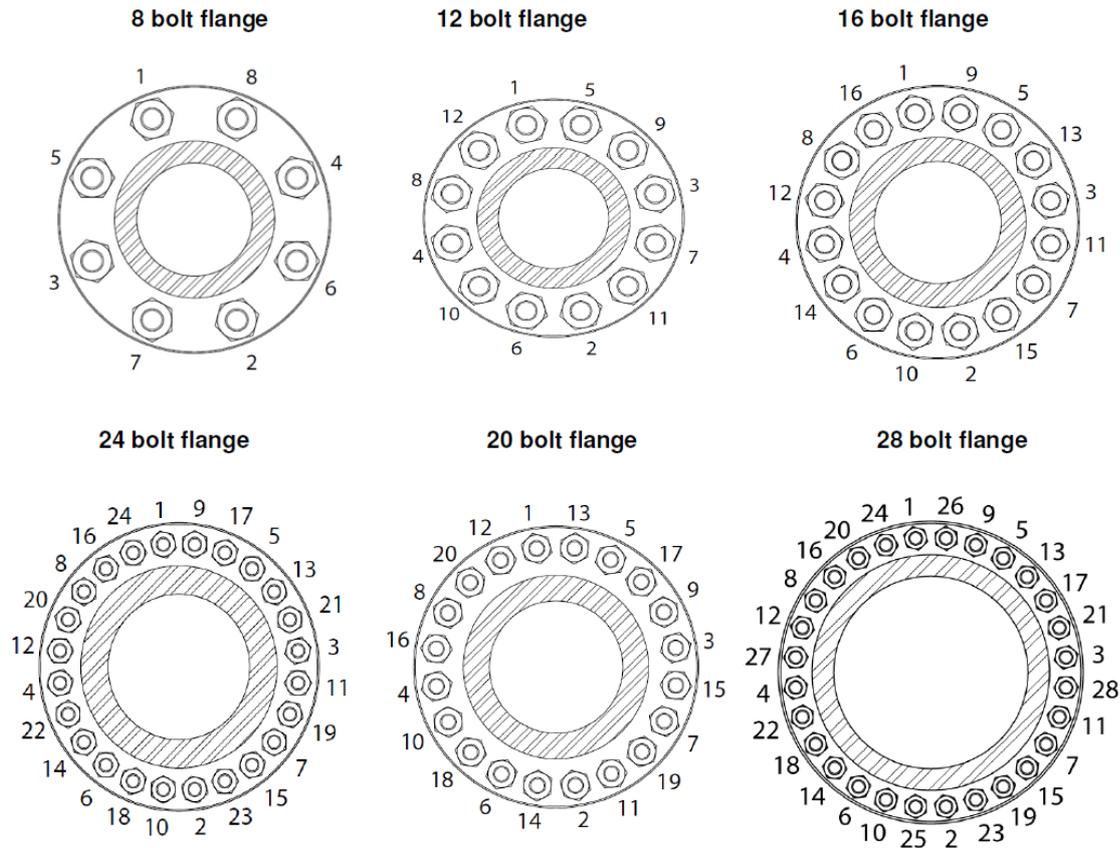
1. Provide fusion operators certified by the pipe manufacturer.
2. Butt fusion equipment for joining procedures shall be capable of meeting conditions recommended by ISO 21307 including, but not limited to, temperature requirements, alignment, and fusion pressures.
3. For cleaning pipe ends, planning unit and heater surfaces, a dry, clean, lint-free, non-synthetic cloth such as cotton is to be used every time. In extreme cases water can be used for cleaning followed by drying with a cloth as above. In the case of oil contamination Acetone or greater than 90% Isopropyl alcohol can be used.
4. Do not bend pipe to greater degree than minimum radius recommended by manufacturer for type and grade.
5. Do not subject pipe to strains that will overstress or buckle piping or impose excessive stress on joints.
6. Branch saddle fusions shall be joined in accordance with manufacturer's recommendations and procedures. Branch saddle fusion equipment shall be of size to facilitate saddle fusion within trench.

7. Trial welds to be undertaken and externally tested prior to production welds being initiated.
8. Clamp the components in the butt fusion jointing machine and adjust as necessary to achieve proper alignment.
9. Plane the pipe or fitting ends to establish clean, parallel mating surfaces.
10. Remove any shavings from the pipe or fittings. Inspect the pipe for incomplete planing, voids or other imperfections and then bring them together to check for proper alignment.
11. Measure the gauge pressure required to overcome the frictional drag force of the machine and pipe. This pressure shall be added to the calculated bead-up and fusion jointing pressure.
12. Heater plate to be checked with hand held thermometer for even temperature distribution. The temperatures are to be taken at a minimum of four positions on the plate, and should not vary by more than 5 degrees. Readings to be recorded in the CQA data.
13. Install the heater plate in the machine and bring both pipe ends simultaneously into full contact with the heater plate to produce molten surfaces for fusion jointing. Pipe ends are not to be over pressurised during the soak time to prevent formation of pockets on the joint, maximum allowed pressure is to be 10% of the fusion pressure, soak pressure to be recorded in the CQA data.
14. At the completion of the heat soak time, pull the pipe from the heater plate then remove the heater plate and bring the pipes together in a controlled manner. The joint shall be held at the jointing pressure for the prescribed jointing time.
15. The molten joint shall be held immobile under pressure in the machine for the prescribed time.
16. An even double roll back bead all around the circumference of the pipe should be visible, both in width and height, with a smooth appearance. The pipes must be properly aligned, no mitered joints allowed, and there must be no visual evidence of any contamination in the bead.
17. Cover at end of each working day open ends of fused pipe. Cap to prevent entry by animals or debris.
18. Use compatible fusion techniques when polyethylenes of different melt indexes are fused together. Refer to manufacturer's specifications for compatible fusion.
19. Remove shavings inside pipe caused by perforation drilling prior to jointing.
20. Remove internal beads on leachate collection pump riser to allow for smooth entry and exit of the pump.

21. The details of the fusion joint procedure and conditions under which the fusion joint was executed must be fully logged. Electronic equipment, such as data loggers, is the preferred method. Data captured must comply with ASTM F3124 – Data capture requirements.

b) Flange Jointing:

1. Used on flanged pipe connection sections.
2. Connect slip-on carbon steel backup flanges with stainless steel nuts and bolts.
3. Butt fuse fabricated/ moulded flange adapters to the pipe.
4. Observe the following precautions in connection of flange joints:
  - a. Align flanges or flange/valve connections to provide a tight seal. Gaskets are not required for HDPE/ HDPE and HDPE/ Carbon connections as specified by the Engineer. Flange faces are undamaged and clean – rectify any surface damage prior to starting the bolt up process.
  - b. Place round washers as may be required on some flanges in accordance with manufacturer's recommendations. Bolts shall be lubricated with grease in accordance with manufacturer's recommendations.
  - c. Tighten flange bolts in a criss-cross sequence and accordance with manufacturer's recommendations. Hand tighten/ normal spanner tighten the bolts and nuts in the required sequence and recheck that there is no gap between the flange faces. The faces must be parallel.



- d. Allow the HDPE to “settle” for a minimum of 4 hrs before the final torque is applied. The correct range size torque wrench must be used and the torque wrench calibration certificate is to be available on site.
5. Pull bolt down by torque in accordance with manufacturer’s recommendations, typical torque values shown in the table blow

Pipe OD (mm)	Bolt diameter (mm)	No. of bolts	Max lubed torque (N.m)
90	16	8	70
110	16	8	90
125	16	8	90
140	16	8	100
160	20	8	100
180	20	8	135
200	20	8	165
225	22	12	165
250	22	12	165

280	22	12	220
315	24	12	300
355	24	12	370
400	24	16	370
450	28	16	410
500	28	20	410
560	32	20	490
630	32	24	590
710	32	28	590
800	38	28	870
900	38	32	950
1000	38	36	950

Refer to Plastics Pipe Institute TN -38/ July 2011

6. Protect below ground bolts and flanges by covering with a 1.5mm thick polyethylene wrap. Denso tape wrap to the HDPE pipe.
7. Electrofusion couplers, where used, shall installed per MAB Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe and Installation Guidelines For Electrofusion Couplings 14" and Larger TN-34/2009 both available on the Plastics Pipe Institute Inc. (PPI) website <http://plasticpipe.org>

### PB 5.3 PIPE PLACEMENT

Pipe placement is to be conducted as follows:

1. Grade control equipment shall be of type to accurately maintain design grades and slopes during installation of pipe.
2. Dewatering: Remove standing water in trench before pipe installation.
3. Unless otherwise specifically stated, install pipe in accordance with manufacturer's recommendations.
4. Maximum lengths of fused pipe to be handled as one section shall be placed according to manufacturer's recommendations as to pipe size, pipe SDR, and topography so as not to cause excessive gouging or surface abrasion; but not to exceed 120m.

5. Cap pipe sections longer than single joining (usually 12m) on both ends during placement except during fusing operations.
6. Notify Engineer prior to installation pipe into trench and allow time for Engineer's inspection, correct irregularities found during inspection.
7. Complete tie-ins within trench whenever possible to prevent overstressed connections.
8. Allow pipe sufficient time to adjust to trench temperature prior to testing, segment tie-ins or backfilling activity.
9. Install reducers adjacent to laterals and tees.
10. To reduce branch saddle stress, install saddles at slope equal to and continuous with lateral piping.
11. Place in trench by allowing minimum 300mm/30m for thermal contraction and expansion.
12. Coordinate construction of pipes near access roads with *Employer* to limit impediment of site operations or operations of other Contractors.

**PB 5.4 PERFORATIONS**

Perforated seepage collection pipes are to be perforated with 4 x 15 mm diameter holes drilled at 150 mm centre to centre, unless stated as solid or shown differently on the drawings.

**PB 5.5 CORRUGATED, SLOTTED AND PERFORATED PIPE**

Specified seepage collector pipes shall be slotted and perforated, double wall corrugated, 160 mm HDPE pipe.

The pipe shall comply with the following specifications:

<b>Property:</b>	<b>Unit:</b>	<b>Value:</b>
Outside diameter	mm	160
Inside diameter	mm	137
Infiltration area	mm <sup>2</sup> /m	> 7000
Nominal slot width	mm	1.8
Nominal hole diameter at 100mm centres	mm	15
Ring stiffness	kPa	> 450

**PB 6 TESTING FOR PRESSURE PIPELINES**

**PB 6.1 PREPARATION**

- a) Commence test procedures when the following conditions have been met.

1. Pipe section to be tested is clean and free of dirt, sand or other foreign material.
  2. Plug pipe outlets with test plugs. Brace each plug securely to prevent blowouts. Use concrete if necessary.
  3. Add compressed air slowly.
  4. Pressurizing equipment shall include regulator set to avoid over-pressurizing and damaging an otherwise acceptable section of pipe.
- a) Provide necessary pipe connections between the section of line being tested and the compressed air supply, together with test pressure equipment, meters, pressure gauge, and other equipment, materials, and facilities necessary to perform the specified tests.
  - b) Furnish and install bulkheads, flanges, valves, bracing, blocking or other temporary sectionalising devices that may be required
  - c) Remove temporary sectionalising devices after tests have been completed

#### PB 6.2 TESTING EQUIPMENT

- a) Contractor shall provide all equipment required for this testing procedure.
- b) Testing Equipment shall include, but may not be limited to:
  1. Polyethylene flange adapter with steel blind flange.
  2. Temperature gauge (0°C to 100°C) tapped and threaded into blind flange.
  3. Pressure gauge (0 to 1000 mb) ASME Standard B40.1 Grade 2A (accuracy of  $\pm 0.5\%$  of full scale) with minor graduation marks no greater than 10 mb.
  4. Inlet valve to facilitate compressed air hose.
  5. Ball valve to release pipe pressure at test completion.
  6. Polyethylene reducers to be used to adapt test flange to size of pipe being tested.
  7. Air compressor shall provide adequate air supply for testing.
  8. Pressurizing equipment shall include a regulator set to avoid over-pressurizing and damaging otherwise acceptable pipe.
- c) Provide verification and results of gauge calibration prior to (less than 60 days) and after Project completion.

#### PB 6.3 TESTING

- a) *EMPLOYER* and *ENGINEER* shall be given 24-hr notification prior to test.
- b) Appropriate Safety precautions must be in-place.
- c) Pipe Test Segments:
  1. Butt-fusion weld pipe segments.

2. Less than 610 meter in length.
  3. Blind flange with test apparatus on one end and fused cap or blind flange assembly on opposite end.
- d) Environment:
1. Place test segment in trench or lay test segment on ground surface and allow it to reach ambient temperature before test.
  2. Perform test during period when pipe segment will be out of direct sunlight to minimize pressure changes as a result of temperature fluctuations.
- e) Test:
1. Apply test pressure of 1000 mb to test segment.
  2. Observe test pressure for 1-hour.
  3. Mathematically correct pressure drop for temperature change.
  4. Temperature corrected pressure drop over 1-hour period should not exceed 1%.
  5. If retest is necessary, allow pressure to relax to 0 mb for a minimum of 8 hours prior to retest.
- f) Test Failure:
1. If retest is necessary, allow pressure to relax to 0 psig for at least 8 hours prior to retest.
  2. Perform the following when pipe segment fails test:
    - i. Check entire length of pipe and fusion welds for cracks, pinholes, perforations or other possible leakage points.
    - ii. Check blocked risers and capped ends for leakage and check gaskets at blind flanges.
    - iii. Verify leaks by applying a soapy water solution and observe for bubble formation.
  3. Repair pipe and fused joint leaks by cutting out leak areas and refusing suitable segments.
  4. After the leaks are repaired, retest the pipe after the 8 hour relaxation period.

#### PB 6.4 TEST REPORT

*Each test shall be reported in writing, on the "HDPE PIPE PRESSURE TEST REPORT" included at the end of this section.*

*If failure occurs, the following information is to be included:*

1. *Location of failure segment.*

2. *Nature of leaks.*
3. Details of repairs performed.
4. *Retest*

**PB 6.5 HYDRAULIC TESTING**

Hydraulic testing in accordance with SANS 1200 L, Section 7.3, and SANS 2001: DP 2 Medium Pressure pipelines is also permissible.

**HDPE PIPE PRESSURE TEST REPORT**

Project Name/No.: \_\_\_\_\_ Date: \_\_\_\_\_  
 Contractor: \_\_\_\_\_ Time: \_\_\_\_\_  
 Person Performing Tests: \_\_\_\_\_  
 Description/Location of Test Segment: (Pipe Diameter, Length, and SDR's)

\_\_\_\_\_  
 \_\_\_\_\_

Location of Pipe Test  
 Segment

Station From: \_\_\_\_\_ Station To: \_\_\_\_\_

- T<sub>i</sub> = Initial Temperature = \_\_\_\_\_ °C  
 P<sub>i</sub> = Initial test pressure = \_\_\_\_\_ mb  
 P<sub>c</sub> = Initial Pressure in mb corrected for temperature (T<sub>t</sub>) at time "t"  
 t = Time in minutes from initiation of test  
 T<sub>t</sub> = Temperature in °C at time 't'  
 P<sub>t</sub> = Test pressure in mb at time 't'

$$P_c = \left[ \frac{(P_i + 1013)(T_i + 273)}{T_i + 273} \right] - 1013$$

$$\text{Percent Pressure Drop} = \frac{P_c - P_t}{P_c} \times 100$$

T<sub>t</sub>                      P<sub>t</sub>                      P<sub>c</sub>

Time (min)	Temp Reading (°C)	Gauge Pressure (mb)	Corrected Pressure (mb)	Pressure Drop (%)
0				
20				
40				
60				

Pass/Fail: \_\_\_\_\_

Retest (yes/no) \_\_\_\_\_

Description/Nature of leaks repair of retest segment:

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**PARTICULAR SPECIFICATION PC : GRASSING**

*PC1 SCOPE*

This specification covers the materials and workmanship required for establishing grass cover and the coverage to be attained.

*PC2 INTERPRETATIONS*

*PD2.1 DEFINITION*

Weeds: Any declared weeds, as well as any tree, shrub, herb, water plant or any other plant which, in the opinion of the *Supervisor*, may pose problems in specified areas at certain times and are therefore regarded as being undesirable.

*PC 3 MATERIALS*

*PC 3.1 FERTILISER/SOIL IMPROVEMENT MATERIAL*

The type of fertiliser/soil improvement material to be used shall be one or more of the following types and any other type of fertiliser/soil improvement material specified in the information sheet or prescribed by the *Project Manager*.

- Soil improvement materials such as dolomitic lime, basic slag, gypsum, superphosphate and agricultural lime
- Fertilisers such as limestone, ammonium nitrate, 2:3:3 (22) and 3:2:1 (25)
- Compost which shall be well decayed, friable and free from weed seeds or other undesirable materials.
- Chicken litter

#### PC 3.2 GRASS

##### PC 3.2.1 Grass cuttings

Grass cuttings shall be fresh cuttings of an approved type of grass with sufficient root material to ensure good growth.

##### PC 3.2.2 Grass Seeds

Only fresh certified seed shall be used and the types of seeds in the seed mixture shall be as specified in the information sheet.

Mixing of various types of grass seeds for obtaining the prescribed grass-seed mixture shall be carried out on the site in the presence of the *Supervisor*. Storing and identifying the grass seeds and the grass-seed mixtures on the site shall be the responsibility of the *Contractor*.

##### PC 3.2.3 Grass sods

Grass sods shall be harvested, delivered, planted and watered within 36 hours unless otherwise authorised by the *Project Manager*. The grass sods shall be free from noxious weeds and diseases. Sods shall be in moist soil not less than 30 mm deep.

Sods shall be of the variety of grass specified in the information sheet, unless the use of an alternative has been approved by the *Project Manager*. The grass shall have been grown specifically for sod purposes, mown regularly and cared for to provide an approved uniformity to the satisfaction of the *Project Manager*. It shall be harvested by special machines manufactured for this purpose to ensure an even depth of cut with sufficient root material and soil.

#### PC 4. PLANT

##### PC 4.1 GENERAL

Plant shall be suitable for the production of the end result required taking into consideration the methods to be used for establishment of the grass cover.

## *PC 5. CONSTRUCTION*

### PC 5.1 PREPARATION FOR GRASSING

#### PC 5.1.1 Preparing for top-soiling

Existing grass is to be moved and erosion gullies are to be backfilled with selected fill material and nominally compacted.

Existing topsoil is to be manually loosened and prepared for geocells installation.

Soil ripping will not be required on the side slopes.

#### PC 5.1.2 Removal of stones

All loose stones exceeding 30 mm in size on areas to be mowed by machine and all stones exceeding 150 mm in size in other areas shall be removed.

#### PC 5.1.3 Areas which require topsoil

Areas requiring topsoil are indicated on the construction drawings.

The topsoil shall be scarified by means of hand-raking or light rotavators and all stones removed as specified for areas not requiring topsoil in sub clause 5.1.2 above.

#### PC 5.1.4 Fertilising

The *Contractor* shall, without any additional compensation, have the top soil stockpile and soil on side slopes tested to determine the quantity and type of fertiliser which will be required for establishing proper growth conditions for the grass. The *Project Manager* shall be furnished with the test results. Only after approval by the *Project Manager* of the nature and quantity of the fertiliser, its application may be proceeded with. The fertiliser shall be evenly applied over all surfaces where grass is to be planted, and shall then be thoroughly mixed with the soil to a depth of 100 mm manually. Where hydroseeding is to be performed, the fertiliser may be mixed with the cellulose pulp and water used in hydroseeding.

#### PC 5.1.5 General

After the area has been prepared for grassing, the grassing shall be completed before crustification. Where a crust has been formed before grassing is done, the *Contractor* shall, at his own cost, loosen the crust.

## PC 5.2 GRASSING

### PC 5.2.1 Hydro-seeding

The types and mixtures of seeds to be used shall be as specified in the information sheet or, if not so specified therein, shall be agreed on by the *Project Manager* and the *Contractor* before any seed he may wish to use is ordered by the *Contractor*. The *Contractor* shall be solely responsible for establishing an acceptable grass cover, and any approval by the *Project Manager* of seed or seed mixtures intended for use by the *Contractor* shall not relieve him of this responsibility.

Cellulose pulp shall be added to the hydro-seeding mix at a rate of 25 kg of pulp per kiloliter of water used, except where otherwise instructed in respect of flat slopes.

Hydro-seeding shall then be carried out with an approved hydro-seeding machine at a rate of application of not less than 40 kg of seed mixture per hectare unless otherwise specified in the information sheet.

When the use of anti-erosion compounds is required and such compound is to be applied simultaneously with the hydro-seeding, it shall be mixed with the hydro-seeding mixture before application. In such cases the quantity of cellulose pulp shall be decreased by one-third to one-half depending on the quantity of anti-erosion compound being added.

### PC 5.2.2 Exotic Grass

Only grass indigenous to southern Africa may be used.

## PC 5.3 MAINTENANCE

### PC 5.3.1 Watering, weeding, mowing and replanting

All sodded and grassed areas shall be adequately watered at regular and frequent intervals to ensure the proper germination of seeds and growth of grass until the grass has established an acceptable cover and thereafter until the beginning of the maintenance period of the grass. The quantity of water and the frequency of watering shall be subject to the *Project Manager's* approval. With hydro seeding the commencement of watering may be postponed until a favourable time of the year, but watering shall in any case commence and continue as soon as the seeds have germinated and growth has started.

The *Contractor* shall further mow the grass on all areas where grass has been established whenever so instructed by the *Project Manager* until the end of the maintenance period. All grass cuttings shall be collected and disposed of if so

directed by the *Project Manager*. Weeds shall be controlled by approved means. Any bare patches where the grass has not taken or where it has been damaged or has dried out shall be recultivated, planted, sodded or hydroseeded at the *Contractor's* own expense.

All grassed areas shall have an acceptable cover as defined below at both the beginning and the end of the maintenance period.

PC 5.3.2 Acceptable cover

An acceptable grass cover shall mean that not less than 75% of the area grassed or hydroseeded shall be covered with grass and that no bare patches exceeding 0,25 m<sup>2</sup> in any area of 1 x 1 m shall occur. In the case of sodding, acceptable cover shall mean that the entire area shall be covered with live grass at the end of any period not less than three months after sodding.

PC 5.3.3 Maintenance period

The maintenance period in respect of grass shall commence when an acceptable grass cover as defined in 5.3.2 above has been established and shall be one year

PC 5.3.4 Time for planting

Grass shall be planted as far as is practicable during periods of the year most likely to produce best growing results. The *Contractor* shall make every effort to programme his operations in such a manner that grass shall, as far as possible, be planted during this period.

PC 5.3.5 Traffic on grassed areas

The *Contractor* shall not plant any grass until all operations which may require equipment to be taken over grassed areas have been completed. No equipment, trucks or water carts shall be allowed onto areas which have been grassed and only equipment required for the preparation of areas, application of fertiliser and spreading of topsoil will be allowed to operate on areas to be grassed.

PC 5.3.6 Erosion prevention

During construction the *Contractor* shall protect all areas susceptible to erosion by installing all the necessary temporary and permanent drainage works as soon as possible and by taking such other measures as may be necessary to prevent the

surface water from being concentrated in streams and from scouring the slopes, banks or other areas.

Any runnels or erosion channels developing during the construction period or during the maintenance period shall be backfilled and compacted, and the areas restored to a proper condition. The *Contractor* shall not allow erosion to develop on a large scale before effecting repairs and all erosion damage shall be repaired as soon as possible and in any case not later than three months before the termination of the maintenance period.

#### PC 5.3.7 Proprietary brand materials used for erosion prevention

Certain proprietary brands of materials which may be necessary for erosion prevention to enable natural grass to become established, shall, if required, be specified in the information sheet. The method according to which the material is to be applied, the surface preparation required, the type of material to be provided and the method of payment shall be as specified in the information sheet.

#### PC 5.3.8 Responsibility for establishing an acceptable cover.

Notwithstanding the fact that the *Project Manager* will determine the method of grassing and that the type of seed or grass used and the rate of application of the seed may be specified or agreed on by the *Project Manager*, and that the frequency of mowing will be as ordered by him, the *Contractor* shall be solely responsible for establishing an acceptable grass cover and for the cost of replanting grass or rehydroseeding where no acceptable cover has been established. Where however, in the opinion of the *Contractor*, it is doubtful from the outset that it will be possible to establish an acceptable cover he may inform the *Project Manager* of his reasons therefor, and the *Project Manager* may, if he agrees, either adopt another method of grassing or agree to accept whatever cover can be obtained, provided that all reasonable efforts shall be made to establish a good grass cover by the proposed method. Any such agreement shall be valid only if given in writing by the *Project Manager* beforehand.

### PC 6 TOLERANCES

Tolerances on the rate of planting of grass cuttings and application of seed by hydroseeding or grass planter shall not be applicable. However, the absence of specified tolerances shall not relieve the Contractor of his obligation to establish an acceptable cover as defined in PD 5.3.2.

### *PC 7 TESTING*

Assessment of the attainment of acceptable cover by visual inspection of the area grassed shall be deemed to be testing of the workmanship 5.2.

### *PC 8 MEASUREMENT AND PAYMENT*

#### PC 8.1 GENERAL

##### PC 8.1.1 Preparation for grassing Unit: m<sup>3</sup>/m<sup>2</sup>

Measurement shall be for manually loosening and preparing topsoil. The tendered rate shall be full compensation for carrying out the work as specified in 5.1.1 or 5.1.2 as applicable.

##### PC 8.1.2 Fertiliser/soil improvement material. Unit: ton

Each type of fertiliser and/or soil improvement material supplied and mixed in with the topsoil shall be measured separately for payment.

The tendered rate shall be for supplying the fertiliser and/or soil improvement material at the place of use, spreading and mixing in irrespective of the method of application.

##### PC 8.1.3 Grassing Unit: m<sup>2</sup>

Grassing by any of the methods included in the specification shall be measured separately for payment.

The tendered rate for grassing by each of the different methods shall be full compensation for supplying grass cuttings, sods or seeds, planting by the appropriate method (all as specified in 5.2) and maintenance to establish an acceptable cover.

Mowing, if ordered by the *Project Manager*, will be measured separately for payment.

Payment for grassing will be made in two stages. When the grassing or hydro-seeding has been completed to the satisfaction of the Engineer, 60% of the payment will be made. The remainder will become due when acceptable cover has been established.

##### PC 8.1.4 Watering already planted grass Unit: kl

The tendered rate for watering shall be full compensation for obtaining, transporting and applying the water.

The *Contractor* shall keep a careful record of the quantity of water used by him for watering the grass and shall submit such information to the Engineer on a daily basis.

Raw water used for watering will be supplied free of charge by the *Employer*.

## **PARTICULAR SPECIFICATION PD: CORROSION PROTECTION**

### *PD 1 SCOPE*

This specification covers the corrosion protection of steel pipes, specials, fittings, valves, strainers and structures, which may be buried or subjected to environments with variable corrosive tendencies.

### *PD 2 INTERPRETATION*

#### PD 2.1 REFERENCES

The interpretation clause of SANS 1200 L : Medium-Pressure Pipelines and the interpretation clauses in the applicable SANS standards listed below, as well as the equivalent ISO standards in the case of brand names specified shall apply:

- SANS 1217 The production of painted and powder coated steel pipes
- SANS Method 769 Cleanliness of blast-cleaned steel surfaces for painting
- SANS Method 772 Profile of blast-cleaned steel surfaces for painting
- SANS ISO 2808 Determination of film thickness
- SANS ISO 8501-1 Preparation of steel substrates before application of paints and related products
- BSS EN ISO 12944 Protective coating of iron and steel structures against corrosion
- SANS ISO 9000 Model for quality assurance in production and installation
- SANS 1117 Plastic wrappings for the protection of steel pipelines
- SANS 10129 Plastics tape wrapping of steel pipelines
- SANS ISO 8501-1 Preparation of steel substrates before application of paints and related products
- SANS ISO 9000 Model for quality assurance in production and installation
- SANS ISO 1461 Steel protection by hot-dip galvanizing

#### PD 2.2 APPLICATION

This particular specification contains clauses that are generally applicable to contracts for the supply and application of coatings and linings. Variations and additions to this particular specification are set out in the Project Specification.

#### PD 3 MATERIALS

**PD 3.1 GENERAL**

The production and application of coatings and linings shall be in accordance with SANS ISO 9000, Quality System. Spray equipment shall be suitable for high quality work. A low speed mixer, which does not introduce air into the coating material being mixed, shall be utilized. All permanent anchors in concrete shall be stainless steel to ASTM A240 Grade 316. Nuts and washers shall be Fusion Bonded Epoxy (FBE) coated to avoid galvanic reaction.

Materials used for the lining of pipes shall be non-toxic and shall not impart any odour, taste, or colour to water. Certification shall be submitted to the Resident Engineer for his approval.

**PE 3.2 COATINGS AND LININGS**

**PD 3.2.1 Surface Preparation**

Surfaces to be treated shall have all projections, sharp edges, laminations and tool marks removed to provide a smooth surface and shall be cleaned in accordance with sections 2, 3 and 4 of SANS Code of Practice 10064 to meet the following requirements:

- a) A cleanliness of not less than Sa 2½ when they are tested according to SANS test method 5767.
- b) (b) A surface profile not exceeding 0.09 mm when they are tested according to SANS test method 5772.
- c) Freedom from dust and debris not more than 0.2% when they are tested according to SANS test method 5769.

The contractor shall at all times enforce health and safety measures necessary to comply with the Occupational Health and Safety Act No 85 of 1993 and the manufacturer's requirements.

**PD 3.2.2 Materials to be used**

Table JWC-1 illustrates the system and minimum thickness of coatings and linings for pipes, valves and specials in their various locations.

**TABLE PD1 COATINGS AND LININGS FOR PIPES, VALVES AND SPECIALS**

ENVIRONMENT	SURFACE	SYSTEM	MINIMUM THICKNESS (µm)
1) Encased in Concrete	Lining	FBE	400
	Coating	FBE	400
2) Above Ground	Lining	FBE	400
	Coating	FBE plus top coat of Re-coatable Polyurethane	400
3) Buried in Soil	Lining	FBE	400

	Coating	FBE plus tape wrapping	400
4) In Chamber Walls	Lining	FBE	400
	Coating	FBE plus top coat of pure Ailphatic Polyurethane plus sealant of Polyurethane	400

Table PD-2 illustrates corrosion protection systems for coupling- and flange adaptors, spare pipes, fasteners and anchors.

**TABLE PD2 COATINGS AND LININGS FOR OTHER**

ITEM TYPE	SURFACE	SYSTEM	MINIMUM THICKNESS (µm)
1) Couplings and Flange Adaptors	Lining and Coating	FBE	400
2) Spare Pipes	Lining	FBE	400
	Coating	FBE plus top coat of Re-coatable Polyurethane. Wrap before burying in soil	400
3) Fasteners for Drilled and Tapped Flange Adaptors	Coating	HDG plus wet assembly with Epoxy or threads coated with Molybdenum Disulphide lubricant	400
4) Anchors in Concrete	Coating	Threads coated with Molybdenum Disulphide Lubricant or Nickel Anti-seize compound	Uniform Cover

a) Internal linings:

Epoxy lining: A solvent-free liquid epoxy such as Copon Solvent Free Hot-cote DW (Plascon code JHCI) or an approved similar product, hot applied in one operation.

b) External coatings:

Fusion-bonded, medium-density polyethylene such as Sintakote or an approved similar product.

PD 3.2.3 Epoxy Linings

Epoxy coatings and linings shall have a total dry-film thickness of at least 400 micron, shall be applied strictly in accordance with the epoxy manufacturer's instructions and shall comply with the requirements of SANS 1217.

The Contractor shall furnish the Engineer with a certificate which confirms that the coatings and/or linings have been applied to the manufacturer's satisfaction. Such certificate shall be signed by the manufacturer.

#### PD 3.2.4 Fusion-bonded, medium density, polyethylene coatings (MDPE)

A uniform MDPE coating shall be obtained by dipping the already prepared and heated pipe into a fluidified bed of MDPE powder which then fuses directly on to the heated surface.

A coating thickness of between 1.8 mm and 2.5 mm depending on the diameter of the pipe and the service for which it is required shall be obtained with the coating extending around the ends of the pipe to under-lap the concrete lining for Sinta Joint pipes.

Fusion bonded MDPE coatings and concrete linings shall meet the applicable SANS requirements for this type of pipe protection.

#### PD 3.2.5 Fusion Bonded Epoxy (FBE) Coating System (Heavy Duty)

The following standard specifications are applicable to FBE coatings and linings:

- SANS 1217 The production of painted and powder coated steel pipes
- SANS Method 769 Cleanliness of blast-cleaned steel surfaces for painting
- SANS Method 772 Profile of blast-cleaned steel surfaces for painting
- SANS 2808 Determination of film thickness
- SANS 8501-3 Preparation of steel substrates before application of paints and related products
- BS 5493 Protective coating of iron and steel structures against corrosion
- SANS ISO 9000 Model for quality assurance in production and installation

The material shall conform to SANS 1217, Type 2, powder coating. Items shall be heated to a temperature of 200°C (only applicable to heavy items) and coated with Fusion Bonded Epoxy by means of an electrostatic powder gun. Colours shall be in accordance with SANS 1091.

#### PD 3.2.6 Tape Wrapping System

The following standard specifications are applicable to tape wrapping systems:

- SANS 1117:2007 Plastic wrappings for the protection of steel pipelines
- SANS 10129:2006 Plastics tape wrapping of steel pipelines
- SANS 8501-3 Preparation of steel substrates before application of paints and related products
- SANS ISO 9000 Model for quality assurance in production and installation

**Protection of mechanical pipe joints:**

All steel and ductile iron fittings and specials that will be buried in soil and exposed to corrosive conditions shall have an inhibitive primer applied over the joint, followed by inert mastic and a petroleum jelly impregnated tape finally overwrapped with a pressure-sensitive PVC or polyethylene tape using a 55% overlap of the tape width according to SANS 10129:2006

**Protection of steel pipelines:**

Plastic wrapping for the protection of steel pipelines shall conform to SANS 1117:2007 type C wrapping and be used with a type 1 primer. A 55% overlap of the tape width should be applied to achieve a double layer of tape wrapping.

**PD 3.2.7 Hot-Dip Galvanizing**

Steel specials shall be in accordance with clause 6 of SANS 121. The surfaces shall be free from nodules, blisters, roughness and sharp points. Un-coated areas, flux residues, lumps and zinc ash shall not be permitted. Notwithstanding Clause 6.1 of SANS 121, in the case of handrails etc. a high quality surface finish is required and a bright smooth surface shall be achieved. Only materials specified under clause 10.2 (b) (i) of SANS 121 shall be utilised. Double dipping shall not be allowed. The thickness of hot-dip galvanizing shall comply with the requirements of Table JWC-3 below.

**TABLE PD3 MINIMUM COATING THICKNESS FOR ITEMS THAT ARE NOT CENTRIFUGED**

ARTICLES AND ITS THICKNESS	HEAVY DUTY COATING	LIGHT DUTY COATING	
	Coating thickness $\mu\text{m}$ (min)	Local coating thickness $\mu\text{m}$ (min)	Mean coating thickness $\mu\text{m}$ (min)
6 mm $\leq$ Steel	105	70	85
3,0 mm $\leq$ Steel < 6,0 mm	80	55	70
1,5 mm $\leq$ Steel < 3,0 mm	65	45	55
Steel < 1,5 mm	55	35	45
Castings $\geq$ 6,0mm	105	70	80
Castings < 6,0 mm	-	60	70

Heavy duty coatings are required except in the following cases:

- a) Where a high surface finish is required.
- b) Where otherwise specified in the Project Specification or as shown on the Drawings.

**PD 3.2.8 Cutting back of linings and coatings**

The extent to which linings and coatings shall be cut back will depend on the type of jointing specified, and the linings and coatings shall be cut back cleanly from the ends of the pipes and specials.

Linings and coatings shall be taken to the ends of pipes for welded and Viking Johnson type couplings and according to the manufacturer's instructions for Sinta Joint pipes. Coatings shall also be applied according to the manufacturer's instructions for Sinta Joint pipes and 50 mm from the end of pipes for Sintakote pipes.

The uncoated portions of the pipe shall be protected with a primer conforming to SANS 926 and applied to a maximum dry thickness of 0.25 mm.

The contractor shall have an approved repair kit on site at all times to make the necessary repairs to damaged lining or coating systems to the satisfaction of the Engineer.

#### PD 3.2.9 Repair of FBE coatings and linings

The total un-coated areas for renovation by the applicator shall not exceed 0,5 percent of the total surface area of a component. Each un-coated area for renovation shall not exceed 2 500 mm<sup>2</sup>. If damaged areas are larger, the items containing such areas shall be re-coated.

The repair of areas showing damage down to the steel surface shall, if approved by the Resident Engineer, be carried out as follows:

- (a) Degrease in accordance with paragraph JWC-3.2.10
- (b) Blast-clean all damaged areas to Sa 3 (SABS ISO 8501-1).
- (c) Feather the surrounding paint for a distance of 25 mm beyond the damaged areas with a medium grade 220 abrasive paper.
- (d) Vacuum-clean the surface to remove dust and debris in accordance with SABS method 769 paragraph 7.4.1.
- (e) Wipe only the abraded paint surface with methyl ethyl ketone and allow to dry.
- (f) Apply as many coats of the following repair material as necessary to achieve the specified thickness and finish.
  - (i) Solvent free Epoxy or
  - (ii) Fusion-bonded Epoxy powder repair kit.

NOTE: Apply a final top coat over the repaired area to achieve an acceptable, uniform finish of the item.

#### PD 3.2.10 Degreasing

All surfaces to be coated shall be tested for oil and grease contamination by the water break free test.

Oil and grease contamination shall be removed by:

- Steam-cleaning.
- An emulsifiable or aqueous detergent applied in accordance with SANS 1344.

- An alkaline cleaning solution.

Allow to react, and then rinse off with clean, potable water to remove all residues prior to surface preparation, all in accordance with clauses 3.3 and 3.4 of SANS 10064.

The surfaces shall be tested after degreasing and show no oil, grease and chemical contamination after degreasing.

Care shall be taken to avoid entrapment of cleaning agents in recesses or other retention areas.

#### *PD 4 PLANT*

##### PD 4.1 MEASURING EQUIPMENT

The Contractor shall have the following measuring equipment at his shop and site at all times:

- Ambient temperature gauge
- Blast profile gauge
- Dew point instrument
- Dry film thickness gauge
- Electric insulation defect detector
- Surface temperature gauge
- Relative humidity instrument
- Wet film comb

All test equipment shall have current calibration certification.

All instruments shall be calibrated daily, except where otherwise specified by manufacturers, to achieve the required accuracy.

Dry film thickness gauges shall be calibrated on a flat surface, provided that the surface profile is in accordance with the specification.

##### PD 4.2 SPRAY EQUIPMENT

Spray equipment shall be suitable for the production of high quality work, capable of properly atomising the coating material and equipped with suitable pressure regulators and gauges. Air caps, needles and nozzles shall be of the type recommended by the coating manufacturer. All spray equipment shall be fitted with suitable oil and moisture traps.

##### PD 4.3 MIXER

A low speed mixer, which does not introduce air into the coating material being mixed, shall be utilised.

#### *PD 5 CONSTRUCTION*

##### PD 5.1 SUPPORTS

When pipes are installed or mounted on concrete supports, rubber insertion shall be used to insulate the pipe from the support. The thickness of the rubber insertion shall not be less than 10 mm and protrude not less than 20 mm all round.

##### PD 5.2 ANCHORS IN CONCRETE

All permanent anchors in concrete shall be stainless steel to ASTM A240 grade 316.

Special care shall be taken to ensure that anchors be installed to the correct level and depth. Anchors shall not be cut after installation without prior inspection and approval of the Engineer.

To avoid a galvanic reaction (stainless steel/galvanizing) under wet conditions, the nut and washer shall be FBE coated. Where necessary, caps shall be specified by the Corrosion Engineer.

#### PD 5.3 SEALING

Pipes that enter or exit concrete shall be sealed on their circumference with a continuous polyurethane or polysulphide flexible sealer, in a 25 mm square recess, approved by the Resident Engineer.

#### PD 5.4 ARMOURING

Armoured or special protection shall be applied to surfaces at all road and rail crossings, through sleeves and culverts, and as requested by the Engineer.

#### PD 5.5 LIFTING

All coated items shall only be lifted by means of broad band slings that will not damage the coating. Slings shall not be less than 500 mm wide for pipes up to 500 mm nominal bore, 1 000 mm wide for larger pipes and 500 mm wide for other items, or as approved by the Engineer.

#### PD 5.6 TRANSPORT

Coated items shall be handled with due regard to the relatively soft nature of organic coatings and appropriate precautions shall be taken.

The Contractor is responsible for the safe delivery of all the items and small parts to site without damage. All items shall be securely packed to prevent damage while in transit.

If transported by a third party, the Contractor is responsible for ensuring protection of items as specified. Precaution shall be taken to support and chock the pipes on padded cradles and/or saw-dust filled bags to prevent movement when loading onto vehicles.

Where stacked pipes are transported, the packing shall be of a thickness and positioned to ensure that pipes do not touch when they flex.

Items shall be firmly lashed or chained with padded lashing. The area of padded surfaces shall be adequate to prevent damage to coatings.

Bolts in strong hessian bags and other small components shall be labelled and crated. The bags and crates shall be tagged using metallic tags and shall be marked in accordance with the following:

Each pipe and special shall be legibly, indelibly and durably marked, (in such a manner that the coating is not damaged), with the following information:

- Contract number,
- Scheme name,
- Serial number of the pipe or special,
- Nominal diameter,

- Grade and thickness of steel,
- Hydrostatic test pressure,
- Item number.

The bags and crates shall be tagged using metallic tags and shall indicate the following information:

- Contract number,
- Scheme name,
- Part numbers,
- Description,
- Sizes,
- Quantities.

Each bag or crate shall have the delivery address listed on a separate metallic tag.

The Resident Engineer shall be notified of the delivery date and of any requirements regarding off-loading and storage at site.

#### **PD 5.7 STACKING AND STORAGE**

The Contractor shall provide all the necessary bunks of timber and saw-dust filled bags used to support the items on soil, concrete or other hard surface and to separate them from each other both at his works, on site and when stringing along the trench.

Pipes shall be stacked to a safe height not exceeding two pipes high on cradles and on level ground. Grass or other vegetation shall not be allowed to grow in the storage area within three metres of the equipment.

#### **PD 6 TOLERANCES**

The dimensional tolerances specified in the applicable standard specifications shall apply.

#### **PD 7 TESTING**

Substrate surfaces shall be tested, by the Contractor with the supervision of the resident Engineer, for the presence of water soluble salt contaminants in accordance with SANS Method 770 or by means of the Weber Reilly Test. Mechanical surface preparation shall be visually compared to the standard shown in SANS 8501-1.

#### **PD 8 MEASUREMENT AND PAYMENT**

The lining and coating of straight pipes shall be measured per linear metre of pipe lined and coated. The lining and coating of specials, whether lined by hand or otherwise, shall be measured per unit of completed specials, except where such specials are lined and coated in a single in-situ operation by mechanical means. In this case the lining and coating of the same shall be included, measured per linear metre of completed pipeline.

Payment for factory applied linings and coatings shall be included in the payment for pipes delivered to site.

Payment for in situ applied linings and coatings shall be for completed linings and coatings at the rates scheduled.

## **PARTICULAR SPECIFICATION PE: FILTER MATERIAL**

### **PE1 SCOPE**

This specification covers the requirements for the filter drains and toe drains to be constructed for control of seepage in the dam.

### **PE2 INTERPRETATIONS**

#### **PE2.1 SUPPORTING SPECIFICATIONS**

Where this specification is required for a project, the following specifications shall, inter alia, form part of the contract document:

SANS 1200 A

SANS 1200 DE

#### **PE2.2 APPLICATION**

This specification contains clauses that are applicable to the construction of a drainage system for small earth dams.

#### **PE2.3 DEFINITIONS**

For the purposes of this specification, the definitions and abbreviations given in SABS 1200 A and SABS 1200 DE shall apply.

### **PE3 MATERIALS**

#### **PE3.1 APPROVAL OF MATERIALS**

The Contractor shall supply in good time to the Engineer for his approval, samples of the materials that he proposes to use in the Works. Samples shall be accompanied by results of tests performed by an approved laboratory on the materials or certificates to the effect that the materials conform to the specified standards.

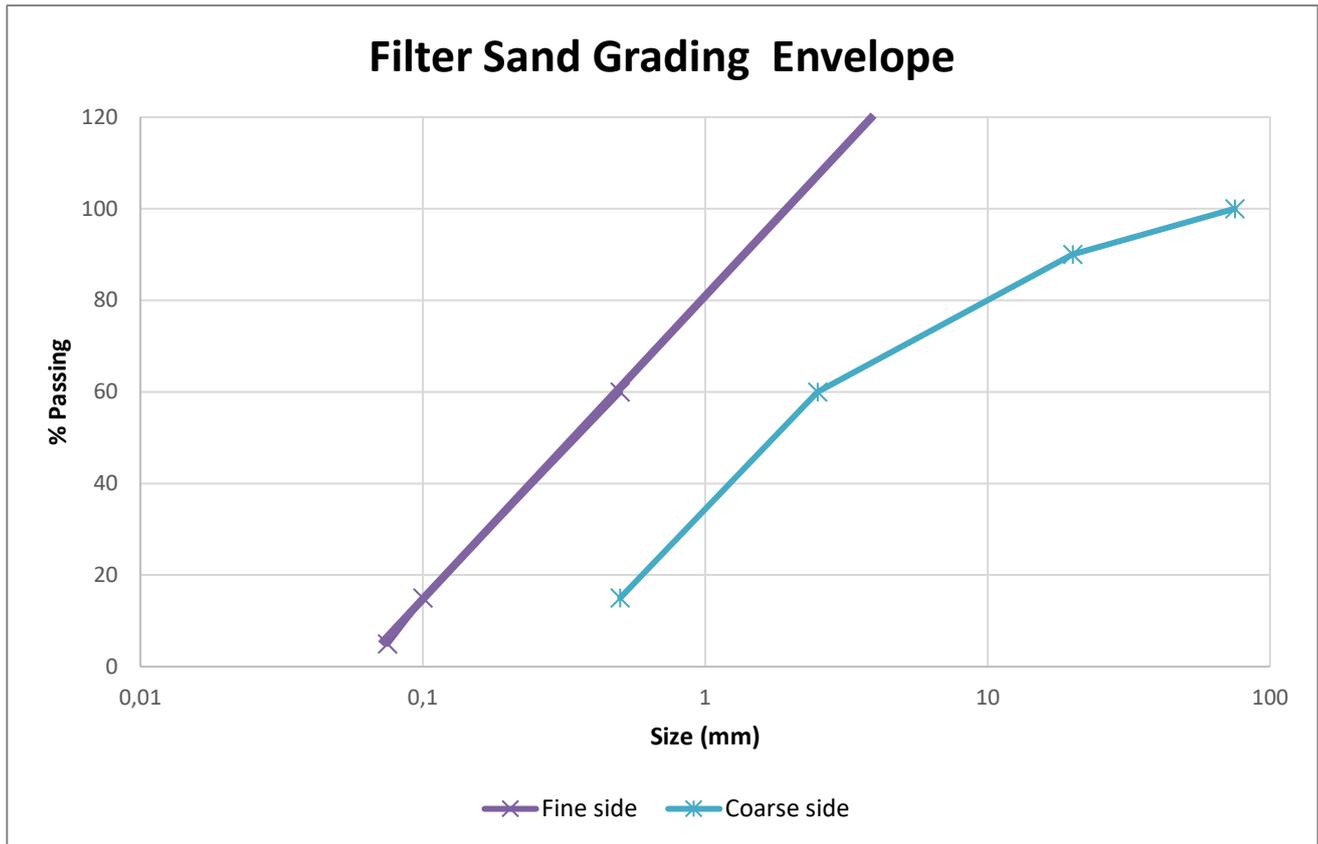
#### **PE3.2 AGGREGATES**

The Contractor is to take sufficient samples of the filter materials as placed in the drains to confirm that the material has not been contaminated during the stockpiling and placing procedure. A minimum rate of testing is 1 sample per 100 m<sup>3</sup> placed.

The Contractor is to submit all test results (gradings and thicknesses) for the section of drain under construction for each individual layer, this is to be approved and signed off by the Engineer prior to placing the next layer.

##### **PE 3.2.1 19 mm Stone**

The 19 mm stone shall be a hard, durable, single sized crushed stone complying with the following grading:



Sieve Size [mm]	Material Passing [%]
26,5	100
19,0	85 – 100
13,2	0 – 30
9,5	0 – 5

**PE 3.2.2 Course Ash**

The course ash shall comply with the grading envelope shown below.

**PE 3.2.3 Filter sand**

Filter sand shall consist of clean hard particles and shall comply with the grading envelope shown below.

**PE7 TESTING**

**PE7.1 AGGREGATES**

A sample shall be taken from each load of filter sand delivered to the site and a grading analysis done immediately to ensure that the material conforms to the specified grading.

Samples shall be taken from at least every second load of pea gravel and 19 mm stone delivered to the site and a grading analysis done to ensure conformity with the specified grading.

The Contractor is to take sufficient samples of the filter materials as placed in the drains to confirm that the material has not been contaminated during the stockpiling and placing procedure.

#### 6.2.4 Applicable Standards

**Table 16: Civil/Structural National/International Standards**

Applicable Civil/Structural Standards		
No	Document No	Description / Title
1	SANS 044	Code of practice for welding
2	SANS 0167	Quality evaluation of fusion-welded joints
3	SANS 10100-1	The structural use of concrete Part 1: Design
4	SANS 10100-2	The structural use of concrete Part 2: Materials and the execution of work
5	SANS 10144	Detailing of reinforcement for concrete
6	SANS 10160	Basis of structural design and actions for buildings and industrial structures Parts 1-8
7	SANS 10161	The design of foundations for buildings
8	SANS 10162-1	The structural use of steel Part 1: Limit state design of hot-rolled steelwork
9	SANS 10162-2	The structural use of steel Part 2: Limit state design of cold-formed steelwork
10	SANS 10162-4	The structural use of steel Part 4: The design of cold formed stainless steel structural members
11	SANS 10164-1	The structural use of masonry Part 1: Unreinforced masonry walling

**Table 17: Employer Civil/Structural Specifications**

Applicable Eskom Civil/Structural Specifications		
No	Document No	Description / Title
1	36 - 1126	Specification for corrosion protection of plant and equipment with coatings.

## 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.

#### General Drawings

Drawing number	Revision	Title
F224-13-001	A	SITE LAYOUT - GENERAL ARRANGEMENT
F224-13-002	A	SITE LAYOUT - LAYOUT OF ALL PACKAGES
F224-13-005	A	INFRASTRUCTURE: TOPSOIL MANAGEMENT
F224-21-001	A	STORM WATER MANAGEMENT : GENERAL ARRANGEMENT
F224-21-002	A	LAYOUT OF INFRASTRUCTURE DEVELOPMENT
F224-21-010	A	STORM WATER MANAGEMENT : TYPICAL SECTIONS AND DETAILS
F224-21-012	A	ENERGY DISSIPATERS - SECTIONS AND DETAILS
F224-21-013	A	CATLADDER AND MANHOLE COVER DETAILS
F224-21-020	A	ENABLING WORKS - LAYOUT, SECTIONS AND DETAILS
F224-22-101	A	STORM WATER MANAGEMENT - LAYOUT 1 OF 2
F224-22-102	A	STORM WATER MANAGEMENT - LAYOUT 1 OF 2
F224-22-110	A	STORM WATER MANAGEMENT - TYPICAL SECTIONS AND DETAILS
F224-22-111	A	ENERGY DISSIPATER AND CONVEYOR ROUTE SECTIONS
F224-06-001	A	ASH DAM 1 - PLAN, SECTION AND DETAILS

F224-06-002	A	ASH DAM 1 - SPILLWAY DETAILS
F224-06-003	A	ASH DAM 1 - INLET SECTIONS AND DETAILS
F224-06-004	A	ASH DAM 1 - OUTLET, SECTIONS AND DETAILS
F224-06-008	A	ASH DAM 1 - SILT TRAP - SHEET 1 OF 2
F224-06-009	A	ASH DAM 1 - SILT TRAP - SHEET 2 OF 2
F224-06-100	A	POLLUTION CONTROL DAM - GENERAL DETAILS
F224-06-101	A	REHAB DAM 1-SECTIONS AND DETAILS
F224-06-102	A	REHAB DAM 1-SPILLWAY-CONCRETE DETAILS
F224-06-105	A	REHAB DAM 1-INLET SECTIONS AND DETAILS
F224-06-106	A	REHAB DAM 1-OUTLET SECTIONS AND DETAILS
F224-10-220	A	ASH DAM 1 - INLET CHANNEL - CONCRETE DETAILS - SHEET 1 OF 2
F224-10-221	A	ASH DAM 1 - INLET CHANNEL - CONCRETE DETAILS - SHEET 2 OF 2
F224-22-111	A	STORMWATER MANAGEMENT PACKAGE 2 TYPICAL SECTIONS AND DETAILS 2 of 2

### Civil Drawings

Drawing number	Revision	Title
B700-C-AD1-01	01	ASH DAM 1 - SECTIONS AND DETAILS
B700-C-AD1-03	01	ASH DAM 1 COMPARTMENT 1 SPILLWAY - CONCRETE AND PIPE
B700-C-RD1-04	01	REHAB DAM 1 - OUTLET, SECTIONS AND DETAILS
B700-C-AD1-IL-01	0	ASH DAM 1 INLET STRUCTURE - REINFORCEMENT DETAILS

B700-C-RD1-01	01	POLLUTION CONTROL DAMS REHAB DAM 1- SECTIONS AND DETAILS
B700-C-RD1-03	01	POLLUTION CONTROL DAMS REHAB DAM 1 COMPARDMENT 1 SPILLWAY – CONCRETE DETAILS
B700-C-RD1-IL-01	0	REHAB DAM 1 INLET STRUCTURE - SECTIONS AND DETAILS
B700-C-SWDA-01	0	STORM WATER DRAINAGE AREAS LAYOUT
B700-C-AD1EW-01	0	ASH DAM 1 - ENABLING WORKS - TEMPORARY PIPE WORKS
B700-C-AD1EW-02	0	ASH DAM 1 - ENABLING WORKS - PERMANENT PIPE WORKS

### Structural Drawings

Drawing number	Revision	Title
B700-S-AD1-IL-01 SH 1 of 3	0	ASH DAM 1 INLET STRUCTURE - REINFORCEMENT DETAILS
B700-S-AD1-IL-01 SH 2 of 3	0	ASH DAM 1 INLET STRUCTURE - REINFORCEMENT DETAILS
B700-S-AD1-IL-01 SH 3 of 3	0	ASH DAM 1 INLET STRUCTURE - REINFORCEMENT DETAILS
B700-S-RD1-IL-01	0	REHAB DAM 1 INLET STRUCTURE - REINFORCEMENT DETAILS
B700-S-RD1-01	0	REHAB DAM 1 COMPARTMENT 1 SPILLWAY - REINFORCEMENT DETAILS

### Bending Schedule

Drawing number	Revision	Title
BS-S-AD1-IL-01	0	ASH DAM 1 - INLET STRUCTURE
BS-S-RD1-01	0	REHAB DAM 1 SPILLWAY
BS-S-RD1-IL-01	0	REHAB DAM 1 - INLET STRUCTURE