ETHEKWINI MUNICIPALITY
Occupational Health & Safety Unit

Site Specific Health and Safety Specification in terms of 2014 Construction Regulations 5.1(b)

Document Title	Site Specific Health and Safety Specification
Client	eThekwini Municipality – Water and Sanitation
Project Name	Thandokuhle Reservoir: Construction of a new 3ML Reinforced Concrete Reservoir, Inlet and Outlet Pipework and Ancillary Works
Contract Number	WS7400
Compiled by (Safety Officer)	Name and Surname: Hlengiwe Njapha Signature: HNJAPHA Date:22/04/2021
Approved by (Safety and Risk Manager)	Name and Surname: Arty Zondi Signature Date: 22/04/2021
Revision Number	SSHSS256/04/2021

PROJECT LOCALITY

Table of contents

1.PROJECT DESCRIPTION

Thandokuhle Reservoir: The Construction of a new 3ML Reinforced Concrete Reservoir, Inlet and Outlet Pipework and Ancillary Works

2. LIMITATIONS OF LIABILITY

The Principal Contractor shall enter into a Mandatary Agreement with the Client, as defined in Section 37(2) of the Occupational Health and Safety ACT.
The Principal Contractor shall ensure that each contractor appointed by the Principal Contractor and each sub-contractor appointed by a contractor also into a Mandatory Agreement with the Principal Contractor, as defined in Section 37(2) of the Occupational Health and Safety ACT. These agreements shall be included in the Principal Contractor's H&S File on site and be valid for the duration of the contractors' work on the construction site.

3. PURPOSE OF THE CONSTRUCTION H&S SPECIFICATION

This document defines the minimum management requirement that is to be implemented by the Principal Contractor/Contractor for the management of Health and Safety on any eThekwini Municipality project.
The aim of this document is to present the health and safety aspects that need to be controlled and managed on the project.
This Health and Safety specification identifies and encompasses the working behaviours and safe work practices that are expected of all employees, Vendors and Contractors, Sub-Contractors and Visitors, engaged on construction site.
Providing a guideline to comply with best Health & Safety practices and the Occupational Health and Safety Act85/1993 as amended, including reference to applicable legislative requirement.

4. PROJECT HEALTH AND SAFETY COST

The Client must ensure that potential Principal Contractor submitting tenders have made adequate provision for the cost of health and safety measures.
The Principal Contractor shall allow in their cost provision for complying with the requirements of this Client Health and Safety Specification; resources for the following H&S controls shall be in place.

	H&S cost item	Description
1.	Full /Part time safety officer	Full/Part time attendance on site of a SACPCMP registered safety officer from the start of construction until the end of project handover
2.	First Aiders	First Aid training
3.	Competent inspectors (trained, certified, competent)	Statutory inspections of excavations, temporary works, fire extinguishers, lifting equipment, lifting machinery, construction vehicles and mobile plant, portable electrical equipment, Electrical Installation Controller etc.
4	Medical certificate of fitness	Medical examination of all employees and certification of fitness by an Occupational Medicine Practitioner Pre- employment and annual
5	PPE	Standards set for all employees Including community and environment
6	Dust mitigation	To reduce dust exposure to the employees and the public
7	Public protection and barricading	Barricading, shoring and notices
8	Employee facilities	Refer to the Facilities Regulations (drinking water, change facility, personal lockers, and wash facilities, eating facilities, ablution toilets)
9	Traffic management	Traffic controller's training and traffic signage
10	Signage	All construction safety signage required for the project
11	Other	

5. SCOPE OF WORK

The works will broadly include but not limited to:
Inlet and Outlet Works
Overflow and scour valves
Interconnecting pipe work
Telemetry installation and power supply
Buildings and Chambers to house mechanical installation for ancillary pipe work stormwater systems
Fencing and associated ancillary works has to be constructed/erected/installed an Access road has to be constructed

6. COMPENSATION FOR OCCUPATIONAL INJURIES AND DISEASES ACT

The Principal Contractor, each contractor and each sub-contractor shall submit proof of Good Standing with COIDA Commissioner or a Mutual Association licensed in terms of Section 30 of COIDA, prior to starting any work on site.

A copy of the Letter of Good Standing with COIDA Commissioner must be included in the H&S Plan of each contractor working on the site and must remain updated for the duration of the construction work.

7. APPLICATION FOR CONSTRUCTION WORK PERMIT

The Principal Contractor shall assist the Client in compiling the evidence required by the Department of Labour for the issuing of the Construction Work Permit.

The Principal Contractor shall ensure that the H&S Plan presented for approvals includes:

- Evidence that the Principal Contractor made adequate provision for the cost of H&S measures
- Evidence that the Principal Contractor has the necessary competencies and resources to carry out the construction work safely.
- A copy of the Letter of appointment of the Construction Manager in terms of CR 8(1) + proof of his qualification, competence and registration where applicable.

- Proof of the registration of the Principal Contractors Health & Safety officer with the SACPCMP.

The Principal Contractor shall display the work permit number at the main site entrance. This display must be conspicuous to the satisfaction of the Department of Labor. The permit must be noticeable.

The construction works can only commence once the construction work permit is issued by the Department of Labor.

8. MANAGEMENT AND SUPERVISION OF CONSTRUCTION WORK

8.1 Construction Manager

The Principal Contractor shall appoint a full-time competent person as the construction manager with the duty of managing all construction on the site including the duty of ensuring occupational health and safety compliance.

The Construction Manager must demonstrate competency in relation to work being performed and the ability to manage construction work which may include making all statutory appointments in terms of health and safety.

8.2 Construction Health and Safety Officer

The Principal Contractor shall appoint a full-time/part time competent Construction health and Safety Officer for the construction work. The Construction Safety Officer shall be full on the construction site for this project.

The Safety Officer shall be registered with the South African Council for the Projects and Construction Management Professions. Proof of competence and registration of the appointed Construction Safety Officer must be included in the H&S Plan.

8.3 Construction Supervisor

A Construction Manager must in writing appoint construction supervisors responsible for construction activities and ensuring occupational health and safety compliance on the construction site. A contractor must, upon having considered the size of the project, in writing appoint one or more competent employees for different sections thereof to assist the construction supervisor contemplated in sub regulation (7)**,** and every such employee has, to the extent clearly defined by the contractor in the letter of appointment, the same duties as the construction supervisor: Provided that the designation of any such employee does not relieve the construction supervisor of any personal accountability for failing in his or her supervisory duties in terms of this regulation.

9. PRINCIPAL CONTRACTOR'S HEALTH AND SAFETY PLAN

The Principal Contractor shall submit a suitable, sufficiently documented and coherent specific health and safety plan based on the Client documented Health and Safety Specification. The health and safety plan shall include but not limited to the following

- Objectives
- Scope of work
- Management of construction and supervision
- Monitoring and review plan
- Sub-contractor management
- Risk Assessment & Written Safe Working Procedures
- Roof work planning/ methodology
- Incident Management & First Aid
- Emergency procedures/ plan
- Fire Prevention & Protection
- Public Health and Safety
- Working Close to Existing Structures
- PPE Provision
- Health & Safety Signage
- Excavations
- Earthworks, Improvements, Compaction and use of Explosives
- Structures
- Site establishment
- Soil poisoning
- Existing services
- Demolishing Structures
- Construction Vehicles and Mobile Plants
- Hand & Electrical Tool Management
- Construction Employees Facilities
- Health & Safety Policies
- Health and Safety Training & Competencies
- Housekeeping
- Hazardous Chemicals
- Inductions
- Medicals
- Site Security
- Stacking and Storage
- Internal and external Audit

- Inspection Registers
- Toolbox Talks
- Site Establishment
- Removal of Rubble and Large Trees
- Corona Virus

10. HAZARD IDENTIFICATION AND RISK ASSESSMENT

The Principal Contractor shall before commencement of any construction and during such construction works have risk assessments performed by appointed competent person in writing which forms part of the health and safety plan to be applied.

The following problems will be encountered during construction Specific attention to be given to the following,

- Methods of excavation
- Compaction equipment and the use thereof
- Blasting- fly rocks and Boulders,
- Drilling- Noise and Vibration,
- Handling of overburden and heavy machinery,
- Storage of diesel,
- Slope failures

The provisions of Regulation 9 of the Construction Regulations shall be followed in every detail.

11. HEALTH AND SAFETY FILE

The Client must discuss and negotiate with a Principal Contractor the content of the Health and Safety Plan and thereafter finally approve the Health and Safety plan for implementation. The recommended Health and Safety file shall include the following:

- Client Health & Safety Specification
- Principal Contractor Health & Safety Plan
- Letter of good standing
- Section 37.2 Mandatory Agreement
- Contractor appointment letter in terms of CR 5.1(k)
- Legal appointments and competencies (Site manager, Site supervisor, Safety officer, Risk assessor, Incident investigator, Fall protection planner, Temporary work designer, Temporary work supervisor, Electrical installation supervisor)
- Risk Assessments as per scope of work
- Written Safe Working Procedures as per risk assessment

- Incident/Accident Management Procedures
- Award letter from SCM
- Organogram as per appointments
- Copy of OHS Act and COID Act
- Environmental Management Procedures (Dumpsite, Water provision, Ablution, Waste management, Concrete works, Refuelling and spillage management, Hazardous chemicals storage and disposal, Environmental awareness training, No Go Areas, Protection of animals, Site demarcation ect.)
- Health and Safety Induction programme
- Emergency Procedures/ Plan
- Medical Fitness Certificate (Safety Officer, Site manager and Supervisor)
- Toolbox Talks Programme/ Plan
- SHE Policy
- Corona Virus

12. HEALTH AND SAFETY REPRESENTATIVES AND COMMITTEE

Health and Safety Representatives

- The Principal Contractor shall ensure that Health and Safety Representatives are appointed in writing and exercise their functions as defined in OHSA.
- The Principal Contractor shall elect and appoint a health and safety representative regardless of the number of employees on the site.
- The H&S representative shall at all times be on site and report to the Health and Safety Officer and Construction Manager.

Health and Safety Committee

- The Principal Contractor shall ensure that the H&S committee meets on a monthly basis
- The Principal Contractor's management and each contractor shall be represented at the H&S committee meeting; contractors with more than 20 employees shall have an H&S representative at each committee meeting and each contractor shall have a management member attending each H&S committee meeting.

13. CLOSE- OUT CONSOLIDATED HEALTH AND SAFETY FILE

The Principal Contractor shall compile a consolidated H&S file and hand over to the Water and Sanitation Unit – Prior Road. OHS Unit will conduct a project close out using the appropriate checklist before the completion of the project.

14. HEALTH AND SAFETY TRAINING

The Principal Contractor shall ensure that employees are trained on health and safety measures this shall include but not limited to:

- Written Safe Working Procedures
- Risk Assessments
- Health and Safety Plan
- Emergency Management Plan
- Induction
- Toolbox Talks
- MSDS

15. INCIDENTS MANAGEMENT & FIRST AID

All incidents and accidents as per Section of the Act must be reported, recorded and investigated as per General Administration Regulation 8 & 9

Where a fatality or permanent disabling injury or incident occurs on the Construction site, the Client must ensure that the Principal Contractor provides the Provincial Director with a report contemplated in Section 24 of the Act and the report includes the measures that the Principal Contractor intends to implement to ensure a safe construction site.

16. HEALTH AND SAFETY AUDITS

The Client must ensure that periodic health and safety audits are conducted at intervals mutually agreed upon between the Principal Contractor and the Client at least every 30 days, the copy of the health and safety audit report must be provided to the Principal Contractor within seven days after the audit.

17. FIRE PRECAUTIONS ON CONSTRUCTION SITE

The Principal Contractor shall provide suitable fire extinguishers which shall be serviced regularly in accordance with the manufacture’s recommendations.

Safety signage shall be prominently displayed in all areas where fire extinguishers are located. The Principal Contractor shall arrange for training of the relevant personnel, in the use of fire extinguishers.

The provisions of Regulation 29 of the Construction Regulations as well as Regulation 9 of Environmental Regulation for Workplaces shall be followed in every detail.

18. ELECTRICAL INSTALLATIONS AND MACHINERY ON CONSTRUCTION SITE.

The Principal Contractor shall designate a competent electrician in writing who shall control all electrical installations.

All temporary electrical installations used by the contractor are inspected at least once a week by a competent person and the inspection findings are recorded in a register kept on the construction site.

All Electrical machinery is inspected by the authorized operator or user on daily basis using a relevant checklist prior to use and the inspection findings are recorded in a register kept on the construction site.

The provisions of Regulation 5, 6 & 9 of the Electrical Installation Regulations shall be followed in every detail.

19. PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING.

The Principal Contractor shall ensure that every employee is issued with, and wears SANS-approved P.P.E. as per the conducted risk assessment.

Failure to use protective equipment as per the risk assessment shall require disciplinary intervention and this process shall be documented in the induction.

No employer shall in respect of anything which he is in terms of this Act required to provide or to do in the interest of health or safety of an employee make any deductions from any employee's remuneration or require or permit any employee to make any payment to him or to any other person.

The provisions of Regulation 2 of the General Safety Regulations shall be followed in every detail.

20. OCCUPATIONAL HEALTH AND SAFETY SIGNAGE

The Principal Contractor shall erect and maintain quality safety signage

The signage shall include but is not limited to:

- The construction work permit number displayed at the entrance
- Access restrictions

- A sign indicating that all visitors must report to the site office and must be accompanied by the Principal Contractor when accessing the site
- The name and telephone number of the responsible person(s)
- Emergency telephone number(s)
- PPE to be worn at the particular site
- When falling objects may occur, relevant barricading and warning signs must be erected
- Excavations, heights structures, temporary structures and all risk areas must be indicated as per the specific methods defined in the H&S Plan.

21. DUTIES OF PRINCIPAL CONTRACTORS AND CONTRACTORS

Contractors and sub-contractors must be given a copy of the H&S specification and any additional specification issued by the Client and shall comply with these specifications integrally. All employers working on the site shall conform to the standard in the CHSS. All the duties of the Principal Contractor in this CHSS equally apply, in full, to contractors of such Principal Contractor and to sub-contractors of such contractors.

The Principal Contractor shall ensure that the comprehensive and updated list of all the contractors and sub-contractors on site includes:

- A reference to the agreements between the parties, including all contractors Section 37(2) agreements with the Principal Contractor
- The type of work being done
- The date of the approval of the H&S Plan
- The date of expiry of the COIDA certificate of good standing
- The date of the last monthly audit

The provisions of Regulation 7 of the Construction Regulations shall be followed in every detail.

22. FALL PROTECTION AND WORKING IN FALL RISK POSITIONS

The Principal Contractor shall ensure that the fall protection plan include a risk assessment for all work carried out from the fall risk position and the safe work procedures.

All employees working from fall risk position are subject to medical examination. The Training Programme must be in place for employees working from a fall risk position. The procedures addressing the inspection, testing and maintenance of all fall risk

protection equipment. The rescue plan detailing procedure, personnel and suitable equipment to be used to rescue a person. The Principal Contractor must that a competent person is designated to be responsible for the preparation of the fall protection plan.

The provisions of Regulation 10 of the Construction Regulations shall be followed in every detail.

23. EXCAVATION AND COMPACTION

The Principal Contractor must ensure that all excavation and compaction work is carried out under the supervision of a competent person who has been appointed in writing for that purpose.

The Principal Contractor shall take cognizance of the geotechnical study pertaining to the conditions of the construction site and must plan all excavation work in accordance with the recommendations of the professional engineer.

The Principal Contractor must ensure that every excavation, including all bracing and shoring, is inspected daily, prior to the commencement of each shift and that no person enters the excavation or works in a risk zone until the excavation is assessed and declared safe.

All excavations must be left open for the minimum of time required and those that are left open on the site must be protected by a barrier or a fence of at least one meter in height as close to the excavation as is practicable. The protective barrier or fence must adequately prevent persons from falling into the excavation and barrier taping is not sufficient for this purpose

Excavation shoring and bracing, if required shall be designed by a designer appointed in writing who shall inspect and approve the installed shoring and bracing

Where persons work, inspect or test excavations, warning signs must be in place next to an excavation.

The provisions of Regulation 13 of the Construction Regulations shall be followed in every detail.

24. PUBLIC HEALTH AND SAFETY

The site shall at all times be secured to prevent the unauthorized access of persons to construction risk areas.

Appropriate health and safety signage shall be posted and access control to site must be exercised via a single access point.

All members entering the site must indicate in what capacity them visiting the site.

The access point must be designed and constructed to allow for temporary parking, entry of construction vehicles, entry of personnel transport vehicles and entry of individual workers and other persons.

The principal Contractor shall ensure that each person visiting the site shall be inducted to the site and such abridged induction shall outline the hazards from on-site activities and the precautions to be observed to avoid or minimize those risks

Visitors must only enter when accompanied by a responsible person designated by the Principal Contractor.

25. NIGHT; WEEK –END WORK

No night or weekend work shall be performed unless authorized by the Principal Agent or Lead Engineers

Where weekend work is planned the Principal Contractor shall ensure that its construction supervisor is on site, this applies even if only contractors or sub-contractors are working on the site

Where weekend work is planned each contractor or sub-contractor shall ensure that its construction supervisor is on site, this applies even if the Principal Contractor's manager or supervisor is on the site.

26. CONSTRUCTION EMPLOYEES FACILITIES

The Principal Contractor shall provide at or within reasonable access of every construction site, the following clean, hygienic and maintained facilities:
(a) Shower facilities after consultation with the employees or employees representatives, or at least one shower facility for every 15 persons;
(b) at least one sanitary facility for each sex and for every 30 workers;
(c) changing facilities for each sex; and
(d) sheltered eating areas.

The provisions of Regulation 2, 3, 4, 6, 7, 9 of the Facilities Regulations shall be followed in every detail.

27. CRANES AND LIFTING OPERATIONS

The Principal Contractor must unsure the cranes used are:
Are designed and erected under the supervision of a competent person;
A relevant risk assessment and method statement are developed and applied; The effects of wind forces on the crane are taken into consideration and that a wind speed device is fitted that provides the operator with an audible warning when the wind speed exceeds the design engineer's specification; The bases for tracks for rail-mounted tower cranes are firm, level and secured; *T*he tower crane operators are competent to carry out the work safely; and *T*he tower crane operators have a medical certificate of fitness to work in such an environment, issued by an occupational health practitioner in the form of Annexure 3

28. STORAGE AND USE OF FLAMMABLE LIQUIDS

No flammable substances must be stored on site unless these are stored in a flammable store or cabinet approved by the Municipal Chief Fire Officer, no other materials shall be stored in the flammable store or cabinet

Where required the H&S Plan shall include a method statement detailing the safe use, storage, decanting and spill controls for all flammable liquids used and stored on site.

The provisions of Regulation 25 of the Construction Regulations shall be followed in every detail.

29. HAZARDOUS CHEMICAL SUBSTANCE

With respect to hazardous chemical substances used, the contractor shall ensure that:

- All MSDS are included in the H&S File
- A HCS risk assessment is included in the H&S Plan
- The safe use, storage, emergency procedures and safe disposal of hazardous substances are addressed in a method statement(s) included in the H&S Plan.
- Proof of competency and signed letters of appointment of the person responsible for chemical handling is included in the H&S File.

Any hazardous chemical substance intended to be applied on site during the project (i.e. after approval of the H&S Plan) shall be subject to an issue-based risk assessment and method statement which must be presented to the Client Agent prior to the substance being introduced on site.

The provisions of Regulation 3, 5, 7, 8, 9, 9A, 10, 11, 14, 15 of the Hazardous Chemical Substances Regulations shall be followed in every detail.

30. EXPLOSIVE AND FASTENING DEVICES

The principal Contractor shall submit proof of competency and the appointment letter of the person in charge of explosives as well as actuating fastening devices and of the person in charge of the issuing and collection of Explosives, cartridges and nails. This shall be placed in the H&S Plan.

The H&S Plan shall include the method statement for the safe use of explosives, actuating fastening devices including the type PPE, barricading and warning notice which the Contractor intends to use and the method of accounting for cartridges and nails and explosives.

The H&S Plan shall include proof of training and competency of all operators using explosive actuating fastening devices.

A template inspection register of explosive, and actuating fastening device shall be included in the H&S Plan.

A template record for the issuing and collection of explosives, cartridges and nails shall be included in the H&S Plan.

For the purpose of acquisition / transport of the cartridges the Principal Contractor is required to hold a permit in terms of the Explosive's Act. This permit for the transportation of Blank cartridges used in Power-Actuated Tools shall be placed in the H&S Plan:

- Application for registration, licenses and permits must be submitted by the Chief Inspectors Office in Pretoria.
- The Principal Contractor is required to be in possession of a continuous transport license but is not required in terms of the Explosives Act to hold a permit for the use of the blank cartridges.
- Once the cartridges are delivered to the appointed responsible person is then required to ensure that the Regulations governing the safe use of explosive powered tools in terms of the Construction Regulation 21 of the Occupational Health and Safety Act, Act 85 of 1993 are complied with.

The provisions of Regulation 21 of the Construction Regulations shall be followed in every detail.

31. HOUSEKEEPING AND GENERAL SAFEGUARDING ON CONSTRUCTION SITE

The Principal Contractor shall appoint a person responsible for general housekeeping and stacking and storage of materials and equipment on the entire site.

The provisions of Regulation 27 of the Construction Regulations shall be followed in every detail.

32. CONSTRUCTION MEDICALS

A Principal Contractor must ensure that all his or her employees have a valid medical certificate of fitness specific to the construction work to be performed and issued by an Occupational Health Practitioner in the form of Annexure 3.

33. STACKING AND STORAGE ON CONSTRUCTION SITE

A Principal Contractor must, in addition to compliance with the provisions for the stacking of articles in the General Safety Regulations, 2003, ensure that—
A competent person is appointed in writing with the duty of supervising all stacking and storage on a construction site; *A*dequate storage areas are provided; *T*here are demarcated storage areas; and *s*torage areas are kept neat and under control.

34. INDUCTION AND TOOLBOX PROGRAMME

No contractor may allow or permit any employee or person to enter any site, unless that employee or person has undergone health and safety induction training pertaining to the hazards prevalent on the site at the time of entry.
A contractor must ensure that all visitors to a construction site undergo health and safety induction pertaining to the hazards prevalent on the site and must ensure that such visitors have the necessary personal protective equipment.
A contractor must at all times keep on his or her construction site records of the health and safety induction training contemplated in sub-regulation (6) and such records must be made available on request to an inspector, the client, the client's agent or the principal contractor. The Principal Contractor must ensure that the toolbox talks are conducted on weekly basis and the training records kept on the safety file

35. STRUCTURES

A contractor must ensure that all reasonably practicable steps are taken to prevent the uncontrolled collapse of any new or existing structure or any part thereof, which may become unstable or is in a temporary state of weakness or instability due to the carrying out of construction work; *N*o structure or part of a structure is loaded in a manner which would render it unsafe; All drawings pertaining to the design of the relevant structure are kept on site and are available on request to an inspector, other contractors, the client and the client's agent or employee.

36.CORONA VIRUS

The Contractor will be required to compile and submit for review and approval, before establishing on site, the following documents:

- COVID-19 Policy: To be signed by the Chief Executive Officer 16(1).
- COVID-19 Prevention and Control Management Plan which will include Procedures on how the Department of Health and the Disaster Management Requirements shall be complied with (see Annexure 9 for checklist that will be used to review and approve the plan).
- Appointment of A COVID-19 Compliance Officer.
- Compliance Commitment letter to be signed by all persons in a supervisory role (Foreman/Supervisor/Construction Manager).

The Contractor will also be responsible for the following, which must be explicitly detailed in there COVID-19 Prevention and Control Management Plan:

- Ensure that all persons on site including Sub-contractors, Visitors, Client and Professional team comply with the COVID-19 Policies and Procedures.
- The Contractor must not permit more persons onto site than what is permitted by the gazetted Disaster Management Regulations which may change from time to time.

DESIGNER COMMENTS ON HEALTH AND SAFETY SPECIFICATION

Designer's Health and Safety Checklist

Name and address of Project_____

_____

Item and Legal Reference	Y/N	Comment
CR 6(1) (a) Has the designer familiarized himself with the Construction Regulations 2014 (particularly Regulation 6) and the Safety Standards incorporated into these Regulations?	Yes	To be included as part
CR 6(1) (b) During the design stage, was the Client's Health and Safety Specifications given due consideration?	yes	Included in Construction tender
The structural design aspects that could have an effect on the pricing of construction work?	yes	On site manufacturing was reviewed
The geotechnical-science aspects?	yes	Major Blasting and Hard rock removal Risk Identified to be addressed by contractor
The weight which the structure is designed to safely withstand?	yes	Standard design

CR 6(1)(d) Has the designer communicated all known and anticipated hazards and risks associated with the construction of the designed structure? Furthermore, has the safe method statement been developed to ensure that construction work is safely executed?	yes	Contractor to note compaction risk close to existing structures
		Contractor to provide prior to construction can commence
CR 6 (1) (e) As far as is reasonably practicable, are the dangerous processes and materials been eliminated or replaced in the design?	Yes	Contractor to consider prior to construction can commence
CR 6(1) (f) Has due consideration been taken during the design stage, for the safe maintenance of the structure after its completion?	Yes	Access roads to be upgraded
CR 6 (g-i) Is the designer aware of his/her responsibility to carry out periodic site inspections to ensure that the structure is constructed correctly in accordance with the design?	Yes	Part of appointment of Engineer
CR 6(1) (j) Have all ergonomic hazards been considered for the lifecycle of the structure (i.e. during construction and after completion)?	Yes	Contractor will be restricted to normal working hours

(Please ensure that the checklist is completed in full particularly the comments column)

Name of Designer_____

Designer's Title (e.g. Engineer, Architect)_____

Signature_____

Date_____

ETHEKWINI MUNICIPALITY
Occupational Health & Safety Unit

BASELINE RISK ASSESSMENT

Document Title	Baseline Risk Assessment
Client	eThekwini Municipality – Water and Sanitation
Project	Thandokuhle Reservoir: Construction of a new 3ML Reinforced Concrete Reservoir, Inlet and Outlet Pipework and Ancillary Works
Contract Number	WS7400
Compiled by (Safety Officer)	Name and Surname: Hlengiwe Njapha Signature: HNJAPHA Date: 28/04/2021
Approved by (Safety and Risk Manager)	Name and Surname: Arty Zondi Signature: Arty Zondi Date: 28/04/2021
Revision Number	BRA256/04/2021

BASELINE RISK ASSESSMENT

1. INTRODUCTION: In accordance with the Occupational Health and Safety Act, (Act 85 of 1993) the Legislator places specific requirements on an Employer. One of these is prescribed in Section 8(i) of the Act where it requires the Employer to ascertain the risks and dangers which may occur within the workplace or section of the workplace and then goes on to establish working procedures or practices.

2. PURPOSE: This is conducted to create a benchmark of the potential risks that apply to the whole project or business operation.

3. SCOPE: This assessment could be approached on a site, regional or national level concerning any facet of the business operation or process or activity.

4. REVIEW AND MONITORING PLAN

The risk assessment form part of the health and safety plan to be applied on the site and must include the following:

(a) The identification of the risk and hazards to which persons may be exposed.
(b) An analysis and evaluation of the risks and hazards identified based on a documented method

5. REFERENCES

(a) **Tender Document**

(b) Occupational Health & Safety Act and its Regulation

SCOPE OF WORK

The works will broadly include but not limited to:

Inlet and Outlet Works

Overflow and scour valves

Interconnecting pipe work

Telemetry installation and power supply

Buildings and Chambers to house mechanical installation for ancillary pipe work stormwater systems

Fencing and associated ancillary works has to be constructed/erected/installed an Access road has to be constructed

1. RISK ESTIMATION AND EVALUATION

RISK CLASSIFICATION USING A RISK SCORE TECHNIQUE

Exposure (E) How frequently does the hazardous event occur	**Risk classification**
Continuously	10
Frequently (daily)	6
Occasionally (weekly)	3
Unusually (monthly)	2
Rarely (few a year)	1

Probability (P) The probability of a loss when the hazardous event does occur	**Risk classification**
Frequent (happens often)	10
Probable (quiet possible)	6
Occasional (unusual, but possible)	3
Remotely possible (has happened somewhere)	1
Improbable (practically impossible)	0.5

Severity (S) Consequences of the hazardous event	**Risk classification**
Catastrophic many fatalities; or interruption of longer than 2 weeks; or asset or environmental damage (or both) exceeding R100m	100
Disaster (few fatalities; or interruption between one and 2 weeks; or asset or environmental damage (or both) exceeding R10m)	40
Very serious (one fatality; or interruption of 6 days; or asset or environmental damage (or both) exceeding R100,000	7
Important (temporary disability; or interruption between 6 and 24 hours; or damage exceeding R10,000	3
Noticeable (first aid needed; or interruption of less than 6 hours; damage exceeding R1000)	1

Risk classification (Risk score = E x P x S)

Risk score	**Risk classification**
Over 400---------5	Very high risk – discontinue operation or activity
200 to 400 ------ 4	High risk – immediate correction needed
70 to 200------- 3	Substantial risk – correction needed
20 to 70--------- 2	Possible risk – attention needed
Under 20 -------- 1	Risk accepted

BASELINE RISK ASSESSMENT WORKSHEET: IDENTIFYING EXISTING & POTENTIAL RISKS

1	**Site Access**								
	Activity	**Hazard**	**Risk**	**Risk Evaluation**			**Risk Score**	**Risk level**	**Risk Rank**
				E	P	S			
	Accessing the site using construction vehicles or walking to site. Delivering of equipment and material to the site	Excessive speed, head on collusion, employees knocked by moving vehicles. Road blocked off due to community protest. Manual Handling and excessive lifting.	Accidents, damage to equipment or severe injuries or death. Back injuries,	6	6	7	252		4
2	**Site Establishment**								
	Manual and mechanical clearing of the land. Off-loading and positioning of offices by mobile crane. Fencing. Installation of temporary water supply, electricity, ablution facilities,	Dust, Snakes, Bees & Wasps. Incompetent operator. Poor connection of temporary services.	Poisoned and death. Collision/impacts of mobile lifting equipment loads and dropped loads with process plant, pipe work, electrical cables and people. Water leaks, Electrocution, improper connection	6	6	7	252		4

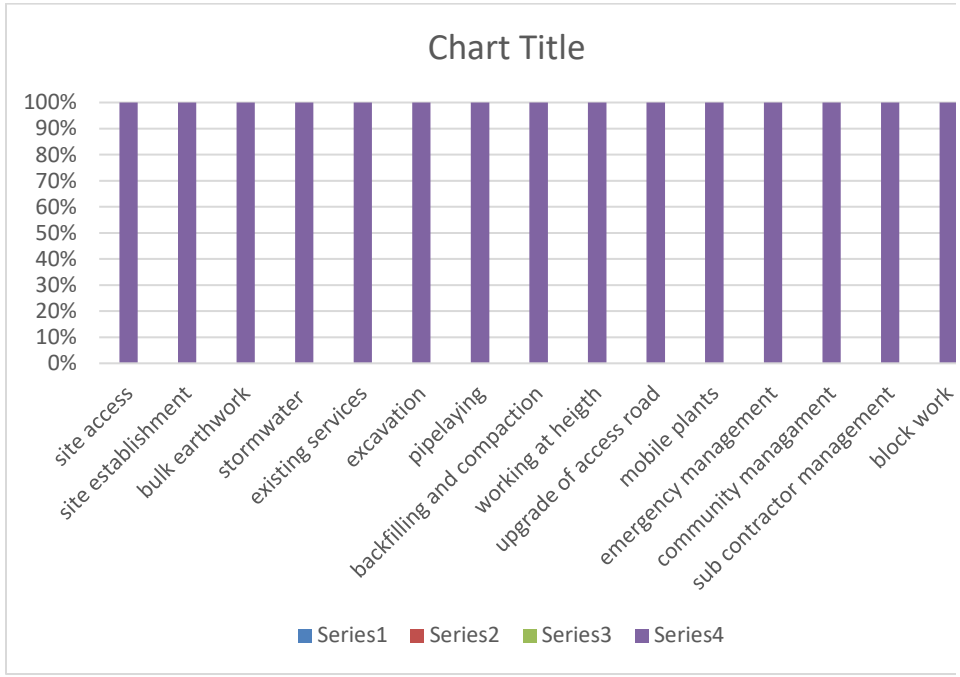
3	**Bulk Earthwork**								
	Mechanical excavation Stockpiling	Incompetent operator. Machine running out of control. Open excavation. Dust Poor stockpiling. Operating mobile plant next to open excavation	Personal injury/amputations Property damage. Respiratory problem. Obstruction of walkways	6	6	7	252		4
4	**Drainage/Storm water**								
	Lay, bed and joint of pipes	Unsafe access to excavation Manual handling of pipes Possible pinch of fingers Engulfment of excavation	Personal injuries. Possible pinch Death/ body injury	6	6	3	108		3
5	**Existing Services**								
	Identify the existing services	Snakes Unforeseen hazards	Poisoned and death. Personal injuries.	6	6	7	252		4
6	**Excavation**								
	Mechanical and manual excavation. Back filling mechanical and manual	Unauthorized operator. Machine running out of control. Open excavation.	Personal injury/possible disabling injuries. Property to damage Respiratory problem.	10	6	7	420		5

		Dust. Operating mobile plant next to open excavation.							
7	**Pipelaying**								
	Accessing trenches Mechanical lifting of Pipe and	Trench collapse, falling objects/material Incorrect lifting of pipes	Personal injuries/death Injury to muscle	6	6	7	252	4	
8	**Backfilling & Compaction**								
	Back filling mechanical or manual Operating a Bomag roller, Wacker etc.	Incompetent operator. Noise. Vibration.	Personal injuries and damage to property. Noise Induce. Hearing loss. Kidney problem. Body pain.	6	6	3	108		3
9	**Working at height**								
	Erection of Scaffolding by a Competent person	Unsafe scaffolding/ trestle scaffolds	Unsafe scaffolding could collapse resulting in critical injuries	6	6	7	252		4
10	**Upgrade of access road**								
	Layer works Compaction	Nose, dust Inclement weather, including localized flooding Smoking/open fires Vibration (rolling	Rain causing slippery conditions and localised flooding causing property damage, injury and possible death Heat stroke from being	6	6	7	252		4

		compaction)	exposed to the sun for too long and sunburn Bush fires caused by cigarette/open fires causing smoke, inhalation possible death						
11	**Construction Mobile Plant and Equipment**								
	Use of Plant & Equipment on site	Incompetent operator Unsafe plant & equipment. Collusion with other vehicles. Petrol and oil spillages.	Personal injuries. Motor vehicle accident. Environmental contamination.	6	6	7	252		4
12	**Emergency Management**								
	Development and Implementation of an Emergency Management Plan	Failure to have a basic, site specific emergency management plan. Workers not trained in the Emergency Plan. Insufficient or no emergency	Injury or damage to property. Inability to respond to emergencies. Insufficient or no emergency equipment.	6	6	3	108		3

		equipment or personnel.							
13	**Community Risk Management**								
	Managing community risk	Failure to adequately monitor and manage the multi-faced social issues.	Violent protests. Injury to employees and property damage.	6	6	3	108		3
14	**Subcontractor Management**								
	Managing subcontractors	Failure to adequately assess subcontractors S.H.E Management System before work commences and at regular intervals. Inadequate Supervision. Utilizing incompetent Subcontractors.	Injury and non-compliance to legislation. High level of employee unsafe behavior. Accidents and property damage.	6	6	3	108		3
15	**Block work (Chambers)**								
	Block work and mixing mortar.	Manual handling of blocks. Mortar inhalation. Mortar contact with body.	Injury to hands. Respiratory problem. Skin problems.	6	6	3	108		3

RISK PROFILE: Thandokuhle Reservoir: Construction of a new 3ML Reinforced Concrete Reservoir, Inlet and Outlet Pipework and Ancillary Works



ETHEKWINI MUNICIPALITY
Occupational Health & Safety Unit

COVID 19 Health and Safety Specification

Document Title	COVID 19 Health & Safety Specification
Client	eThekwini Municipality – Water and Sanitation
Project Name	Thandokuhle Reservoir: Construction of a new 3ML Reinforced Concrete Reservoir, Inlet and Outlet Pipework and Ancillary Works
Contract Number	WS7400
Internal Reference no.	COVID 451 /04/2021
Compiled by (Safety officer)	Name and surname: Hlengiwe Njapha Signature: HNJAPHA Date: 30/04/2021
Reviewed by (Manager: Safety& Risk)	Name and surname: Arty Zondi Signature: Date: 30/04/2021

ETHEKWINI MUNICIPALITY
OCCUPATIONAL HEALTH AND SAFETY UNIT

COVID 19 HEALTH AND SAFETY SPECIFICATION

Background:

Corona viruses are a large family of viruses that are found both in humans and animals. Some of these viruses are known to cause illnesses ranging from common cold to severe respiratory diseases. Corona virus (COVID-19) was identified in December 2019 in China. COVID-19 infections have spread to other countries in the world. Exposure to Covid-19 may cause flue like symptoms such as coughing, sneezing, headaches, fever, sore throat and at times affect the lungs and airways of employees. Symptoms can be mild, moderate, severe or fatal.

Coronavirus Disease 2019 (COVID-19) is a respiratory disease caused by the SARS-CoV-2 virus. To reduce the impact of COVID-19 outbreak conditions on businesses, workers, customers, and the public, it is important for all employers to plan now for COVID-19. For employers who have already planned for influenza outbreaks involving many staff members, planning for COVID-19 may involve updating plans to address the specific sources of exposure, routes of transmission, and other unique characteristics of SARS-CoV-2 (i.e. compared to influenza virus outbreaks).

Introduction

The legislation governing workplaces in relation to COVID-19 is the Occupational Health and Safety Act, Act 85 of 1993, as amended, read with the Hazardous Biological Agents Regulations. Section 8 (1) of the Occupational Health and Safety (OHS) Act, Act 85 of 1993, as amended, requires the employer to provide and maintain as far as is reasonably practicable a working environment that is safe and without risks to the health of employees. Specifically, section 8(2)(b) requires steps such as may be reasonably practicable to eliminate or mitigate

any hazard or potential hazard before resorting to Personal Protective Equipment (PPE). However, in the case of COVID-19, a combination of controls is required, although the main principle is to follow the hierarchy of controls.

While engineering and administrative controls are considered more effective in minimizing exposure to SARS-cov-2, PPE may also be needed to prevent certain exposures. While correctly using PPE can help prevent some exposures, it should not take the place of other prevention strategies

This is a risk assessment for dealing with the current COVID-19 situation in the construction site. It may not likely to cover all scenarios therefore Construction Management should develop Standard Operating Procedures as there may be unique circumstances and make a necessary call in the interest of the health and safety of employees

This is a risk assessment for dealing with the current COVID-19 situation in the construction site. It may not likely to cover all scenarios therefore management should develop SOP's as there may be unique circumstances and make a necessary call in the interest of the health and safety of Contractor employees

Definitions

"**BCEA**" means the Basic Conditions of Employment Act, 1997 (Act No.75 of 1997)

"**COVID-19**" means Coronavirus Disease 2019

"**Disaster Management Act**" means the Disaster Management Act, 2002 (Act No.57 of 2002)

"**OHSA**"means the Occupational Health and Safety Act, 1993 (Act No.85 of 1993)

"**PPE**" means personal protective equipment

"**virus**" means SARS-Cov-2 virus

"**Worker**" means any person who works in an employer's workplace including an employee of the employer or contractor, a self-employed person or volunteer

"**workplace**" means any premises or place where a person performs work

"**NICD**" means National Institute for Communicable Diseases

"**OMP**" means Occupational Medical Practitioner

COVID 19 Risk Assessment:

- The Contractor must ensure that COVID 19 Risk Assessment (COVID 19 Health and Safety Plan) is conducted and submitted to the Client prior to the commencement of the construction work, it must be in line with the Client COVID 19 Health and Safety Specification.
- The Contractor must appoint COVID 19 Compliance Manager to ensure that all necessary COVID 19 safety precautions are implemented to prevent the spread.

Training and awareness:

- The Contractor must ensure that all employees are inducted on COVID19 contractor risk assessment to prevent the spread.
- The Contractor must ensure that the employees are trained on COVID 19 to prevent the spread of the virus, training records must be kept in the Safety File.
- COVID-19 Direction on Health and Safety in the Workplace Government Gazette dated 29 April 2020, must be used as guideline and be customized to specific construction site.
- The Contractor must provide workers with information that raises awareness in any form or manner, including where reasonably practicable leaflets and notices placed in conspicuous places in the workplace informing workers of the dangers of the virus, the manner of its transmission, the measures to prevent transmission such as personal hygiene, social distancing, use of cloth masks, cough etiquette and where to go for screening or testing if presenting with symptoms .

Hand Hygiene:

- The Contractor must provide adequate facilities for the washing of hands with soap and clean water on each construction site.
- The Contractor must provide 70% alcohol-based hand sanitizers at strategic points of the construction site.
- The Contractor must paper towels to dry hands after hand washing.

Cleaning and Disinfecting surfaces:

- The Contractor must take measures to ensure that all work surfaces and equipment are disinfected before work begins, regular during the working period and upon completion the work.
- The Contractor must ensure frequently cleaning and disinfecting objects and surfaces that are touched regularly particularly in areas of high use such as shared tools, taps, ablution facilities, hand rails light switches, eating and changeroom areas, shared construction vehicles, etc. using appropriate disinfecting solutions such clean water, soap and bleach

Social Distancing:

- The Contractor must arrange the construction site to ensure minimal contact between workers and as far as practicable that there is a minimum of 1,5meter distance between workers while they are working. employees are aware to maintain social distance when working.
- The Contractor must ensure that social distancing measures are implemented through supervision of both the construction site and in the common areas outside the workplace, through queue control or within the workplace, these measures may include dividing the workers into groups or staggering break times to avoid the concentration of workers in common areas.
- The Contractor must ensure that where the minimum distance is impossible employees must always be instructed to wear cloth mask/FFP1/2 mask or reducing the number of workers present in the construction site at any time to achieve the required social distancing.
- The Contractor must ensure that employees working in offices are provided with physical barriers placed between work their workstations

Personal Protective Equipment (PPE)

- The Contractor must ensure that every worker is provided with two cloth masks to be worn when in workplace or public which comply with the requirement set out in the guideline issued by Department of Trade, Industry and Competition.
- The main benefit of everyone wearing a cloth mask is to reduce the amount of virus droplets being coughed up by those with infection and transmitted to others and to surface that others may touch.
- Every Contractor must ensure that workers are informed, instructed, trained and informed as to the correct use of cloth mask.
- The Contractor must ensure to issue face shield/visors where applicable as double protection

Point of entry screening

- The Contractor must identify the screening area for each construction site.
- The Contractor must ensure that the daily point of entry screening is conducted when entering construction site by a person nominated by the Contractor.
- The Contractor must ensure that all employees and visitors are screened and only those with all clear will be given clearance to carry on with construction work.
- The Contractor must ensure that during the screening a 1.5 m distance is maintained and FFP1/2 mask to be worn by a nominated person.
- The Contractor must ensure that the screening person is trained.
- The Contractor must ensure that a bottle of sanitiser is available at the screening area.
- The Contractor must ensure that the thermal device are provided during the screening process.
- The Contractor must ensure that all employees complete a COVID 19 Questionnaire which will be used to screen potential risk personnel entering the construction site.

Symptomatic employees

- The Contractor must ensure that any person who ticks YES to one or more symptoms will be sent home and be advised to seek testing by a healthcare provider.
- The Contractor must ensure that employees who are sick with continuous cough, sore throat, difficulty breathing, or a high temperature in the workplace will be encouraged to stay home.
- The Contractor must ensure that the positive tested COVID 19 case, the employee is on paid sick leave in terms of section 22 of BCEA or if the employee's sick leave is exhausted, the Contractor shall apply for an illness benefit.
- The Contractor must ensure that employees confirmed to have COVID 19 will be managed in line with National Department of Health COVID 19 guidelines.
- The Contractor must isolate the worker with confirmed COVID case and issued him/her with FFP2 or surgical mask, arrange for the worker to be transported for further medical examination or testing, in a manner that does not place other workers or members of the public at risk
- The Contractor must ensure that the driver who is transporting the Person Under Investigation is provided with surgical mask or FFP2 mask.
- The Contractor must assess the risk of transmission, disinfect the work area and refer those workers who may be at risk for screening to prevent possible transmission.
- The Contractor must advise the Communicable Disease Centre (CDC) so that other contacts be identified and be investigated
- The Contractor must ensure that tested positive for COVID 19 is not discriminated in terms of Employment Equity Act no. 55 of 1998.
- The Contractor must ensure that if there is evidence that the worker contracted COVID 19 as a result of occupational exposure, lodge a claim for compensation in terms of the Compensation for Occupational Injuries and Diseases Act no. 130 of 1993.
- The Contractor must ensure that if a worker has been diagnosed with COVID 19 and isolated in accordance with the National Department of Health Guidelines, a Contractor may only allow a worker to return to work on the following conditions, the worker has undergone a medical evaluation confirming that the worker has been tested negative for COVID 19.

Emergency Numbers

- Corona virus (COVID-19) 24-Hour Hotline number:0800 029 999
- Corona virus (COVID-19) WhatsApp Number: 0600 12 3456
- COVID-19 National Crisis Helpline - 0861 322 322
- NICD (National Institute of Communicable Diseases) 24-Hour toll-free hotline number: 0800 029 999 or 0800 111 132
- SAPS gender-based violence service complaints (SAPS) - 0800 333 177
- GBV (Gender Based Violence) Command Centre -0800 428 428/ *120*7867# (free from any cell phone)/ SMS Line: 32312
- Women Abuse Helpline - 0800 150 150
- People Opposing Women Abuse (POWA) - Tel: 011 642 4345/ Afterhours cellphone: 0837651235
- Child Line - 0800 055 555

- Lifeline South Africa - 0800 012 322 (free on mobile networks including landlines)
- FAMSA - Advice on family relationships - 011 975 7107
- Human trafficking - Report cases of human trafficking - hotline operated by the Salvation Army and Be Heard - 08007 37283 (0 8000-rescue)
- National Human Trafficking Helpline - 0800 222 777
- Persons with Disabilities - SMS 'help' to 31531
- National AIDS Helpline - 0800 012 322
- Suicide Helpline - 0800 567 567
- Stop Gender Violence - Anonymous, confidential and accessible telephonic information, counselling and referrals, in all 11 official languages - 0800 150 15
- Substance Abuse Helpline - 0800 12 13 14

Recommended Best Practice

- The Contractor must ensure that vulnerable and 60 years old workers are identified and received a special measure for their protection.
- The Contractor must ensure that for communication strategy Microsoft Team, ZOOM or Skype or cell phones are used to prevent the spread of COVID 19 virus.
- The Contractor must ensure to keep the workplace well ventilated by natural or mechanical means to reduce the SARS – CoV – 2 viral loads.

References

- COVID-19 Disaster Management Act
- Occupational Health & Safety Act 85 of 1993
- The Department of Employment and Labour: Workplace Preparedness: COVID-19 (SARS-CoV-19 virus)
- COVID-19 Occupational Health and Safety Measures in Workplaces COVID-19 (C19 OHS), 2020
- Hazardous Biological Agents Regulations
- National Institute for Occupational Health (NIOH)

N.B. Please be aware that we are waiting for COVID 19 Construction Health and Safety Guideline issued by Department of Labour, which that they might be changes on this SPECIFICATION.

COMPANY LOGO

Covid-19 access into construction site, point of entry screening questionaire

Company / Construction Site: _____

Name and Surname: _____ **Co No:** _____

Line Manager Name: _____

Question:	**Yes**	**No**
1. Have you had flu or symptoms of flu in the last few weeks?		
2. Do you have a persistent cough that has started in the last few days?		
3. Do you have symptoms of fever? (red, tearing or burning eyes, sweats, clammy hands)?		
4. Do you have any signs of a respiratory infection, shortness of breath, difficulty breathing? *(Self-test: Hold in your breath for 10 seconds)*		
5. In the last 14 to 21 days, have you travelled outside the borders of South Africa?		
6. In the last 14 to 21 days, have had contact with anybody that has travelled outside the Provincial or South African borders?		
7. Have you been near or in contact with anyone who has symptoms or tested positive for COVID-19?		
If you have answered yes to any of the above questions, please inform your supervisor immediately. Brief description of events (When, where and who else were you with: _____ _____ _____		
Personal Commitment		
✓ I further undertake to immediately report any change in my medical condition to my supervisor/manager!		
✓ I will always maintain excellent personal and company hygiene standards!		
✓ I will maintain and keep the minimum social distance of 1m between myself and other employees!		
✓ I will utilize PPE and sanitizers provided to me to prevent the spread of the virus!		
✓ I will ensure all equipment / materials handed over to another person has been cleaned and sanitized!		
✓ I will not abuse, misuse, share or lose the PPE and related materials / equipment issued to me!		
Employee Signature		
Date		

Temperature:_____ ºC. (if temperature is at 38ºC or higher refer to Process Flow Annexure 1 document then deny entry, isolate and start reporting process)

Entry Cleared Yes ☐ **No** ☐

Construction Manager/Supervisor: _____ **Signature:** _____**Date:** _____

Comments:_____
_____
_____
_____

PEM: ENVIRONMENTAL MANAGEMENT SPECIFICATION

PEM1 PURPOSE

The purpose of the EMP is to encourage good management practices through planning and commitment with respect to environmental issues, and to provide rational and practical environmental guidelines to minimise disturbance of the natural environment.

PEM2 RESPONSIBILITIES FOR ENVIRONMENTAL MANAGEMENT

The contractor will be responsible for environmental control on site during construction and the maintenance period. The construction activities will be monitored by an independent environmental specialist and audited against the EMP.

PEM3 TRAINING AND INDUCTION OF EMPLOYEES

The contractor has a responsibility to ensure that all those people involved in the project are aware of and familiar with the environmental requirements for the project (this includes sub-contractors, casual labour, etc.).

PEM4 COMPLAINTS REGISTER AND ENVIROMENTAL INCIDENT BOOK

Any complaints received by the project team from the community will be recorded. The complaint will be brought to the attention of the site manager.

All complaints received will be investigated and a response given to the complainant within 28 days.

All environmental incidents occurring on the site will also be recorded.

PEM 5 ENVIROMENTAL SAFETY

The management of impacts associated with various categories of concern is discussed as separate topics, indicated below.

PEM 5.1 Soil

(a) Topsoil should be temporarily stockpiled, separately from (clay) subsoil and rocky material, when areas are cleared. If mixed with clay sub-soil the usefulness of the topsoil for rehabilitation of the site will be lost.

(b) Stockpiled topsoil should not be compacted and should be replaced as the final soil layer. No vehicles are allowed access onto the stockpiles after they have been placed.

(c) Stockpiled soil should be protected by erosion-control berms if exposed for a period of greater than 14 days during the wet season. The need for such measures will be indicated in the site-specific report.

(d) Topsoil stripped from different sites must be stockpiled separately and clearly identified as such. Topsoil obtained from sites with different soil types must not be mixed.

(e) Topsoil stockpiles must not be contaminated with oil, diesel, petrol, waste or any other foreign matter, which may inhibit the later growth of vegetation and micro-organisms in the soil.

(f) Soil must not be stockpiled on drainage lines or near watercourses without prior consent from the Project Manager.

(g) Soil should be exposed for the minimum time possible once cleared of invasive

vegetation, that is the timing of clearing and grubbing should be co-ordinated as much as possible to avoid prolonged exposure of soils to wind and water erosion. Stockpiled topsoil must be either vegetated with indigenous grasses or covered with a suitable fabric to prevent erosion and invasion by weeds.

(h) Limited vehicular access is allowed across rocky outcrops and ridges.

(i) All cut and fill surfaces need to be stabilized with appropriate material or measures when major civil works are complete.

(j) Erosion and donga crossings must be dealt with as river crossings. Appropriate soil erosion and control procedures must be applied to all embankments that are disturbed and destabilized.

(k) All equipment must be inspected regularly for oil or fuel leaks before it is operated. Leakages must be repaired on mobile equipment or containment trays placed underneath immobile equipment until such leakage has been repaired.

(l) Soil contaminated with oil must be appropriately treated and disposed of at a permitted landfill site or the soil can be regenerated using bio-remediation methods.

(m) Runoff must be reduced by channelling water into existing surface drainage system.

PEM5.2 Water

(a) Adequate sedimentation control measures must be instituted at any river crossings when excavations or disturbance of a riverbanks or riverbeds takes place.

(b) Adequate sedimentation control measures must be implemented where excavations or disturbance of drainage lines of a wetland may take place.

(c) All fuel, chemical, oil, etc spills must be confined to areas where the drainage of water can be controlled. Use appropriate structures and methods to confine spillages such as the construction of berms and pans, or through the application of surface treatments that neutralise the toxic effects prior to the entry into a water course.

(d) Oil absorbent fibres must be used to contain oil spilt in water.

(e) During construction through a wetland, the majority of the flow of the wetland should be allowed to pass down stream.

(f) Vehicular traffic across wetland areas must be avoided.

(g) No dumping of foreign material in streams, rivers and/or wetland areas is allowed.

(h) The wetland area and/or river must not be drained, filled or altered in any way including alteration of a bed and/or, banks, without prior consent from the DWAF. The necessary licenses must be obtained in terms of Section 21 and 22 of the National Water Act, 36 of 1998 from DWAF.

(i) No fires or open flames are allowed in the vicinity of the wetland, especially during the dry season.

(j) No swimming, washing (including vehicles and equipment), fishing or related activity is permitted in a wetland or river without written permission from the Project Manager.

(k) Disturbances to nesting, breeding and roaming sites of animals in or adjacent to wetland areas must be minimized.

PEM5.3 Air

(a) Speed limits must be implemented in all areas, including public roads and private property to limit the levels of dust pollution.

(b) Dust must be suppressed on access roads and construction sites during dry periods by the regular application of water or a biodegradable soil stabilisation agent. Water used for this purpose must be used in quantities that must not result in the generation of run-off.

(c) The site-specific investigation will quantify the impact of dust on nearby wetlands, rivers and dams in terms of sedimentation. Mitigation measures identified during the site specific study must be implemented.

(d) The Contractor must notify the Principal of all schools within 50m of the site of proposed activities. The Principal must in turn ensure that children with allergies and respiratory ailments take the necessary precautionary measures during the construction period. The Contractor must ensure that construction activities do not disturb school activities e.g. dust clouds may reduce visibility affecting sports activities.

(e) Waste must be disposed of, as soon as possible at a municipal transfer station, skip or on a permitted landfill site. Waste must not be allowed to stand on site to decay, resulting in malodours.

(f) Noise control measures must be implemented. All noise levels must be controlled at the source. All employees must be given the necessary ear protection gear. IAP's must be informed of the excessive noise factors.

(g) The Contractor must inform all adjacent landowners of any after-hour construction activities and any other activity that could cause a nuisance e.g. the application of chemicals to the work surface. Normal working hours must be clearly indicated to adjacent land owners.

(h) No loud music is allowed on site and in construction camps.

(i) No fires are allowed if smoke from such fires will cause a nuisance to IAP's.

PEM5.4 Social and Cultural

(a) Access by non-construction people onto any construction sites must be restricted. The Contractors activities and movement of staff must be restricted to designated construction areas only.

(b) The Contractors crew must be easily identifiable due to clothing, identification cards or other methods.

(c) Rapid migration of job seekers could lead to squatting and social conflict with resident communities and increase in social pathologies if not properly addressed. The Contractor must ensure that signs indicating the availability of jobs are installed.

(d) Criteria for selection and appointment (by the Contractor) of construction labour must be established to allow for preferential employment of local communities. The Local Authority must be actively involved in the process of appointing temporary labourers.

(e) Sub-Contractors and their employees must comply with all the requirements of this document and supporting documents e.g. the Contract document that applies to the Contractor. Absence of specific reference to the sub-contractor in any specification does not imply that the sub-contractor is not bound by this document.

(f) No member of the construction workforce is allowed to wander around private property, except within the immediate surrounding of the site.

(g) The Contractor must provide suitable sanitation facilities for site staff. Sanitation provided during the construction phase should be managed so that it does not cause

environmental health problems. The use of the surrounding veld for toilet purposes is not permitted under any circumstance.

(h) The Contractor must arrange for all his employees and those of his sub-contractors to be informed of the findings of the environmental report before the commencement of construction to ensure:

- A basic understanding of the key environmental features of the work site and environments, and
- Familiarity with the requirements of this document and the site specific report.

(i) Supervisory staff of the Contractor or his sub-contractors must not direct any person to undertake any activities which would place such person in contravention of the specifications of this document, endanger his/her life or cause him/her to damage the environment.

(j) The demand for construction materials and supplies will have an effect on the local economy. This impact can be optimised by sourcing and purchasing materials locally and regionally wherever possible, insofar as the material complies with the design specification.

(k) The Contractor must maintain a detailed complaints register. This must be forwarded, together with solutions, to the authorities when requested.

PEM5.5 Aesthetics

(a) Scenic Quality

Damage to the natural environment must be minimized.

Trees and tall woody shrubs must be protected from damage to provide a natural visual shield. Excavated material must not be placed on such plants and movement across them must not be allowed, as far as practical.

The clearing of all sites must be kept to a minimum and surrounding vegetation must, as far as possible, be left intact as a natural shield.

No painting or marking of natural features must be allowed.

(b) All above ground structures could be treated or painted to blend in with the natural environment.

(c) Cut and fill areas, river and stream crossings and other soil stabilisation works must be constructed to blend in with the natural environment.

(d) Natural outcrops, rocky ridges and other natural linear features, must not be bisected. Vegetation on such features must, as far as possible, not be cut unless absolutely necessary for construction.

(e) Excavated material must be flattened (not compacted) or removed from site. No heaps of spoil material must be left on site once the Contractor has moved to a new construction site.

(f) Any complaints from interest groups regarding the appearance of the construction site must be recorded and addressed promptly by the Contractor.

PEM5.6 Archaeology and Cultural Sites

(a) All finds of human remains must be reported to the nearest police station.

(b) Human remains from the graves of victims of conflict, or any burial ground or part thereof which contains such graves and any other graves that are deemed to be of cultural significance may not be destroyed, damaged, altered, exhumed or removed from their original positions without a permit from the South African Heritage and Resource Agency (SAHRA).

(c) Work in areas where artefacts are found must cease immediately.

(d) Under no circumstances must the Contractor, his/her employees, his/her sub-contractors or his/her sub-contractors' employees remove, destroy or interfere with archaeological artefacts. Any person who causes intentional damage to archaeological or historical sites and/or artefacts could be penalised or legally prosecuted in terms of the National Heritage Resources Act, 25 of 1999.

(e) A fence at least 2 m outside the extremities of the site must be erected to protect archaeological sites.

(f) All known and identified archaeological and historical sites must be left untouched.

(g) Work in the area can only be resumed once the site has been completely investigated. The Project Manager will inform the Contractor when work can resume.

PEM5.7 Flora

(a) All suitable and rare flora and seeds must be rescued and removed from the site. They must be suitably stored, for future use in rehabilitation.

(b) The felling and/or cutting of trees and clearing of bush must be minimised.

(c) Bush must only be cleared to provide essential access for construction purposes.

(d) The spread of alien vegetation must be minimized.

(e) Any incident of unauthorised removal of plant material, as well as accidental damage to priority plants, must be documented by the Contractor.

(f) Woody vegetative matter stripped during construction must either be spread randomly throughout the surrounding veld so as to provide biomass for other micro-organisms and habitats for small mammals and birds, or it may be stockpiled for later redistribution over the reinstated topsoiled surface. No vegetative matter must be burnt or removed for firewood other than those removed during the grubbing and clearing phase. Such vegetation can be made available to the local inhabitants to be used as firewood.

(g) No tree outside the footprint of the Works area must be damaged.

PEM5.8 Fauna

(a) No species of animal may be poached, snared, hunted, captured or willfully damaged or destroyed.

(b) Snakes and other reptiles that may be encountered on the construction site must not be killed unless the animal endangers the life of an employee.

(c) Anthills and/or termite nests that occur must not be disturbed unless it is unavoidable for construction purposes.

(d) Disturbances to nesting sites of birds must be minimized.

(e) The Contractor must ensure that the work site is kept clean and free from rubbish, which could attract pests.

PEM5.9 Infrastructure

(a) The relevant authorities must be notified of any interruptions of services, especially the Local Municipality, National Road Agency, Spoornet, TELKOM and ESKOM. In addition, care must be taken to avoid damaging major and minor pipelines and other services.

(b) The integrity of property fences must be maintained.

(c) No telephone lines must be dropped during the construction operations, except were prior agreement by relevant parties is obtained. All crossings must be protected, raised or relocated as necessary.

(d) All complaints and/or problems related to impacts on man-made facilities and activities must be promptly addressed by the Contractor and documented.

(e) Storage Facilities

- Proper storage facilities should be provided for the storage of oils, grease, fuels, chemicals and hazardous materials.
- The Contractor must ensure that accidental spillage does not pollute soil and water resources.
- Fuel stock reconciliation must be done on all underground tanks to ensure no loss of oil, which could pollute groundwater resources.
- Cement must be stored and mixed on an impermeable substratum.

(f) Traffic Control

All reasonable precautions must be taken during construction to avoid severely interrupting the traffic flow on existing roads, especially during peak periods.

Before any work can start the Local Traffic Department must be consulted about measures to be taken regarding pedestrian and vehicular traffic control.

(g) Access Roads

The Contractor and the affected landowner must collaborate on the planning and construction of new access routes and the repair or upgrading of existing routes.

Access to the site must be controlled such that only vehicles and persons directly associated with the work gains access to the site.

Temporary access roads must not be opened until required and must be restored to its former state as soon as the road is no longer needed.

(h) Batching Plants

Concrete must be mixed only in an area demarcated for this purpose. All concrete spilled outside this area, must be promptly removed by the Contractor and taken to a permitted waste disposal site. After all concrete mixing is complete, all waste concrete must be removed from the batching area and disposed of at an approved dumpsite. Stormwater must not be allowed to flow through the batching area. Water laden with cement must be collected in a retention area for evaporation and not allowed to escape the batching area. Operators must wear suitable safety clothing.

(i) Chemical toilet facilities should be managed and serviced by a qualified company. No disposal or leakage of sewerage should occur on or near the site.

(j) Blasting

Blasting must not endanger public or private property.

Noise mufflers and/or soft explosives must be used to minimize the impact on animals.

All the provisions of the Explosives Act, 26 of 1956 and the Minerals Act, 50 of 1991 must be complied with.

The Contractor must take measures to limit flyrock.

PEM5.10 Safety

(a) Measures must be taken to prevent any interference that could result in flashover of power lines due to breaching of clearances or the collapse of power lines due to collisions by vehicles and equipment.

(b) Measures must be taken during thunderstorms to protect workers and equipment from lightning strikes.

(c) All tall structures must be properly earthed and protected against lightning strikes.

(d) The process of excavation and back filling must be carried out as a sequential process following one another as quickly as possible. Excavations must only remain open for a minimum period of time and during this time they must be clearly demarcated. If excavations place the public at risk these sites must be fenced.

(e) The residents directly affected by open trenches must be notified of the dangers. This will be done during the site-specific phase.

PEM5.11 Waste

Solid Waste

(a) Littering on site and the surrounding areas is prohibited.

(b) Clearly marked litterbins must be provided on site. The Contractor must monitor the presence of litter on the work sites as well as the construction campsite.

(c) All bins must be cleaned of litter regularly.

(d) All waste removed from site must be disposed at a municipal/permitted waste disposal site.

(e) Excess concrete, building rubble or other material must be disposed of in areas designated specifically for this purpose and not indiscriminately over
(f) the construction site.

(g) The entire works area and all construction sites must be swept of all pieces of wire, metal, wood or other material foreign to the natural environment.
(h) Contaminated soil must be treated and disposed of at a permitted waste disposal site, or be removed and the area rehabilitated immediately.

(i) Waste must be recycled wherever possible.

Liquid Waste

(a) The Contractor must maintain mobile toilets on site.

(b) The Contractor must provide adequate and approved facilities for the storage and recycling of used oil and contaminated hydrocarbons. Such facilities must be designed and sited with the intention of preventing pollution of the surrounding area and environment.

(c) All vehicles must be regularly serviced in designated area within the Contractors camp such that they do not drip oil.

(d) All chemical spills must be contained and cleaned up by the supplier or professional pollution control personnel. Run-off from wash bays must be intercepted.

Hazardous Waste

(a) No hazardous materials must be disposed of in the veld or anyplace other than a registered landfill for hazardous material. Hazardous waste must be stored in containers with tight lids that must be sealed and must be disposed at an appropriately permitted hazardous waste disposal site. Such containers must not be used for purposes other than those originally designed for.

(b) The Contractor must maintain a hazardous material register.

PEM5.12 Rehabilitation and Site clearance

(a) When all major construction activities are completed, the site must be inspected to determine site-specific rehabilitation measures. This may be considered as unplanned work e.g. soil rehabilitation due to oil spills.

(b) All temporary buildings and foundations, equipment, lumber, refuse, surplus materials, waste, construction rubble fencing and other materials foreign to the area must be removed.

(c) If waste products cannot be recycled they must be disposed of at a permitted landfill site.

(d) All drainage deficiencies including abandoned pit latrines and waste pits must be corrected.

(e) Cut and fill areas must be restored and re-shaped.

(f) The area must be restored to its natural vegetation condition using indigenous trees, shrubs and grasses as directed by a grassland and/or rehabilitation expert.

(g) Borrow pits must be re-shaped into even slopes and surfaces to blend with the natural terrain and topsoil must be replaced.

(h) The grass mix, shrubs and trees used for rehabilitation must be compatible with the species identified in the site-specific investigation.

(i) Areas compacted by vehicles during construction must be scarified to allow penetration of plant roots and the regrowth of natural vegetation.

(a) PEM6 MEASUREMENT AND PAYMENT

An item has been included in the Bill of Quantities to comply with the above actions.

ETHEKWINI MUNICIPALITY

ETHEKWINI WATER AND SANITATION PARTICULAR SPECIFICATIONS FOR DAYWORK SCHEDULE

PAA.1 GENERAL

In cases where the Engineer orders any variation in the form, quality or quantity of the work or any extra work to such an extent that the tendered rates for specific items are no longer applicable, or where a combination of tendered rates cannot be applied to compensate for such work, the Engineer may, in terms of the General Conditions of Contract, order that the amended or extra work be carried out as daywork at the cost of labour, plant and materials. For that purpose provision is made for the Contractor to tender his rates for labour and plant in the Daywork Schedule which forms part of this contract.

No work will be measured as daywork unless:

(a) the Engineer agrees that the varied work is not in accordance with the specification or scope of a measured item in the contract;

(b) the Engineer has issued an order in writing for the execution of such varied work; and

(c) statements of plant and labour are submitted daily to the Engineer for his consideration and approval.

All work valued at the tendered rates in the Daywork Schedule will be subject to contract price adjustment as applicable to the Contract.

PAA.2 SALARIES AND WAGES OF WORKMEN

The amount to be paid for labour will be based on the rates tendered in the Daywork Schedule for the workers executing the work. The tendered rates shall be all-inclusive and shall be held to cover all charges for the Contractor's profits, timekeeping, clerical work, insurance, establishment, superintendence, the use of hand tools, etc, and no additional surcharge over and above the tendered rates will be applicable.

PAA.3 CONSTRUCTIONAL PLANT

The rates for constructional plant as tendered in the Daywork Schedule shall cover all costs, overheads and profit for the contractor and no further surcharge will be payable on the tendered rates. The cost of operators shall be included in the tendered rates except where otherwise specified in Clause PAA-5 (Measurement and Payment) hereafter.

Where plant or equipment for which no rates exist in the Daywork schedule are employed, the cost thereof shall be determined as agreed with the Engineer in terms of the General Conditions of Contract. In such case contract price adjustment will only be applicable if the agreed cost is based on rental rates at the time of the base month before closing of tenders, or if the ruling rates current at the time of the execution of the work are de-escalated to the base month.

The Contractor will be paid for the transport to and from the site of constructional plant not on site and specially ordered by the Engineer to be brought on site. No payment

will be made for transport of equipment listed in the Contractor's Schedule of Constructional Plant in the tender document, or for equipment which has been removed from the site on request of the Contractor, or for equipment already on site, regardless of whether it appears on the Schedule of Constructional plant or not.

PAA.4 MATERIALS

Materials required for daywork items which cannot be compensated under existing rates and have to be purchased, will be paid for at cost, excluding VAT, plus a surcharge of 15%. The cost of materials provided for daywork at current rates at the time when the work is executed, will not be subject to contract price adjustment unless the prices of the materials are de-escalated to the base month for escalation.

PAA.5 MEASUREMENT AND PAYMENT

Item Unit

PAA.5.1 Labour

(a) Unskilled workers ..... hour (h)

(b) Skilled workers (Artisans)..... hour (h)

(c) Operators and drivers (where measured separately) ..... hour (h)

(d) Foremen ..... hour (h)

(e) Others (specify) ..... hour (h)

The unit of measurement is the hour or part thereof during which workers were engaged in daywork.

The tendered rate shall include full compensation for all salaries, wages, bonuses, pension, insurance, medical aid and other benefits as well as overheads arising from administrative personnel, site agents, supervisors, tools and profit. No surcharge will be paid on the tendered rates

The cost of operators included in the rates for constructional plant, will not be measured again under Labour.

Item Unit

PAA.5.2 Constructional Plant

(a) Lowbed transport of plant to and from the site……ton-kilometre (t.km)

(b) Bulldozer and ripper

(i) ..... (Specify power and mass) ..... hour (h)
(ii) ..... etc (for other bulldozers)..... hour (h)

(c) Grader

(i) ..... (Specify power and mass) ..... hour (h)
(ii) ..... etc (for other graders)..... hour (h)

(d) Front-end loaders

(i) ..... (Specify type, power and mass)..... hour (h)
(ii) ..... etc (for other front-end loaders)..... hour (h)

(e) Back-acting excavators

(i) ..... (Specify type, power and mass)..... hour (h)
(ii) ..... etc (for other back-acting excavators) ..... hour (h)

(f) Tractors and drawn rollers and trailers

(i) Tractor ..... (Specify type, power and mass)..... hour (h)
(ii) Roller ..... (Specify types, masses) ..... hour (h)
(iii) Tractor with trailer, complete (Specify tractor, and type and capacity of trailer) ..... hour (h)

(g) Compactors

(i) ..... (Specify type and mass) ..... hour (h)
(ii) ..... etc (for other types and masses)..... hour (h)

(h) Compressors

(i) ..... (Specify capacity and number of tools)..... hour (h)
(ii) ..... etc (for other compressors and tools)..... hour (h)

(i) Trucks

(i) ..... (Specify type, and capacity)..... hour (h)
(ii) ..... etc (for other trucks)..... hour (h)

(j) Light delivery vehicles

(i) ..... (Specify load capacity)..... kilometre (km)
(ii) ..... etc (for other)..... kilometre (km)

Item Unit

PAA.5.3 Cost of materials delivered to .....site (specify) P-Sum or as scheduled

The unit of measurement for subitem 5.2(a) is the ton constructional equipment multiplied by the kilometre distance over which the plant has been transported with a lowbed transporter as ordered by the Engineer.

The unit of measurement for subitems 5.2(b) to (i) is the hour or part thereof during which the item of plant had been in active use for the daywork operation, including stopping time of less than five minutes.

Where applicable travel time to and from the normal parking position on site, or the position of the most recent non-daywork activity, as well as stopping time exceeding five minutes shall be multiplied by a factor of 0,6. Time shall be measured by means of a vibrating clock card.

The unit of measurement for subitem 5.2(j) is the kilometre travelled to collect or transport small quantities of materials. Kilometres travelled in light delivery vehicles by supervisors in the execution of normal supervisional duties, shall not be measured for payment.

The tendered rates shall include full compensation for the supply, maintenance, service, repairs, depreciation as well as fuel, lubricants, licensing, insurance, overheads and profit. It shall also include the cost of drivers and operators except in the case of subitem PAA-5.2(h) where the operators of tools are paid for under labour.

ETHEKWINI MUNICIPALITY

ETHEKWINI WATER AND SANITATION PARTICULAR SPECIFICATIONS FOR COMMUNITY LIAISON OFFICER (CLO)

PCL.1 COMMUNITY LIAISON OFFICER & LOCAL LABOUR

A Provisional Sum has been provided in the document for the employment of a community Liaison Officer (CLO) for the duration of the contract. The primary role of the CLO shall be liaison and facilitation of communication which shall include inter alia: -

- assist in all aspects related to the recruitment of local labour, and advise them of their rights
- act as a source of information for the community and Councillors on issues related to the contract
- keeping the contractor advised on community issues
- keeping the contractor advised on any issues pertaining to local security
- assisting in setting up any meetings/ negotiations with affected parties
- keeping a site diary and recording details of any labour/community issues that may arise
- monitoring and reporting on general Health & Safety issues on site
- assisting in HIV/AIDS awareness programmes
- it must be noted that the CLO has no authority to issue any instructions to the Contractor

The CLO needs to be seen as neutral by all parties, and therefore should endeavour not to take sides should conflict arise

The minimum skills for a CLO shall include: -

- An ability to work with others
- An ability to communicate in Zulu and English
- An ability to communicate in writing
- Sound interpersonal skills

The Ward Councillor shall be responsible for the selection of the CLO, however the selected CLO shall be accountable to the Contractor. Where a project traverses several different wards, the respective Ward Councillors shall collectively identify a single CLO. The Ward Councillor should consult with the local community and other affected Councillors when identifying the CLO.

The CLO shall be employed on a full day basis, for the duration of the contract, and shall be paid at a rate based on 200% of the Civil Engineering Industry minimum wage. In addition to this, all statutory conditions of employment in respect of UIF, Workmen's Compensation etc should be met.

Responsibility for the identification of a pool of suitable labour shall rest with the CLO, although the contractor shall have the right to choose from that pool. The contractor and sub contractors shall have the right to determine the total number of labourers required at any time, and this will vary through the duration of the contract.

The contractor shall have the right to replace labour that is not performing adequately. The contractor should ensure that the replacement of any labour due to inadequate performance is done so in conjunction with the CLO.

Local labour shall be paid in accordance with the Civil Engineering Industry minimum wage, and all statutory conditions of employment shall be met.

ETHEKWINI MUNICIPALITY

EMC : CODE OF CONDUCT

Applicable to the Procurement of Goods, Services, Engineering and Construction Works

1. INTRODUCTION

a) Section 217.(1) of the Constitution of the Republic of South Africa reads as follows:
"When an organ of state in the national, provincial or local sphere of governments, or any other institution identified in national legislation, contracts for goods or services, it must do so in accordance with a system which is fair, equitable, transparent, competitive and cost-effective".

b) It goes without saying that, in addition to the foregoing requirements, it is essential that the procurement of goods and services, including engineering and construction works, by eThekwini Municipality should not be affected, or tainted, by illegal action, or default, at any stage of the process, by any party involved.

c) The foregoing serves to establish the broad framework within which an action, or default, by any party to the procurement process should be judged. Any action, or default, which conflicts with the objectives of section 217.(1) of the Constitution, or which is illegal, is unacceptable.

d) A party to the procurement process, who wittingly, commits an unacceptable action, or default, renders itself liable to the appropriate sanction, or even, in the case of an illegal action, or default, to prosecution.

e) This document contains examples of actions, or defaults, by parties to the public procurement process, which are unacceptable. The lists of examples are, however, not exhaustive and each party must, itself, assess whether an action, or default, would be unacceptable in the light of section 217.(1) of the Constitution, or be illegal.

2. INVOLVEMENT OF PARTIES IN THE PROCUREMENT PROCESS

a) The various parties that could be involved in the procurement of goods, services and engineering and construction works by a public process are the following, which are denoted by capital initial letters in this document.

Employer: Any Output Unit or Department within eThekwini Municipality procuring goods, services or engineering and construction works, including other public bodies/ partners assisting in, or exercising control over, the procurement process e.g. Procurement and Tenders Sub-Committee etc.

Official: An employee of the Employer.

Agent: One who acts on behalf of the Employer.

Consultant: A professional service provider engaged by the Employer.

Tenderer: One who submits a competitive bid for the supply of goods, services, or engineering and construction works to the Employer.

Contractor: The successful Tenderer to whom the Employer awards the contract for the supply of goods, services, engineering or construction works.

Subcontractor: One who contracts to a Contractor to assist the latter in the execution of his/her contract by supplying certain goods, services, or works.

Representative: A political, or other, representative of the public, or of the private sector, who serves on the Procurement and Tenders Sub-committee responsible for policy, oversight of the appointment process or approving any aspect of procurement by eThekwini Municipality.

3. UNACCEPTABLE ACTIONS AND ESSENTIAL PRACTICES

a) Examples of actions which are unacceptable and essential practices, which would constitute unacceptable defaults if not observed, are given below. The schedules are not exhaustive, but serve to highlight unacceptable actions and defaults which are more commonly encountered.

3.1 The Employer

The Employer should, himself, or through his officials, or agents:

3.1.1 Not invite tenders without having a firm intention to proceed with the procurement.
3.1.2 Ensure that the basis on which tenders will be adjudicated is clearly set out in the tender documents and that tenders are adjudicated and awarded accordingly.
3.1.3 Ensure that the tender documents are clear and comprehensive and set out the rights and obligation of all parties.
3.1.4 Not breach the confidentiality of information, particularly intellectual property, provided by Tenderers in support of their tenders.
3.1.5 Not attempt to “trade off” Tenderers against each other in an attempt to obtain better offers.
3.1.6 Ensure that all Tenderers are fairly treated and that tenders are adjudicated without bias.
3.1.7 Ensure that, except when extra ordinary circumstances dictate otherwise, transparency is maintained in the tendering process. This implies, *inter alia,* inviting tenders as widely and publicly as possible, opening tenders in public and reading out/ making available key information, such as tender prices, basic award criteria and times required for completion, and, in due course, making known to unsuccessful Tenderers the outcome of the adjudication process.
3.1.8 Ensure that his/her obligations in terms of contracts with Contractors and Consultants are scrupulously and timeously met, particularly in regard to making payments and giving decisions.

3.2 Officials

An Official should:-

3.2.1 Strictly observe all code of conduct laid down by the Employer.
3.2.2 Ensure that he is not responsible for an unacceptable action, or default, being attributed to the Employer.
3.2.3 Not allow himself/herself to be influenced in the execution of his/her duties by any consideration other than the legitimate and reasonable interests of the Employer.
3.2.4 Not accept any gifts, favours or other considerations, of anything more than token value from any other party to the procurement process.
3.2.5 Administer contracts in an even-handed manner.
3.2.6 Disclose any circumstance which may possibly be construed as constituting a conflict of interest and excuse himself/herself from deliberations in such matters

3.3 Agents

An Agent should, insofar as is relevant, act in the same way as the Official is expected to act in terms of Section 3.2.

3.4 Consultants

A Consultant should:

3.4.1 Strictly observe the code of conduct laid down by the body governing his/her profession.
3.4.2 Act in an impartial manner towards all other parties in the procurement process and take account of the legitimate and reasonable interests of them all.
3.4.3 Not accept gifts, favours or other considerations, of anything more than token value from any other party to the procurement process.
3.4.4 Not undermine the development objectives of the Employer through tokenism, fronting or any other misrepresentation.
3.4.5 Disclose any circumstance which may possibly be construed as constituting a conflict of interest and excuse himself/herself from deliberations in such matters.

3.5 Tenderers

A Tenderer should:

3.5.1 Not, except for the purpose of joint venture formation, become involved in collusion with other Tenderers, or potential Tenderers.
3.5.2 Not exchange information regarding tenders with any other Tenderer prior to the closing date for tenders.
3.5.3 Not knowingly price his/her tender in such a way as to gain an unfair advantage from an obvious error, or oversight, in the tender documents.
3.5.4 Not attempt, in any way, to influence the tender adjudication process.
3.5.5 Not approach any Representative or Official directly in connection with a tender, subsequent to the closing of all tenders.
3.5.6 Tenders only on projects for which they are capable of executing with the resources they are able to marshal in accordance with the terms and conditions of contracts.

3.6 The Contractor

The Contractor should:

3.6.1 Undertake the contract with the objective of fulfilling it in accordance with the needs of and in the best interests of the Employer and, in pursuit of this objective, co-operate with all other parties in the procurement process.
3.6.2 Aim to meet all statutory and contractual obligations fully and timeously in regard to, inter alia, conditions of employment, occupational safety, training, employment of subcontractors and fiscal matters.
3.6.3 Not attempt to influence the judgement, or actions, of Consultants, Officials/Agents, or Representatives by inducements of any sort.3.6.4 Employ Subcontractors only on the basis of fair, unbiased, written subcontracts.
3.6.5 Not engage in unfair, or unethical, practices in order to drive subcontract prices down.
3.6.6 Not make unwarranted claims for additional payment, or time, in the belief that “nothing venture, nothing gain”.
3.6.7 Not approach any Representative directly in connection with a contract.
3.6.8 Not undermine the development objectives of the Employer through tokenism, fronting or any other misrepresentation.

3.7 Subcontractors

A Subcontractor should, insofar as is relevant, act in the same way as the Contractor is expected to act in terms of Section 3.6.

3.8 Representatives

A Representative should:

3.8.1 Perform his duties in an unbiased and conscientious manner, bearing in mind the legitimate interest of all parties to the procurement process and the public.

3.8.2 Not entertain representations, except through the Employer or such person as may be delegated by the Employer, from any Consultant, Tenderer, Contractor, or Subcontractor, in regard to a tender, or contract.

3.8.3 Not allow himself to be unduly influenced by, or accept any gifts, favours or other considerations from any party which might have an interest in the procurement process.

3.8.4 Disclose any circumstance which may possibly be construed as constituting a conflict of interest and excuse himself/herself from deliberations in such matters.

3.9 Penalties

Where there is non-compliance with this code of conduct, sanctions and/penalties will be applied as follows:

3.9.1 Officials and Representatives

Reference to the Multi-Disciplinary Team in the first instance and thereafter, appropriate action by Management, if applicable.

3.9.2 Contractors/suppliers

Depending on the severity of the non-compliance, a contractor/supplier may be disqualified as a registered contractor/supplier for a period of not less than six months. Over and above that financial penalties may be imposed in terms of the Conditions of Contract.

ETHEKWINI MUNICIPALITY

ETHEKWINI WATER AND SANITATION

DEPARTMENTAL SPECIFICATION

FOR STEEL PIPES

100mm TO 2 000mm NOMINAL DIAMETER

STPIPE v13: DATED 2017-04-28

REVISIONS

Version No.	Section(s)	Clause(s)	Information
STPIPEv13	Rigid Polyurethane Coating	Table PCS5.2	Item 4: Corrected Frequency
	2 Layer PE Coating	PSC7 PSC7.2 Table 7.2	Amended Title Amended incorrect table reference Item 2: Corrected Requirement & Test Method
	2 Layer GRE Coating	PSC8	Added section "PSC8: Two Layer Glass-fibre Reinforced Epoxy (GRE)/Visco-elastic Polyisobutene Coating System"
STPIPEv12	Plant	A.4.3	Corrections to Repair of damage to coating/lining references
	2 Layer PE Coating	PSC7	Visco-elastic Polyisobutene (2LPE) Coating added
STPIPE v11	Tolerances & Testing	A6, A7	Updates SANS references
STPIPE v10	Rigid Polyurethane	PSC5.3	Mixing ratio of 1:1 added

INDEX TO PART A : STEEL PIPES 100MM TO 2 000MM NOMINAL DIAMETER

LIST OF CLAUSE HEADINGS

PART A : STEEL PIPES 100mm TO 2 000mm NOMINAL DIAMETER

A.1 SCOPE

This specification covers the material and manufacturing requirements for electric welded low carbon steel pipes in sizes 100mm to 2 000 mm nominal diameter to be buried in soil and to be used for the conveyance of potable water. The pipes shall be internally lined and externally coated with systems selected from Appendices A to D. The requirements of SANS 1217 'Guidelines for internal and external organic coating protection for buried pipelines' shall apply to all coating and lining activities. Where there is conflict between this document and the SANS specification, the requirements of this document will prevail.

A.2 INTERPRETATIONS

A.2.1 Supporting Specifications

Reference to Standard Specifications and Codes of Practice shall be deemed to be references to the latest issues or amendments of the relevant Specifications and Codes at the time of tender.

Any reference to a South African Standard shall be deemed to include approved equivalent International Standards. Copies of the South African National Standards specifications (S.A.N.S.) can be obtained from:

S A Bureau of Standards
Private Bag X191
PRETORIA 0001
SOUTH AFRICA

S.A.N.S.62-1 Steel Pipes Part 1: Pipes suitable for threading and of nominal size not exceeding 150 mm.

S.A.N.S.62-2 Steel Pipes Part 2: Screwed pieces and pipe fittings of nominal size not exceeding 150 mm.

S.A.N.S.719 Electric welded low carbon steel pipes for aqueous fluids (large bore)

S.A.N.S.1083 Aggregate from natural sources – Aggregate for concrete

S.A.N.S.1117 Plastic wrappings for the protection of steel pipelines.

S.A.N.S.1217 Guidelines for internal and external organic coating protection for buried pipelines.

S.A.N.S.1224 Polish stripper.

S.A.N.S.1365 Solvent degreaser that contain chlorinated hydrocarbons.

S.A.N.S.2808 Paints and Varnishes – Determination of film thickness

S.A.N.S.5767 Cleanliness of blast-cleaned steel surfaces for painting (assessed by pictorial standards)

S.A.N.S.5769 Cleanliness of blast-cleaned steel surfaces for painting (assessed by freedom from dust and debris)

S.A.N.S.5772 Profile of blast cleaned steel surfaces for painting (determined by micrometer profile gauge)

S.A.N.S.5863 Concrete Tests – Compressive strength of hardened concrete.

S.A.N.S.10129 Plastic tape wrapping of steel pipelines.

A.S. 4321 (Australian Standard) Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings – 1995

ASTM D2370-82 Tensile Properties of Organic Coatings.

ASTM D2240 Standard Test Method for Rubber Property (Durometer Hardness)

ASTM D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM D5162 Standard practice for discontinuity (holiday) testing of nonconductive protective coating on metallic substrates

ASTM G8 Standard Test Methods for Cathodic Disbonding of Pipeline coatings.

ASTM G14 Direct and Reverse Impact

BS 3900 Part F3 Resistance to artificial weathering (enclosed carbon arc)

BS 3900 Part F4 Resistance to continuous salt spray.

CAN/CSA-Z245.20-02 (National Standards of Canada) External Fusion Bond Epoxy Coating for Steel Pipe.

CAN/CSA-Z245.21-02 (National Standards of Canada) External Polyethylene Coating for Pipe.

GBE/CW6: Part 1 (British Gas) Requirements for Coating Materials and Methods of Test

ISO 4624 Paints and varnishes – Pull off test for adhesion

ISO 8501-1 Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness.

NACE RP0394 Application, Performance, and Quality Control of Plant-applied, Fusion-Bonded Epoxy External Pipe Coating

A.2.2 Application

The pipes supplied are to be used for the transportation of potable water and shall be internally lined and externally coated with systems selected from Appendices A and B respectively. The length, size, wall thickness, grade of steel and type of lining and coating required shall be as detailed in the schedule of technical requirements which forms part of these tender documents.

A.2.3 Terminology

For the purposes of this contract the client is defined as being eThekwini Water and Sanitation.

Reference made to the "Head: eThekwini Water and Sanitation " shall also imply any official appointed by eThekwini Water and Sanitation.

Whenever the terminology "approved by eThekwini Water and Sanitation", "to the satisfaction of eThekwini Water and Sanitation", etc., is used, it shall also imply that such work is to the satisfaction and approval of an independent inspectorate body appointed by the eThekwini Water and Sanitation to carry out Quality Assurance on any materials and goods covered by this contract.

A.3 MATERIALS

A.3.1 Steel

Steel from which the pipes are to be manufactured shall comply with clause 3 of S.A.N.S. 719, API Line Pipe Specification or an equivalent International Standard and shall be one of the following grades:

i) Grade X -42
ii) Grade X -52
iii) Grade X -65

The Contractor shall, if required by the Head: Water and Sanitation, provide certificates covering the chemical analysis and physical properties of the steel used in the manufacture of the pipes.

A.3.2 Internal Linings

Appendix A lists the approved internal lining systems. Appendix B contains the specification details for each system.

A.3.3 External Coatings

Appendix C lists the approved external coating systems. Appendix D contains the specification details for each system.

A.4 PLANT

A.4.1 General

As this contact includes not only the manufacture of the pipes but also their delivery, off-loading and stacking, it is of prime importance that the pipes and the protective systems are not damaged. Any damaged pipes may be rejected or acceptance by eThekwini Water and Sanitation may be withheld until such damages are reinstated to the full satisfaction of the Head: eThekwini Water and Sanitation.

A.4.2 Handling

Coated pipes shall be moved with the use of padded slings of width sufficient to prevent damage to the coating. Chain slings, hooks, wire ropes, rope slings without canvas covers, composition belt slings with protruding rivets, and any other equipment liable to damage the coating shall not be used. Lifting centres shall not be less than 6m apart. To ensure that coated pipes do not bear against each other whilst being transported, use shall be made of a resilient material as dunnage

which shall not disintegrate or deteriorate when exposed to the elements for prolonged periods. The pipes shall be stacked with a minimum clearance of 50mm between adjacent pipe walls.

The pipes shall be stacked in a manner that limits the loading on the lower layer of pipes. Any pipe showing permanent ovality due to surcharge loading shall be rejected. Stacking of smaller diameter pipes within larger diameter pipes will be accepted for unlined/uncoated pipes. This method of stacking will not be accepted for pipes which are lined and coated unless adequate dunnage is provided to prevent damage to the coating and lining. All ropes used for fastening shall be so padded as to prevent damage to the coating.

A.4.3 Off-Loading

The Contractor shall be responsible for off-loading the pipes at the pipe yard and shall ensure that the plant used shall be such that no pipe shell is over-stressed. Any pipes showing signs of damage to the coating are to be repaired as specified in the relevant lining/coating specification, where applicable - and such repaired surfaces "Holiday" tested prior to stacking.

All pipes are to be lifted with the aid of a "spreader" lifting beam and special care is to be taken to ensure that no damages occur to the pipe coatings by preventing the pipes from sliding on or hitting adjacent pipes.

Slings as specified in clause A.4.2 above shall be suitably rated for the loads to be handled and in good condition. The use of deteriorating and frayed slings is prohibited.

A.4.4 Storage

Dunnage as specified in clause A.4.2 shall also be used in the stacking of the pipes at the pipe yard on delivery, and the Contractor shall provide sufficient bags so that the pipes can be stacked a minimum of 300mm clear of the ground and do not touch each other. Pipes in 6m lengths shall be stacked with a minimum of 2 dunnage supports. Pipes in 9m and 12m lengths shall be stacked with a minimum of 3 dunnage supports (i.e. one support at each pipe end and one at midspan). Pipes in 18m lengths shall be stacked with a minimum of 4 dunnage supports (i.e. one support at each pipe end and one 6m from each pipe end). Stacked pipes shall have a minimum clearance of 50mm between adjacent pipe walls.

A.5 CONSTRUCTION

A.5.1 Steel Pipe

A.5.1.1 General

All pipes shall be manufactured in accordance with S.A.N.S. 719 (for pipes larger than 150mm nominal diameter) and in accordance with S.A.N.S. 62 (for pipes 150mm nominal diameter and smaller), and shall be coated and lined as detailed in the schedule of technical requirements and in accordance with the technical specification of the product manufacturer and the attached technical specification.

Wherever there is conflict of requirements of the eThekwini Water and Sanitation specification shall prevail.

A.5.1.2 Grade of Steel

All pipes larger than 150mm nominal diameter shall be manufactured from the grade of steel specified in the Schedule of Technical requirements and in accordance with S.A.N.S. 719 and all pipes 150mm nominal diameter and smaller in accordance with S.A.N.S. 62 and shall be medium class unless otherwise specified in the Schedule of Technical requirements.

A.5.1.3 Outside Diameter of Pipes

The following standard outside diameter of pipes shall be used:

Nominal Internal Diameter (mm)	Standard Outside Diameter (mm)
100	114
150	165
200	219
250	273
300	324
400	406
500	508
600	610
700	711
800	813
900	914
1 000	1 016
1 200	1 220
1 400	1 420
1 800	1 820
2 000	2 020

In order to match existing pipes, non-standard outside diameter pipes may be required as detailed in the schedule of technical requirements which forms part of this tender document.

A.5.1.4 Weld Reinforcement

The shape of welds shall be gently convex and the height of the weld reinforcement shall not exceed 1mm internally and 3mm externally. Undercuts, sharp protrusions, blowholes and discontinuity of reinforcement are not permitted.

All pipes of 200mm nominal diameter or less shall be scarfed.

A.5.1.5 End Preparation

All pipes up to and including 250mm nominal diameter shall have plain ends free from indentations and projections for a length of 150mm.

All pipes from 300mm nominal diameter up to and including 600mm nominal diameter shall have one end plain and one end belled as indicated in Fig.1 attached hereto. The inside diameter of the bell shall be 3mm larger than the outside diameter of the pipe.

All pipes over 600mm nominal diameter shall have their ends finished for butt welding with a width of root face 1,6mm (+ 0,8mm) and bevelled at an angle of 30º (+5 º - 0 º).The ends shall be free of indentations and projections for a length of 50mm.

All pipe ends shall conform with the tolerances specified in clause A.6 of this specification.

A.5.1.6 Preparation of Pipes for Coating

The fabricator of the pipes shall ensure that each pipe complies with the following requirements:

i) Weld splatter shall have been removed by chipping or grinding to a smooth surface flush with the surrounding steel.
ii) Weld seams shall have a smooth contour, free from sharp edges, protrusions and undercuts.
iii) Sharp edges and protrusions shall have been removed by grinding to a smooth radius of curvature of not less than 3mm.
iv) The pipe shall have been approved for compliance with all the requirements for the pipe specification after completion of work required to comply with clauses (a) to (c) above.

A.5.1.7 Condition of Pipes

All pipes to be coated shall be in Rust Condition A to C of ISO 8501-1. Pipes in rust condition D will be rejected.

A.5.1.8 Length of Pipes

Pipes shall be 6m, 9m, 12m or 18m long as specified in the Schedule of Technical requirements. Should pipes be supplied in lengths which differ from those specified above, the total length to be ordered will be adjusted to a multiple of the nearest whole pipe length.

A.5.1.9 Marking

All pipes shall be clearly marked in characters not less than 40mm in height (for pipes 500 mm NB or larger) or not less than 25 mm in height (for pipes up to and including 450 mm NB), with the contract number, the nominal diameter and the plate thickness in durable yellow paint on a durable black background.

Steel pipes fabricated from material other than Grade B steel are to be marked externally with 50mm wide bands of enamel paint, (traffic yellow), both at the quarter and mid points of the pipe as follows:

Grade X42 steel - one band
Grade X52 steel - two bands
Grade X65 steel - three bands

In addition to the above each pipe shall be marked, by hard stamping the contract number, the relevant item number and the pipe number onto the external face of each pipe. The information shall be stamped within 50mm of the pipe end and adjacent to the weld seam. On pipes from

300mm nominal diameter up to and including 600mm nominal diameter the information shall be stamped on the belled end.

e.g. WS.5482/ (Item Number)/(Pipe Number)

The characters shall not be less than 5mm in height.

A.5.2 Internal Linings

The internal linings shall be applied in strict accordance with the requirements specified for each generic system in Appendix B.

A.5.3 External Coatings

The external coatings shall be applied in strict accordance with the requirements specified for each generic system in Appendix D.

A.6 TOLERANCES

The required tolerance and method of measurement shall be as described in Sections 5 and 6 of S.A.N.S 719. The natural sagging of the pipe shall be calculated using the empirical Mannesmann formula:

$$\text{Natural sagging (h)} = \frac{Dm^4}{t^2} \times 1{,}312 \times 10^{-6}$$

where Dm = mean diameter
t = wall thickness

A.7 TESTING

A.7.1 Steel Pipe

The steel pipe shall be subject to all tests specified in terms of:

i) clause 6 of S.A.N.S. 719 for pipes 200mm nominal bore and greater
ii) clause 5 of S.A.N.S. 62 for pipe 150mm nominal bore and smaller.

All pipes shall be hydraulically tested in accordance with:

i) clause 7.3 of S.A.N.S. 719 for pipes 200mm nominal bore and greater
ii) clause 5.2 of S.A.N.S. 62 for pipes 150mm nominal bore and smaller

The hydraulic test pressure shall be in accordance with:

i) clause 5.2.4 of S.A.N.S. 719 for pipes 200mm nominal bore and greater
ii) clause 5.2 of S.A.N.S. 62 for pipes 150mm nominal bore and smaller

Hydraulic test certificates shall be provided for each pipe, the pipe number being indicated on the test certificates.

A.7.2 Internal Linings

The performance criteria and frequency of testing shall be as specified for each generic system in Appendix B.

A.7.3 External Coatings

The performance criteria and frequency of testing shall be as specified for each generic system in Appendix D.

A.7.4 Inspection of Manufacture and Material Delivery

A.7.4.1 Quality Control

The Contractor shall ensure that all materials used in the execution of the contract comply with the technical requirements specified.

The Contractor shall maintain accurate and up to date records of all materials, processes, process parameters and measurements necessary to ensure compliance with this specification.

A.7.4.2 Quality Surveillance

eThekwini Water and Sanitation may appoint an independent body to carry out Quality Surveillance on its behalf. The Contractor shall provide all facilities and access to premises at all reasonable times as may be necessary for the independent inspectorate to carry out its function. The cost of Quality Surveillance shall be borne by eThekwini Water and Sanitation, except for surveillance resulting in rejection or a fruitless call when the cost incurred will be back charged to the Contractor.

Advance notice of a minimum of 24 hours shall be given by the Contractor to the appointed inspectorate body when requesting inspection of any portion of the goods for acceptance, and a minimum of 3 working days before commencement of the contract.

The Contractor's quality control records shall be available for inspection at all times. Copies of these records shall be made available on request.

Notwithstanding any surveillance carried out by eThekwini Water and Sanitation or its appointed representative, the Contractor shall retain full responsibility for the quality of the goods supplied under the contract.

All pipes shall be inspected on delivery to eThekwini Water and Sanitation stores and all defects shall be made good by the Contractor at his expense.

A.8 MEASUREMENT AND PAYMENT

No payment shall be made until satisfactory test certificates have been provided. Such certificates shall be posted under separate cover and not dispatched with the deliveries of pipes.

APPENDIX A: APPROVED INTERNAL LINING SYSTEMS

APPENDIX B: SPECIFICATION DETAILS FOR INTERNAL LININGS

PLS 1: Solvent Free Epoxy Lining System

PLS1.1 Approval of Supplier

The epoxy lining shall be a solvent free liquid epoxy, Copon Hycote 162 PW, Sigmalining SF23 (7623), Pipecoat SF or a similar approved liquid epoxy lining. The approved supplier shall be S.A.N.S. 9001 certificated.

The brand type or grade, and the supplier of the solvent free liquid epoxy to be used shall be approved in writing by eThekwini Water and Sanitation. To obtain approval, the supplier shall:

i) provide independent test results in writing that demonstrate that the proposed lining material is capable of meeting the requirements specified in Table PLS1.1.

ii) provide an Infrared Scan fingerprint for the material to be retained as a standard for comparison for all subsequent batches supplied to eThekwini Water and Sanitation.

To maintain their approved status, suppliers will carry out the above tests on an annual basis and submit their results to eThekwini Water and Sanitation for approval.

PLS1.2 Approval of Batches

Each batch of epoxy paint to be used by the applicator shall be approved by eThekwini Water and Sanitation before use. No change in formulation of the liquid epoxy is permitted without prior approval of eThekwini Water and Sanitation. Such approval shall not exonerate the Contractor from the due performance of the paint systems in terms of this specification.

The manufacturer shall supply Quality Control Certificates and Infrared Scan fingerprints for each batch of material supplied. The Quality Control Certificates shall include results of tests carried out in accordance with the manufacturer's approved procedures. The number of epoxy paint batches shall be kept to a minimum so as to avoid excessive costs being incurred with the Quality Control testing required prior to application of the products.

Pipes lined with epoxy paint products that have not been approved by eThekwini Water and Sanitation may be rejected.

PLS1.3 Preparation and Cleaning of Pipe

i) Degreasing

Pipes shall be degreased internally (and externally) by the use of an approved water rinsable solvent degreaser or by passing the pipes over gas burners to carbonise contaminants.

Abrasive used for blast cleaning shall be free from oil or grease, as shall be the compressed air used in air blast cleaning.

ii) Blast Cleaning

The interior surface of the pipe shall be blast cleaned by centrifugal or air blast cleaning methods, then vacuum cleaned or blown off to achieve the following standards:

a) Cleanliness shall be equal to Sa3 of ISO 8501-1 when tested in accordance with S.A.N.S. Method 767.

b) The profile produced by blast cleaning shall be angular and shall have an average peak to valley height of 50 to 100 micrometers (or as recommended by the approved supplier), when tested in accordance with either S.A.N.S. 5772 or Testex Replica Tape.

Hackles shall be removed with coarse abrasive paper.

c) Residual dust and debris shall not exceed 0,2% when tested in accordance with S.A.N.S. 5769.

d) Water soluble salts shall not exceed 100mg/m^2 at any point when tested with the Weber-Reilly Reagent.

e) Any laminations revealed by blast cleaning shall be ground out and reblast cleaned to meet the requirements given in (a) to (d) above. If grinding penetrates the steel to a depth greater than 8% of the nominal wall thickness, the pipe shall be rejected.

iii) Handling of Cleaned Pipe

After cleaning, the pipe surface shall not be contaminated in any way. Operators shall wear clean gloves and all surfaces in contact with the pipe surface shall be clean and free from oil, grease, grit, dirt and other contamination.

iv) Cut Back of Lining

The blast cleaned surface shall be stopped off or cut back by suitable masking which shall not contaminate the cleaned surface, to 50mm from both ends of the pipe.

v) Protection of Uncoated Pipe Ends

All pipe surfaces left unlined due to cut back of the solvent free liquid epoxy lining shall be painted with an approved weldable vinyl butyral etch primer to a dry film thickness of 15 to 25 micometers. This coating shall overlap the lining by 20mm.

PLS1.4 Application of Lining

i) Method of Application

The two components shall be thoroughly and completely mixed in the proportions specified by the manufacturer. Application shall be by dual feed hot airless equipment or by single component airless equipment, as appropriate and as recommended by the

material manufacturer. The lining shall be applied in a uniform manner and, when cured, shall comply with all the appropriate requirements of the specifications.

The specified thickness shall be achieved in one application for solvent free epoxies. In the event of the thickness being less than the minimum specified the lining shall be removed and the pipe length shall be reblasted and relined to comply with the specification.

The specified thickness may be achieved in multicoat applications for solvent borne epoxies. When more than one coat is applied, the time interval between coats shall be not less than the minimum, nor greater than the maximum specified by the manufacturer and appropriate to the pipe surface temperature.

Applicators are recommended to measure wet film thickness at the time of application to avoid rejection or recoating when the dry film thickness is outside the specified limits of the specification.

ii) Thickness of Lining

The pipes shall be lined to a dry film of a minimum of 300 and a maximum of 500 micrometers with a solvent free liquid epoxy as specified.

iii) Cut Back of Lining

The lining shall be cut back as specified in clause PLS1.3(iv).

iv) Repairs

Repairs of electrical insulation defects may be carried out provided that the number of repairs necessary does not exceed 20 per 12 metre length of pipe.

A cluster of pinholes within a radius of 25mm shall be regarded as one defect.

Any pipe needing repairs in excess of the number given above or where the lining shows any sign of flaking or loss of adhesion shall not be repaired. The lining shall be removed and the pipe length shall be reblasted, cleaned and recoated to comply with the requirements of the specification.

v) Method of Repair

When repairs are permissible, the following method shall be used.

a) Abrade an area at least 25mm diameter around and beyond the defective area.

The abrasive paper shall not be coarser than 220 mesh but preferably 400 mesh. It shall preferably be used wet to avoid excessive removal of coating.

The repair area shall be smoothly feathered into the surrounding sound area. The repair area shall be abraded to a matt finish, free from deep scratches and excessive removal of coating.

After abrasion, the area shall be wiped clean with M.E.K. or other suitable clean solvent and allowed to dry.

b) Repair material shall be solvent free epoxy repair material sourced from the supplier of the lining being repaired and approved by the eThekwini Water and Sanitation. The colour shall differ from the colour of the epoxy lining. It shall be thoroughly mixed in the correct proportions as recommended by the supplier. The materials shall be sufficiently thixotropic that 500 micrometres dry film thickness can be achieved in one application without sagging. If this requirement is not achieved, the material shall be rejected.

c) Repair material shall be mixed in the proportions supplied by the manufacturer. No splitting of packs shall be permitted unless the material is supplied in self metering packs.

The mixed repair material shall be applied to the clean, dry, abraded repair area so as to cover the defect and extend to within 1 or 2mm of the edge of the abraded area. A "halo" of abraded area shall be visible around the repair material.

d) After curing, the repair and at least 250mm surrounding area shall be tested for electrical insulation defects as specified in the contract. There shall be no electrical insulation defects.

PLS1.5 Performance Criteria

The applied solvent free lining shall comply with all the requirements given in TABLE PLS1.1.

PLS1.6 Frequency of Testing

Tests 1 to 3 of TABLE PLS1.1 shall be applied to each and every pipe.

Tests 4, 5(a) and 6 shall be applied to at least one pipe selected at random from the first day's production or from each batch of liquid epoxy, whichever is more frequent.

Tests 5(b) shall be applied to at least one pipe or sample panel from each lining application run. A lining application run is defined as the continuous operation of the twin feed airless spray equipment from start-up to shut-down.

TABLE PLS1.1: REQUIREMENTS OF CURED SOLVENT FREE EPOXY LINING

PROPERTY	REQUIREMENT	TEST METHOD
1. Visual	Smooth glossy or semi glossy finish, free from excessive runs, sags, orange peel, occlusions or other visible defects	Use an experienced observer. Runs may not exceed 600 micron in thickness.
2. Coating Thickness	Min. 300 Max 500 microns Thickness readings outside this range will be assessed in terms of S.A.N.S. 1217 Clause 5.1.2. using a ± 20% criteria	S.A.N.S. Method 141. Take a minimum of 2 readings per m^2 of surface up to 300mm nominal dia., or 1 reading per m^2 over 300mm.
3. Electrical Insulation Defects	Lining: Nil defects at 90 Volts, 2 MegaOhm	S.A.N.S. 1217 Section 8.12.1
4. Impact Resistance	No defect at 1 Joule	S.A.N.S. 1217 Section 8.7 but modified as given in Note 1 below
5. Degree of Cure: (a) Static Test	No softening or discolouration when fully cured	S.A.N.S. 1217 Section 8.9. Cure time shall be in accordance with the manufacturer's data
(b) Dynamic Test	No softening or discolouration when fully cured	50 double rubs with cotton wool swab soaked in MEK. Cure time shall be in accordance with the manufacturer's data See Note 2 below.
6. Adhesion (Hot water soak)	Disbonded length not to exceed 15mm from point of V	Immerse in water at 75° C for 48 hr. Remove and make V-cut at 30 degree angle. Test adhesion when cooled to 25 ° C See Note 3 below.

NOTE 1:
Impact resistance shall be carried out on a sample of production pipe firmly clamped and chocked (to be rebound free) to a rigid base. No electrical insulation defects shall be detected at the point of impact when tested at 1 Joule.

NOTE 2:
The Degree of Cure - Dynamic Test is required to confirm that the lining applied to the pipe has the correct ratio of base to curing agent as determined by the settings on the twin feed airless spraying equipment. An >off-ratio mix produces a defective lining. To enable this test to be carried out timeously, sample panels (See Note 3 below) with a maximum coating thickness of 250 micron may be force cured at 60°C for 4 hours, allowed to cool to ambient temperature, and then tested.

NOTE 3:
Tests to be carried out on a coupon cut from the pipe or a certified test panel coated during the same lining application run as the pipe. Additional tests may be required at the discretion of eThekwini Water and Sanitation.

PLS 2: Cement Mortar Lining System

PLS2.1 Cement-Mortar Lining

Cement shall comply with S.A.N.S. 471 while the aggregate shall comply with S.A.N.S. 1083 in respect of organic impurities and dust content.

PLS2.2 Thickness of Lining

a) Pipes up to and including 150mm nominal diameter: 6mm

b) Pipes greater than 150mm nominal diameter up to and including 300mm nominal diameter: 10mm

c) Pipes greater than 300mm nominal diameter up to and including 600mm nominal diameter: 12,5mm

d) Pipes greater than 600mm nominal diameter up to and including 1 200mm nominal diameter: 19mm

e) Pipes greater than 1 200mm nominal diameter: 25mm

PLS2.3 Cut Back of Lining

For diameters up to and including 250mm the lining shall run the total length of the pipe and shall finish square with the end of the pipe.

For diameters from 300mm up to and including 600mm (i.e. belled end pipe), the lining shall be stopped-off flush with the plain end and at the start of the bell section as indicated in Fig. 1. attached hereto.

For diameters of 700mm and larger the lining shall be stopped-off or cut back 50mm from the ends of the pipe.

PLS2.4 Protection of Uncoated Pipe Ends

All pipe surfaces left unlined due to cut back of the cement-mortar lining shall be painted with an approved weldable vinyl butyral etch primer to a dry film thickness of 25 micrometres.

PLS2.5 Cleaning of Pipe

All surfaces to be cement mortar lined shall be cleaned as follows:

a) Weld spatter shall be removed by chipping or minimal grinding or both.

b) Gross deposits of grease and oil shall be removed by scraping and wiping with cloths soaked in white spirit or a similar solvent.

c) The pipe shall be degreased internally by the use of a water rinsable solvent degreaser such as that complying with S.A.N.S. 1244 or, for use in enclosed systems, with S.A.N.S.

1365. After complete removal of oil or grease contamination, the pipe shall be thoroughly washed with clean potable water to remove all residues. The surface shall be water break free.

PLS2.6 Mixing of Cement-Mortar

The ratio of cement to aggregate shall be 1:2 by mass or richer. The water cement ratio shall be approximately 45:100. Only clean fresh water shall be used, and the cement-mortar shall be free from all foreign matter. Only freshly mixed concrete shall be used. The maximum size of aggregate shall not exceed one third the thickness of the lining. The mortar shall be mixed in batches and shall be placed within 1 hour from the time of discharge from the mixer. Re-tempering by the addition of water or other material will not be permitted.

From each batch of cement-mortar, three 150mm test cubes shall be prepared, the cubes being thoroughly vibrated, in accordance with S.A.N.S. Method 863.

When tested after 28 days curing, the compressive strength shall not be less than 30 MPa.

PLS2.7 Lining of Pipe

The cleaned pipe shall be lined by either drag trowel or spinning methods. The resultant lining shall be smooth and of uniform thickness not less than that specified in clause A.5.3.1.

The Contractor shall take whatever measurers are necessary to compensate for any bow along the pipe which will give rise to variation of lining thickness greater than the permissible tolerance (see Clause A.5.3.8)

PLS2.8 Curing of Cement-Mortar

After lining, the pipes shall be closed with approved waterproof end caps or similar means and the pipe shall be left undisturbed for 48 hours for the cement mortar to set.

After 48 hours the lining shall be sprayed with water, and shall be kept moist for 7 days. Pipes shall not be dispatched within 7 days of the date of applying the lining.

During the application and the curing of the cement-mortar lining, the pipes shall be kept covered or protected from direct sunlight to avoid "baking" of the mortar lining and the formation of excessive shrinkage cracks and disbondment.

PLS2.9 Appearance and Quality

Cement-mortar linings shall be smooth and even. The thickness tolerance shall be within $\pm$3mm for pipe 100mm up to and including 250mm diameter and $\pm$4mm for pipe larger than 250mm nominal diameter.

All defects such as substandard surface finish, thin spots, cracking as a result of impacts and spalling shall be cut out and replaced to the full required thickness of the lining.

Temperature and shrinkage cracks in the mortar lining less than 1,5mm in width need not be repaired. Cracks wider than 1,5mm shall be chipped back and the lining replaced to the full required thickness.

PLS2.10 Reinforcing

No reinforcing mesh will be required for the cement-mortar lining of pipes up to and including 1 000mm diameter unless specifically called for in the Special Conditions of Contract.

Cement-mortar lining to pipes of diameter greater than 1 000mm shall be reinforced by means of a welded or woven steel wire mesh.

The wire shall be 3mm in diameter and spaced at 100mm centres both ways.

The reinforcing shall be secured by adequate tack welding to the pipe to ensure that it is not displaced during the lining procedure.

APPENDIX C: APPROVED EXTERNAL COATING SYSTEMS

Specification Number	Coating Type	Page No
PCS 1	Fusion bonded epoxy powder	22
PCS 2	Fusion bonded medium density polyethylene powder	29
PCS 3	Bitumen/polyolefin sleeve duplex coating	36
PCS 4	3 Layer polyethylene pipe coating system	39
PCS 5	Rigid polyurethane coating	46
PCS 6	Polyamide 11 (Nylon 11) thermoplastic lining and coating for 100 to 300 mm piping	50
PCS 7	Two layer Polyethylene / Visco-elastic Polyisobutene Coating system (2LPE)	54
PCS 8	Two layer Glass-fibre Reinforced Epoxy / Visco-elastic Polyisobutene Coating system (2LGRE)	60

APPENDIX D: SPECIFICATION DETAILS FOR EXTERNAL COATING SYSTEMS

PCS 1: Fusion Bonded Epoxy Powder

PCS1.1 Approval of Supplier

The epoxy coating shall be a fusion bonded epoxy powder coating, Interpon PCL 331, Vedoc VPC 2001, BASF Basepox PE50-1080 or a similar approved fusion bonded epoxy powder.

The brand type or grade, and the supplier of the powder to be used shall be approved in writing by eThekwini Water and Sanitation. To obtain approval, the supplier shall provide independent test results in writing that demonstrate that the powder is capable of meeting the requirements 1 to 20 specified in Table PCS1.1. Following initial approval, eThekwini Water and Sanitation reserves the right to have any or all of the tests repeated on an annual basis in order to confirm that formulation changes have not been made.

PCS1.2 Approval of Batches

Each batch of powder supplied to the applicator shall be approved by eThekwini Water and Sanitation. No change in formulation of powder is permitted without prior approval of eThekwini Water and Sanitation. Such approval shall not exonerate the Contractor from the due performance of the coating system in terms of this specification.

The manufacturer shall supply Batch Conformance Certificates for each batch, which shall include results of tests 1, 2, 3, 4, 7, 8, 9, 10, 11, and 12 of Table PCS1.2. The number of batches shall be kept to a minimum so as to avoid excessive costs being incurred with the Quality Control testing required prior to application of the product.

Pipes coated with powder that has not been approved by eThekwini Water and Sanitation may be rejected.

PCS1.3 Preparation and Cleaning of Pipe

i) Degreasing

Pipes shall be degreased externally (and internally) by the use of a water rinsable solvent degreaser or by passing the pipes over gas burners to carbonise contaminants.

The pipes shall then be abrasive blast cleaned.

Abrasive used for blast cleaning shall be free from oil or grease, as shall be the compressed air used in air blast cleaning.

ii) Blast Cleaning

The exterior surface of the pipe shall be blast cleaned by centrifugal or air blast cleaning methods, then vacuum cleaned or blown off to achieve the following standards:

a) Cleanliness shall be equal to Sa3 of ISO 8501-1 when tested in accordance with S.A.N.S. 5767. Cleanliness equal to Sa2½ will be allowed when recommended by the approved powder manufacturer and quoted in his Product Data Sheet.

b) The profile produced by blast cleaning shall be angular and shall have an average peak to valley height of 40 to 90 microns (or as recommended by the approved supplier), when tested in accordance with S.A.N.S. 5772.
Hackles shall be removed with coarse abrasive paper.

c) Residual dust and debris shall not exceed 0,2% when tested in accordance with S.A.N.S. 5769.

d) Water soluble salts shall not exceed 100mg/m^2 at any point when tested with the Weber-Reilly Reagent.

e) Any laminations revealed by blast cleaning shall be ground out and reblast cleaned to meet the requirements given in (a) to (d) above. If grinding penetrates the steel to a depth greater than 8% of the nominal wall thickness, the pipe shall be rejected.

iii) Handling of Cleaned Pipe

After cleaning, the pipe surface shall not be contaminated in any way. Operators shall wear clean gloves and all surfaces in contact with the pipe surface shall be clean and free from oil, grease, grit, dirt and other contamination.

iv) Cut Back of Coating

The blast cleaned surface shall be stopped off or cut back by suitable masking which shall not contaminate the cleaned surface as follows:

a) All pipes up to and including 250mm nominal diameter - 100mm from both ends of the pipe.

b) All pipes from 300mm nominal diameter up to and including 600mm nominal diameter - 50mm from the belled end of the pipe and 100mm from the plain end of the pipe. (See Fig. 1).

c) All pipes larger than 600mm nominal diameter - 100mm from both ends of the pipe.

v) Protection of Uncoated Pipe Ends

All pipe surfaces left uncoated due to cut back of the fusion bonded epoxy powder coating shall be painted with an approved weldable vinyl butyral etch primer to a dry film thickness of 25 microns. This coating shall overlap the fusion bonded epoxy powder coating by 20mm.

vi) Chemical Treatment

Chemical pre-treatment of the blast cleaned pipe surface may be applied provided that:

a) The process to be used is approved by eThekwini Water and Sanitation in writing.

b) The process is applied in a manner and in such quantity as is specified by the manufacturer of the powder.

vii) Heating of the Pipe

Heating of the pipe shall be affected by heat soak in an oven or by the use of electric induction coils provided that:

a) The pipe surface is not contaminated by fumes, soot deposition, acid deposits or other harmful contamination

b) The pipe surface is not discoloured by excessive heat

c) The surface temperature of the pipe is uniform and does not vary by more than $\pm$5° C from optimum coating temperature when measured immediately prior to coating. Pipe temperature shall not exceed 275° C at any point.

d) Infra red pyrometers shall be calibrated by measurement of pipe temperature by thermocouple, heat sensitive crayon or other approved method.

PCS1.4 Application of Coating

i) Method of Application

Powder shall be applied by electronic spray guns whilst the pipe is rotated and moved forward on a suitable conveyor. The number and grouping of the guns, distance from the pipe surface, angle of projection, air pressure, conveyor speed and other variables shall be determined by the Contractor to obtain a uniform application on each pipe such that the coating complies with the requirements of the specification.

Powder shall pass through a magnetic separator (which shall be regularly cleaned) in order to remove any iron or steel particles.

Powder reclaimed from the spray booth shall not be mixed with virgin powder. The normal in-process system for powder reclaiming is permitted to a maximum of 20% of virgin powder. Powder recovery during any cleaning process may not be introduced into the system.

The specified thickness shall be achieved in one application. In the event of the thickness being less than the minimum specified, the coating shall be removed and the pipe length shall be reblasted and recoated to comply with the specification.

ii) Thickness of Coating

The pipes shall be coated to a dry film of a minimum of 300 microns and a maximum of 600 microns with a fusion bonded epoxy powder.

iii) Cut back of Coating

The coating shall be cut back as specified in clause PCS1.3(iv)

iv) Handling of Coated Pipe

Coated pipe shall not touch the conveyor rollers until the coating has cured to a sufficient degree that contact with the rollers does not mark or damage the coating.

v) Quenching of the Coated Pipe

Quenching of the pipe with clean water is permitted provided that the coating is fully cured and complies in all respects with the requirements of the specification.

vi) Repairs

Repairs of electrical insulation defects may be carried out provided that the number of repairs necessary does not exceed 20 per 12 m pipe length.

A cluster of pinholes within a radius of 25mm shall be regarded as one defect.

Any pipe needing repairs in excess of the number given above or where the coating shows any sign of flaking or loss of adhesion shall not be repaired. The coating shall be removed and the pipe length shall be reblast, cleaned and recoated to comply with the requirements of the specification.

vii) Method of repair

When repairs are permissible, the following method shall be used.

a) Abrade an area at least 25mm diameter around and beyond the defective area.

The abrasive paper shall not be coarser than 220 mesh but preferably 400 mesh. It shall preferably be used wet to avoid excessive removal of coating.

The repair area shall be smoothly feathered into the surrounding sound area. The repair area shall be abraded to a matt finish, free from deep scratches and excessive removal of coating.

After abrasion, the area shall be wiped clean with M.E.K. or other suitable clean solvent and allowed to dry.

b) Repair material shall be solvent free epoxy or polyurethane repair material approved by the eThekwini Water and Sanitation. The colour shall differ from the colour of the epoxy coating. It shall be thoroughly mixed in the correct proportions as recommended by the supplier.

c) Repair material shall be mixed in the proportions supplied by the manufacturer. No splitting of packs shall be permitted unless the material is supplied in self metering packs.

The mixed repair material shall be applied to the clean, dry, abraded repair area so as to cover the defect and extend to within 1 or 2mm of the edge of the abraded area. A "halo" of abraded area shall be visible around the repair material.

d) Pipes shall not be moved until the repair material is cured and sufficiently hard to withstand the pressure of the pipes on the ramps. Cure may be accelerated by heating with infra red lamps provided that the heat applied is insufficient to cause any damage to the surrounding coating.

e) After curing, the repair and at least 250mm surrounding area shall be tested for electrical insulation defects as specified in the contract. There shall be no electrical insulation defects.

PCS1.5 Performance Criteria

The applied coating shall comply with all the requirements given in TABLE PCS1.2

PCS1.6 Frequency of Testing

Tests 1 to 3 of TABLE PCS1.2 shall be applied to each and every pipe.

Tests 4, 5, 6, and 7 shall be applied to at least one pipe selected at random from each powder application production run.

A production run is defined as the continuous operation of the FBE application plant from start-up to shut-down.

Additional tests may be required at the discretion of eThekwini Water and Sanitation.

TABLE PCS1.1: QUALIFICATION REQUIREMENTS FOR EPOXY POWDER

PROPERTY	REQUIREMENT	TEST METHOD
1. I.R. Spectrogram	For reference against contract supplies	Potassium Bromide disc
2. Thermal Characteristics	ΔT_g $\pm$5°C	Differential Scanning Calorimetry 20° C/min scan rate
3. Gel Time at 180°C	26 to 32 seconds.	Hot plate
4. Particle Size Distribution	< 1% above 250 µm < 5% above 150 µm < 8% below 10 µm	Lazer Diffraction Analyser
5. Dielectric Strength	Not less than 30 V/µm	S.A.N.S. 1217 Section 8.10
6. Accelerated Cathodic Disbonding (48 hr)	Total disbonded area (including holiday) ≤ 10mm dia	GBE/CW6 Part 1 Appendix F, or CAN/CZA-Z245.20-M92: 12.8 Impressed current, - 3,5V potential at 65° C for 48 hr, 3mm dia. holiday
7. Hot Water Soak Adhesion Test	Disbonded length not to exceed 5mm from point of V	Immerse in water at 75 ° C for 48 hr. Remove and make V-cut at 30 degree angle. Test adhesion when cooled to 25° C
8. Flexibility Test	No electrical insulation defects after bending over mandrels: 300 mm @ 5°C 200 mm @ 20°C	GBE/CW6 Part 1 Appendix B
9. Impact Resistance	No electrical insulation defects after impact of 6 joules	ASTM G14 direct and reverse impact on 0,8 mm sheet.
10. Density	1,45 $\pm$0,07 gm/cm^3	Mass divided by volume (g per ml) Volume determined by volumetric displacement using of a suitable solvent (white spirit) and a pycnometer.
11. Moisture Content	< 5% by weight	Mass loss of sample after 3 hours at 110°C.
12. Appearance	Free from pin-holes, blistering and cissing.	350 - 500 µm coating applied at to a pre-heated mild steel panel and visually assessed.
13. Sagging	No sagging.	350 - 500 µm coating applied at to a pre-heated vertical mild steel panel and visually assessed.
14. Hardness	F to mar.	Pencil Hardness.
15. Porosity of Coating	Rating 4	CAN/CZA-Z245.20-M92: 12.10 Figure 12.6
16. Tensile Strength and Elongation	50 MPa	ASTM D2370-82 Head speed 75mm/min
17. Water absorption (detached film)	< 3%	Water absorbed as weight gain after 3 months immersion at 20°C.
18. Strain Polarisation Cracking Test	No electrical insulation defects or disbonding	GBE/CW6 Part 1 Appendix G Bend at 20°C. Polarised @ -1,5 V for 28 days.
19. Salt Spray Resistance	No under film creep or blistering.	BS3900 F4, 1000 hrs
20. Artificial Weathering Test.	No deterioration, only superficial chalking	BS3900 F3, 1000 hrs

TABLE PCS1.2: REQUIREMENTS OF CURED FUSION BONDED EPOXY POWDER COATING

PROPERTY	REQUIREMENT	TEST METHOD
1. Visual	Smooth glossy or semi glossy finish, free from excessive runs, sags, orange peel, occlusions, lumps or other visible defects.	Use an experienced observer
2. Coating Thickness	Min. 300 Max 500 microns	S.A.N.S. Method 141. Take a minimum of 2 readings per m^2 of surface up to 300mm nominal dia., or 1 reading per m^2 over 300mm.
3. Electrical Insulation Defects	Nil defects at 3500 Volts. 20 repairs allowed per 12 m pipe length.	S.A.N.S. 1217 Section 8.12.2
4. Impact Resistance	No defect at 2 Joule	S.A.N.S. 1217 Section 8.7 but modified as given in Note 1 below
5. Degree of Cure: Thermal Characteristics	ΔT_g $\pm 5^oC$	Differential Scanning Calorimetry 201C/min scan rate
6. Hot Water Soak Adhesion Test	Disbonded length not to exceed 5mm from point of V	Immerse in water at 75^oC for 48 hr. Remove and make V-cut at 301angle. Test adhesion when cooled to 25^oC
7. Accelerated Cathodic Disbonding (24 hr)	Total disbonded area (including holiday) $\pm$ 10mm dia	GBE/CW6 Part 1 Appendix F, or CAN/CZA-Z245.20-M92: 12.8.3.5(c) Impressed current, - 3,5V potential at 65^o C for 24 hr, 3mm dia. holiday

NOTE 1:
Impact resistance shall be carried out on a sample of production pipe. The inside of the pipe shall be supported by a wooden block fitted vertically across the internal pipe diameter and chocked so as to fit tightly and immediately beneath the point of impact. Damage to the coating shall be assessed by measuring electrical insulation defects at the point of impact. No defect is permitted after impact at 2 Joules. Alternatively, the test may be carried out on a sample cut from the pipe and rigidly supported beneath the point of impact.

PCS 2: Fusion Bonded Medium Density Polyethylene Powder

PCS2.1 Compliance

The medium density polyethylene powder shall comply with clause 4 -MATERIALS of A.S. 4321. A certificate of compliance with Clauses 4.2 and 4.3 shall be provided by the polyethylene compound manufacturer.

PCS2.2 Application

Fusion Bonded Medium Density Polyethylene powder shall be applied generally in accordance with this specification and the Australian Standard AS 4321 (1995). Where a discrepancy in requirements arises the eThekwini Water and Sanitation Specification shall take precedence.

PCS2.3 Preparation And Cleaning Of Pipe

i) Degreasing

Pipes shall be degreased as specified.

ii) Blast Cleaning

Pipes shall be blast cleaned to grade SA2½ .

iii) Handling of Cleaned Pipe

After cleaning, the pipe surface shall not be contaminated in any way. Operators shall wear clean gloves and all surfaces in contact with the pipe surface shall be clean and free from oil, grease, grit, dirt and other contamination.

iv) Cut Back of Coating

The blast cleaned surface shall be stopped off or cut back by suitable masking which shall not contaminate the cleaned surface as follows:

a) All pipes up to and including 250mm nominal diameter - 100mm from both ends of the pipe.

b) All pipes from 300mm nominal diameter up to and including 600mm nominal diameter - 50mm from the belled end of the pipe and 100mm from the plain end of the pipe. (See Fig. 1).

c) All pipes larger than 600mm nominal diameter - 100mm from both ends of the pipe

v) Protection of Uncoated Pipe Ends

All pipe surfaces left uncoated due to cut back of the coating shall be painted with an approved weldable vinyl butyral etch primer to a dry film thickness of 25 microns. This

coating shall overlap the fusion bonded epoxy powder coating by 20mm.

PCS2.4 Application of Coating

i) Method of Application

The coating shall be applied in accordance with clause 5 'COATING AND LINING APPLICATION' of AS 4321.

ii) Thickness of Coating

The pipes shall be coated to a minimum film thickness as follows:

Nominal pipe diameter (mm)	Coating thickness (mm)
> 100 ≤ 250	1,6
≥ 250 < 500	1,8
≥ 500 < 750	2,0
≥750	2,3

iii) Cut Back of Coating

The coating shall be cut back in accordance with clause PCS2.3(iv).

iv) Repairs

Repairs of electrical insulation defects may be carried out provided that the number of repairs necessary does not exceed 3 per 9m pipe length (or equivalent pro rata number per pipe length). The area of any single repair shall not exceed 0,01m^2

Where a pinhole is located it shall be repaired to produce a continuous coating. Damaged areas that pass the continuity test need not be repaired provided the coating thickness remains greater than or equal to 1,0 mm.

v) Method of Repair

When repairs are permissible, they shall be carried using one of the following methods:

(a) Fusion bonded repairs.

(b) Heat shrink sleeve repairs.

(c) Hot gas welding repairs.

(d) Repairs using pipeline wrapping system.

Methods (a), (b) and (c) shall be carried out in accordance with Clause 8 of AS 4321. Method (d) shall be carried out as follows:

vi) Repairs Using Pipeline Wrapping System

a) Description

The Repair System comprises:

a polymer bitumen primer:

Denso Primer D or equivalent approved an inner seal of modified rubber bitumen sealing tape:

Denso Mastic Sealing Tape or equivalent approved an outer protective layer of acrylic coated/modified bitumen adhesive pipeline tape:

Denso Acrylic Pipeline Tape or equivalent approved

b) Cleaning Of Area To Be Repaired - Pinholes And Large Areas.

Grease and oil shall be removed with a suitable cleaning solvent.

At each repair section, the surrounding area shall be abraded to a minimum area of 175 mm x 175 mm in the case of pinholes or small defect areas.

The area is demarcated by using a suitable template 175 mm x 175 mm and tracing the perimeter with a marking pen. The marked area shall be abraded with emery paper 80 to 100 mesh, so as to provide a suitably rough surface profile without causing the removal of excessive amounts of coating material.

All debris, dust, grease and oil shall be removed with a suitable cleaning solvent by means of a clean rag or brush.

Immediately the solvent has flashed off, apply the polymer bitumen primer at a nominal coverage rate of $8m^2/l$ by brush to the prepared surface in a uniformly thin film free of runs and sags, and allow to flash off for a minimum period of 15 minutes depending on ambient temperatures.

c) Tape Application - Pinholes

Once the polymer bitumen primer has dried, the prepared surface is then covered with a patch of modified rubber bitumen sealing tape 100 mm x 100 mm, followed by an outer patch of acrylic coated/modified bitumen adhesive pipeline tape 150 mm x 150 mm.

To ensure a bond free of voids and air bubbles, the tape is applied by firstly bonding the leading edge of the square and then smoothing out by thumbs or hand pressure in an outward direction. To ensure a perfect bond of the tape, roll out the entire area using an aluminium fluted roller.

d) Tape Application - Larger damaged areas

When repairing larger areas, the edges of the damaged coating must first be chamfered with a sharp Stanley knife or blade to remove potential void areas.

Pre-cut the correct sizes of modified rubber bitumen sealing tape and apply to the reclined and primed areas in weatherboard fashion with a 55% overlap to provide a double thickness of material, working up towards the crown of the pipe to endure that overlaps are facing downwards.

Overwork by hand or finger pressure to ensure full bond is achieved and no air is entrapped.

Finally, apply pre-cut strips of acrylic coated/modified bitumen adhesive pipeline tape with a 25 mm overlap, ensuring that it is 50 mm wider on all sides of the inner repair tape.

Notes:

Where the pipe has been severely damaged in numerous areas, a full spiral circumferential wrap is recommended.

Maximum width of the inner modified rubber bitumen sealing tape and outer acrylic coated/modified bitumen adhesive pipeline tape should not exceed 150 mm.

Apply the tapes with sufficient tension to ensure full conformance to the shop coating, and stagger the spiral overlaps which should be no less than 50 mm.

Commence and end the wrapping/repair system by a minimum of 100 mm each side of the damaged sections.

PCS2.5 Performance Criteria

The coating material shall comply with all the requirements given in TABLE PCS2.1. The applied coating shall comply with all the requirements given in TABLE PCS2.2

PSC2.6 Frequency of Testing

Tests 1 to 7 and 9 to 11 of TABLE PCS2.1 shall be carried out on the first contract using this material and thereafter at intervals of no greater than five years and at any change in formulation or source of polyurethane compounds and at any change in the application process.

Test 8 of TABLE PCS2.1 shall be carried out on the first contract using this material and thereafter at intervals of no greater than one year and at any change in formulation or source of polyurethane compounds and at any change in the application process.

Tests 1 to 3 of TABLE PCS2.2 shall be carried out on every pipe.

Test 4 of TABLE PCS2.2 shall be carried out at a frequency of two per shift.

Test 5 of TABLE PCS2.2 shall be carried out on at least two pipes selected at random from each item.

Additional tests may be required at the discretion of eThekwini Water and Sanitation.

TABLE PCS2.1: QUALIFICATION REQUIREMENTS FOR FUSION BONDED MEDIUM DENSITY POLYETHYLENE POWDER COATING

PROPERTY	REQUIREMENT	TEST METHOD
POLYETHYLENE COATING COMPOUND		
1. Thermal Stability	Melt flow index must not change by more than 35% after exposure to air at 100°C for 100 days	AS 4321, Appendix B
2. Water Absorption	≤0,1% when immersed in water at 23°C for 100days	AS 4321, Appendix C
3. Penetration Resistance	Compressive stress of 10 MPa: ≤0,15 mm penetration at 23°C ≤0,25 mm penetration at 70°C	AS 4321, Appendix D
4. Tensile Stress at Yield	≥ 15,0 MPa	AS 4321, Appendix E
5. Environmental Stress Cracking Resistance	$F_{50} \geq$ 100h	AS 4321, Appendix F
6. Density	≥ 920 kg/m^3 at 23°C	AS 4321, Clause 6.1.2.7
7. Impact Resistance	≥ 18,0 J	AS 4321, Appendix H (See Note 1)
8. Cathodic disbondment	Disbondment length ≤ 15 mm after 28 days	AS 4321, Appendix N
POLYETHYLENE REINSTATEMENT COMPOUND		
9. Water Absorption	≤0,2% when immersed in water at 23°C for 100days	AS 4321, Appendix C
10. Adhesion to Steel	Bond strength to steel ≥ 3,0 N/mm width of strip	AS 4321, Appendix I
11. Adhesion to polyethylene coating compound	Bond strength to polyurethane ≥ 3,0 N/mm width of strip	AS 4321, Appendix J

NOTE 1:
Impact resistance shall be carried out on a sample of production pipe. The inside of the pipe shall be supported by a wooden block fitted vertically across the internal pipe diameter and chocked so as to fit tightly and immediately beneath the point of impact. Damage to the coating shall be assessed by measuring electrical insulation defects at the point of impact. No defect is permitted after impact at 10 Joules. Alternatively, the test may be carried out on a sample cut from the pipe and rigidly supported beneath the point of impact.

TABLE PCS2.2: REQUIREMENTS OF CURED FUSION BONDED MEDIUM DENSITY POLYETHYLENE POWDER COATING

PROPERTY	REQUIREMENT	TEST METHOD
1. Visual	Smooth finish, free from visible defect	Use an experienced observer
2. Coating Thickness	> 100 # 250mm dia. - 1,6mm > 250 < 500mm dia. - 1,8mm ≥ 500 < 750mm dia. - 2,0mm ≥ 750mm dia. - 2,3mm	ISO 2820 Method 5. Take a minimum of 2 readings per m^2 of surface up to 300mm nominal dia., or 1 reading per m^2 over 300mm. Thickness tolerance as per AS 4321, Clause 6.3.2
3. Continuity Test (Electrical Insulation Defects)	Nil defects at 12 kV For conditions of repair see clause A.5.5.2.(vii)	S.A.N.S. 1217 Section 8.12.2 Note: DC instrument to be used
4. Bond Strength	Bond strength to steel ≥ 3,0 N/mm width of strip.	AS 4321, Appendix M
5. Cathodic disbondment	Disbondment length ≤ 15 mm after 28 days	AS 4321, Appendix N

PCS 3: Bitumen/Polyolefin Sleeve Duplex Coating

PCS3.1 Approval of Supplier

The coating shall be a bitumen/polyolefin sleeve duplex coating, TOSAWRAP, or similar approved.

PCS3.2 Approval of Batches

All raw materials as compounded in the manufacturer's Quality Assurance Manual. A compliance certificate must be provided by each raw material supplier.

PCS3.3 Preparation And Cleaning Of Pipe

i) Degreasing

Pipes shall be degreased by passing a gas flame over the surface to carbonise any contaminants.

ii) Pipe Cleaning

Pipes shall be mechanically wire brushed to Grade St 2 of ISO 8501-1 and all rust and foreign matter removed by means of blowing with compressed air, or solvent wiping.

PCS3.4 Application of Coating

i) Inner Layer

The molten compound shall be hot poured onto the pipe surface and smoothed to the required thickness before it cools.

ii) Outer Layer

Once the sleeve is positioned over the full length of the pipe, the heat shrinking of the sleeve is commenced one end to eliminate the risk of air entrapment. The sleeve edge is trimmed from each side of the pipe before it is transferred to the pipe inspection table.

iii) Thickness of Coating

The pipe shall be coated to a minimum thickness as follows;

Inner layer	1,0mm
Outer layer	1,0mm
Overall thickness	2,0mm

iv) Method of Repairs

The area of a single repair shall not exceed 10mm^2. The repair shall be carried out using a compatible melt stick. The number of repairs shall not exceed 3 per 6 metre length of pipe.

v) Cut Back of Coating

The coating shall be cut back for a distance of 100mm to facilitate site welding.

PCS3.5 Performance Criteria

The coating material shall comply with all the requirements given in TABLE PCS3.1. The applied coating shall comply with all the requirements given in TABLE PCS3.2.

PCS3.6 Frequency of Testing

Tests 2 and 6 of TABLE PCS3.1 shall be carried out on the first contract using this material and thereafter at intervals of no greater than one year and at any change in formulation or source of sleeve and primer compounds and at any change in the application process.

Tests 1, 3, 4, 5 and 7 of TABLE PCS3.2 shall be carried out on the first contract using this material and thereafter at intervals of no greater than five years and at any change in formulation or source of sleeve compounds and at any change in the application process.

Tests 1 to 3 of TABLE PCS3.2 shall be carried out on every pipe.

Test 4 of TABLE PCS3.2 shall be carried out on every 100th pipe.

Additional tests may be required at the discretion of eThekwini Water and Sanitation.

TABLE PCS3.1: QUALIFICATION REQUIREMENTS FOR BITUMEN/POLYOLEFIN SLEEVE DUPLEX COATING MATERIALS

PROPERTY	REQUIREMENT	TEST METHOD	FREQUENCY
1. Water absorption of sleeve	≤ 0,1% when immersed in water at 23°C for 100 days	S.A.N.S 1117	5 years
2. Cathodic disbondment of duplex system	Disbondment length ≤ 15 mm after 28 days	S.A.N.S 1117	Annually
3. Tensile strength of sleeve at yield	≥ 10 MPa	ASTM D 882	5 years
4. Tensile strength of sleeve at break	≥ 15 MPa	ASTM D 882	5 years
5. Elongation of sleeve at break	≥ 500%	ASTM D 882	5 years
6. Adhesion to steel of duplex system	Adhesion to steel > 2 N/mm	S.A.N.S. 1117	Annually
7. Density of sleeve	≥ 915 kg /m2	ASTM D1505	5 years

TABLE PCS3.2: REQUIREMENTS OF APPLIED BITUMEN/POLYOLEFIN SLEEVE DUPLEX COATING

PROPERTY	REQUIREMENT	TEST METHOD	FREQUENCY
1. Visual	Free from visible defect	Observation	100%
2. Coating thickness	2,0 mm	Take a minimum of three readings per 6 mm pipe.	100%
3. Holiday test	Nil defects at 15 KV	S.A.N.S 10129	100%
4. Bond strength	$\geq$ 1,5 N/mm width of strip (not temperature dependant)	In house	1 in 100

PCS 4: 3 Layer Polyethylene Pipe Coating System

PCS4.1 Approval of Supplier

The 3-layer polyethylene coating system consists of a powdered epoxy primer, a polymeric adhesive and a polyethylene outer sheath classified as System B1 in terms of the Canadian Standards Association specification Z245.21-02. The respective layers of the 3-layer system shall comprise of the following materials:

Fusion Bonded Epoxy primer:

Akzo Nobel	Akzo Nobel PCL 331 (or similar approved)
Jotun	Jotun CORRO-COAT EP-F 1003 HW (or similar approved)

Adhesive:

Borealis	Borcoat ME0420 (or similar approved)
Industrie Polieco M.P.B. SRL	Industrie Polieco Cohesive L8.92.8 (or similar approved)

High Density Polyethylene Outer Sheath:

Borealis	Borcoat HE3450 (or similar approved)

NOTE:
Pipe is not laid (i.e. buried) immediately upon delivery but is generally stockpiled in exposed pipe yards for "free issue" at a later date or kept as stock for emergency use. As a result of this extended exposure of the polyethylene coating to effect of UV it will be a requirement that the supplier of the coating provide written proof to the City Council that the polyethylene product to be used in the High Density Polyethylene Outer Sheath contains a **minimum of 2% finely dispersed carbon black**.

PCS4.2 Approval of Batches

Each batch of materials supplied to the applicator shall be approved by eThekwini Water and Sanitation. No change in formulation of the materials is permitted without prior approval of eThekwini Water and Sanitation. Such approval shall not exonerate the Contractor from the due performance of the coating system in terms of this specification.

The manufacturers shall supply Batch Conformance Certificates for each batch, which shall include results of all tests listed in Table PCS4.1.

Pipes coated with powder that has not been approved by eThekwini Water and Sanitation may be rejected.

PCS4.3 3 Layer Polyethylene Pipe Coating System

The 3 Layer Polyethylene Pipe Coating System shall be applied generally in accordance with this specification and the Canadian Standards Association specification Z245.21-02.

PCS4.3.1 Preparation And Cleaning Of Pipe

i) Degreasing

Pipes shall be degreased as specified.

ii) Blast Cleaning

Pipes shall be blast cleaned to Grade Sa3.

iii) Handling of Cleaned Pipe

After cleaning, the pipe surface shall not be contaminated in any way. Operators shall wear clean gloves and all surfaces in contact with the pipe surface shall be clean and free from oil, grease, grit, dirt and other contamination.

iv) Cut Back of Coating

The blast cleaned surface shall be stopped off or cut back by suitable masking which shall not contaminate the cleaned surface as follows:

a) All pipes up to and including 250mm nominal diameter - 100mm from both ends of the pipe.

b) All pipes from 300mm nominal diameter up to and including 600mm nominal diameter - 50mm from the belled end of the pipe and 100mm from the plain end of the pipe. (See Fig. 1).

c) All pipes larger than 600mm nominal diameter - 100mm from both ends of the pipe

v) Protection of Uncoated Pipe Ends

All pipe surfaces left uncoated due to cut back of the coating shall be painted with an approved weldable vinyl butyral etch primer to a dry film thickness of 25 microns. This coating shall overlap the fusion bonded epoxy powder coating by 20mm.

PCS4.4 Application of System

i) Application of Primer

The epoxy powder primer shall be applied in accordance with the powder manufacturer's recommendations. The thickness of the primer shall be between 150 and 200 µm.

ii) Application of Adhesive

The adhesive shall be applied in accordance with the powder manufacturer's recommendations. The thickness of the adhesive shall be between 150 and 250 µm.

iii) Application of Polyethylene

The polyethylene shall be applied immediately following the application of the adhesive to the pipe. The thickness of the polyethylene shall be a minimum of 1 mm.

The coating application shall be a continuous process in order to provide an outer sheath of uniform thickness, free from pin-holes, cracks and visible defects.

PCS4.5 Repairs

Any damage to the coating system occurring during manufacturing, storage or transportation of the coated pipes shall be repaired in accordance with the relevant repair procedure as follows;

i) For Damage Not Greater Than 25mm In Diameter And Where The Steel Surface Is Not Exposed.

a) Remove damaged coating with a razor knife; sand grinder, power wire brush or equivalent.

b) Care should be taken not to expose the steel surface during the repair procedure.

c) Eliminate all sharp edges.

d) Clean the damaged area and adjacent pipe coating with a dry clean cloth to remove the presence of dust, dirt and any foreign material.

e) Abrade (using sandpaper) adjacent HDPE coating extending 100mm beyond the damage.

f) Clean damaged area again

g) A melt stick (such as those obtained from CANUSA or RAYCHEM) can be used to fill the damaged area.

h) Use a low intensity yellow flame for preheating the coating and applying the repair product.

i) With quick back and forth strokes, pre-heat the repair zone sufficiently to remove moisture and assist in adhesion.

j) Heat the melt stick with the torch until it becomes fluid.

k) Heat the melt stick and repair zone simultaneously with the torch and spread the melt stick over the damaged area.

l) Keep the flame moving to prevent damage to the coating.

m) Some ignition of the melt stick is acceptable.

n) Continue spreading the melt stick over the repair zone until the entire area is covered.

o) After sufficient melt stick material is on the surface, apply additional heat in quick back-and-forth strokes to create a smooth surface.

p) Ensure that the melt stick material completely covers the repair zone.

q) The melt stick material should be spread liberally so that the material is raised above the coating surface.

r) Holiday detection shall be performed on each repair using a maximum voltage of 15kV.

ii) <u>For Damaged Areas Greater Than 25mm In Diameter, And Where The Steel Surface Is Not Exposed.</u>

a) Use an appropriate heat-shrinkable sleeve, if the damage has a diameter greater than 150mm x 150mm.

b) Mastic Filler (MF) is used to fill larger voids and deep crevices in damaged coatings prior to the application of repair patches. Melt sticks may also be used as a filler material below Coating Repair Patches.

c) Follow steps i) a) to i) f) above.

d) Unroll the filler material and cut off the required amount, leaving the release paper in place.

e) Use a low intensity yellow flame for pre-heating the coating and applying the repair products.

f) With quick back and forth strokes, pre-heat the repair zone sufficiently to remove moisture and assist in adhesion.

g) Place the filler material onto the damaged area with the release paper facing up.

h) Firmly press the material into the damaged area by hand and remove the release paper.

i) After filling the damaged area, remove the excess filler to create a smooth surface.

j) As an option, use a low intensity yellow flame to warm the filler material and assist in smoothing it out.

k) Patch Preparation:

- Cut a patch of CRP large enough to extend a minimum of 50mm beyond the edge of the repair zone.
- Trim each corner of the patch about 10-25mm at a 45° angle.

l) Warm the damaged area (repair zone + 50mm overlap) to remove moisture and assist in adhesion.

m) Take the cut repair patch and remove the release liner.

n) Place the patch with the adhesive side up on a heat resistant-gloved hand or on top of the pipe, and heat gently.

o) Heat until the adhesive softens and the surface becomes glossy. Also, reheat the damaged area to keep it warm.

p) Apply the softened adhesive side of the patch to the damaged area and press down firmly.

q) Heat the patch with a low intensity flame, and using a roller or a gloved hand, pat down and remove any air or wrinkles. Roll to ensure a good bond.

r) Allow the patch to cool down to ambient temperatures prior to further handling.

s) The heat shrink sleeve shall then be applied over the repair patch as per the manufacturer's recommendations.

t) Holiday detection shall be performed on each repair using a maximum voltage of 15kV.

iii) <u>For All Damaged Areas Where The Steel Surface Has Been Exposed.</u>

a) The repair system shall consist of two layers: a 2 part 100% solid epoxy primer and a cross-linked polyethylene, in the form of a self adhesive shrink sleeve.

b) Clean the damaged area to a "white metal finish" (Sa 2½), using sandpaper or blasting equipment.

c) Slightly abrade the line coating that shall be covered to a distance 50mm beyond the sleeve width.

d) Using a clean cloth, remove all dust and particles that may be present.

e) Follow the Preparation, Mixing and Application instructions provided with the supplied Epoxy Pack.

f) Apply mixed epoxy to a minimum uniform thickness of 150 microns on both the bare metal and the abraded portion of the mill coating, with a cloth, brush or applicator pad.

g) Preheat the area with a low to moderate intensity flame to substantially cure the epoxy and warm the surface. Drying time is dependent on preheating, weathering conditions and ambient temperature.

h) Follow steps ii) k) to ii) s) above.

i) Prior to sleeve application, check that the entire steel surface is fully covered with the epoxy. Holiday detection is suggested.

j) Using the propane torch, reheat the area to be covered with the heat shrink sleeve to the manufacturer's recommended temperature.

k) Wrap the sleeve around the heated epoxy ensuring proper overlap onto the mill applied coating.

l) Holiday detection shall be performed on each repair using a maximum voltage of 15kV.

PCS4.6 Performance Criteria

The coating material shall comply with all the requirements given in TABLES PCS4.1 and PCS4.2. The applied coating shall comply with all the requirements given in TABLE PCS4.3.

PCS4.7 Frequency of Testing

The tests of TABLE PCS4.1 shall be carried out on each batch of supplied materials.

The tests of Table PCS4.2 shall be carried out for each pipe diameter for each contract.

Tests 1 to 3 of TABLE PCS4.3 shall be carried out on every pipe.

Tests 4 and 5 of TABLE PCS4.3 shall be carried out at a frequency of one per shift.

Tests 6 and 7 of TABLE PCS4.3 shall be carried out once per week.

Additional tests may be required at the discretion of eThekwini Water and Sanitation.

TABLE PCS4.1: MATERIAL BATCH TEST REQUIREMENTS FOR POWDER PRIMER, ADHESIVE AND OUTER SHEATH OF 3 LAYER POLYETHYLENE COATING

PROPERTY	REQUIREMENT	TEST METHOD
POWDER PRIMER		
1. Gel time (s)	Within 20% of manufacturer's specified nominal	CSA Z245.20, Clause 12.2
ADHESIVE		
1. Flow rate (g/10 min)	Within 20% of manufacturer's specified nominal	ASTM D 1238 190ºC/2.16 kg
POLYETHYLENE OUTER SHEATH		
1. Density (g/cm^3)	>0,940	ASTM D 792 or ASTM D 1505
2. Elongation at break (%)	600 minimum	ASTM D 638 Type IV sample: crosshead speed 50 mm/min
3. Flow rate (g/10 min)	0,15 – 0,80	ASTM D 1238 190ºC/2.16 kg
4. Hardness (Shore D)	60 minimum	ASTM D 2240
5. Heat aging (MPa, %)	At least 65% of original tensile stress at yield; minimum elongation of 150%	CSA Z245.21, Clause 12.6
6. Tensile stress at yield (MPa)	18,5 minimum	ASTM D 638 Type IV sample: crosshead speed 50 mm/min
7. Oxidative-induction time in oxygen at 220ºC, aluminium pan, no screen (minute)	10 minimum	ASTM D 3895
8. Brittleness temperature (ºC)	-70 or lower (for F_{20})	ASTM D 746
9. Environmental stress-cracking resistance condition (h)	300 minimum (for F_{50}). Condition "B"	ASTM D 1693 100% Igepal
10. Vicat softening point (ºC)	120 minimum	ASTM D 1525

TABLE PCS4.2: QUALIFICATION REQUIREMENTS FOR 3 LAYER POLYETHYLENE COATING

PROPERTY	REQUIREMENT	TEST METHOD
1. 28 d cathodic disbonding at 20°C.	12 mm maximum radius	CSA Z245.21, Clause 12.3 *
2. Impact resistance	A minimum of 3.0 J/mm of actual total coating thickness	CSA Z245.20, Clause 12.12, except that for each µm of thickness, the voltage setting for the dc holiday detector (see Clause 12.12.3.3) shall be 10 V per µm thickness up to a maximum of 15 000 V.
3. Flexibility	No cracking of polyethylene	CSA Z245.20, Clause 12.11; bend of 2,5°
4. Peel adhesion	150.0 N minimum	CSA Z245.21, Clause 12.14 or 12.15
5. Polyethylene tensile stress at yield	17.0 MPa minimum	ASTM D 638 Type IV sample: crosshead speed 50 mm/min
6. Polyethylene elongation at break	300% minimum	ASTM D 638 Type IV sample: crosshead speed 50 mm/min

* In clause 12.3.3.6 the radial cuts may be replaced by circumferential chiseling to remove the test area circle.

TABLE PCS4.3: REQUIREMENTS OF APPLIED 3 LAYER POLYETHYLENE COATING

PROPERTY	REQUIREMENT	TEST METHOD	FREQUENCY
1. Visual	Smooth finish, free from visible defects	Visual	Every pipe
2. Coating Thickness	Minimum of 1,3 mm	ISO 2808	Every pipe
3. Holiday test	Nil defects at 15 kV	CSA Z245.21, Clause 7.4.2. 10 V per µm thickness up to a maximum of 15 000 V.	Every pipe
4. Peel adhesion	150.0 N minimum	CSA Z245.21, Clause 12.14 or 12.15	1 test per shift
5. 24 h cathodic disbondment at 65°C.	7 mm maximum radius	CSA Z245.21, Clause 12.3 *	1 test per shift
6. Tensile stress at yield	17,0 MPa minimum	ASTM D 638 Type IV sample: crosshead speed 50 mm/min	1 test per week
7. Elongation at break	300% minimum	ASTM D 638 Type IV sample: crosshead speed 50 mm/min	1 test per week

* In clause 12.3.3.6 the radial cuts may be replaced by circumferential chiseling to remove the test area circle.

PCS 5: Rigid Polyurethane Coating

PCS5.1 Approval of Supplier

The rigid polyurethane coating system proposed by the contractor shall be prequalified in accordance with tests 1 to 7 listed in Table 11 and shall be identified in the bid by coating manufacturer name and product number. These prequalification test results shall be submitted at the time of tender. All coatings proposed shall have established case histories of use on the external surfaces of buried pipelines with complementary cathodic protection systems.

PCS5.2 Approval of Batches

Each batch of materials supplied to the applicator shall be approved by eThekwini Water and Sanitation. No change in formulation of the materials is permitted without prior approval of eThekwini Water and Sanitation. Such approval shall not exonerate the Contractor from the due performance of the coating system in terms of this specification.

The manufacturers shall supply Batch Conformance Certificates for each batch together with the FTIR Fingerprint that will be compared with the qualification fingerprint from Table PCS5.1.

Pipes coated with rigid polyurethane materials that have not been approved by eThekwini Water and Sanitation may be rejected.

PCS5.3 Rigid Polyurethane Coating

The required coating shall be a two component liquid applied rigid polyurethane, the mixing ratio being 1:1. The two coating components shall have different colours allowing the verification of the correct mixing and checking of the uniformity of the colour of the mixed product. The coating is considered cured when it has attained the hardness recommended by the product manufacturer. The coating materials shall be handled, stored, applied, and cured in accordance with the recommendation of the material manufacturers.

PCS5.4 Preparation and Cleaning Of Pipe

i) Degreasing

Prior to blast cleaning, all surfaces shall be inspected and any oil or grease shall be removed by means of solvent cleaning in accordance with the manufacturer's recommendations using water dispersible cleaners. The solvent shall leave no residue.

ii) Blast Cleaning

The exterior surface of the pipe shall be blast cleaned by centrifugal or air blast cleaning methods, then vacuum cleaned or blown off to achieve the following standards:

a) Cleanliness shall be equal to Sa3 of ISO 8501-1 when tested in accordance with S.A.N.S. 5767.

b) The profile produced by blast cleaning shall be angular and shall have an average peak to valley height as recommended by the approved supplier, when tested in accordance with S.A.N.S. 5772. When recycling abrasives, daily additions of new grit are required to retain the angularity of the profile.

Hackles shall be removed with coarse abrasive paper.

c) Residual dust and debris shall not exceed 0,2% when tested in accordance with S.A.N.S. 5769.

d) Water soluble salts shall not exceed 100mg/m^2 at any point when tested with the Weber-Reilly Reagent.

e) Any laminations revealed by blast cleaning shall be ground out and reblast cleaned to meet the requirements given in (a) to (d) above. If grinding penetrates the steel to a depth greater than 8% of the nominal wall thickness, the pipe shall be rejected.

iii) Handling of Cleaned Pipe

After cleaning, the pipe surface shall not be contaminated in any way. Operators shall wear clean gloves and all surfaces in contact with the pipe surface shall be clean and free from oil, grease, grit, dirt and other contamination.

iv) Cut Back of Coating

The blast cleaned surface shall be stopped off or cut back by suitable masking which shall not contaminate the cleaned surface as follows:

a) All pipes up to and including 250 mm nominal diameter – 100 mm from both ends of the pipe.

b) All pipes from 300 mm nominal diameter up to and including 600 mm nominal diameter - 50mm from the belled end of the pipe and 100mm from the plain end of the pipe. (See Fig. 1).

c) All pipes larger than 600 mm nominal diameter - 100 mm from both ends of the pipe.

v) Protection of Uncoated Pipe Ends

All pipe surfaces left uncoated due to cut back of the fusion bonded epoxy powder coating shall be painted with an approved weldable vinyl butyral etch primer to a dry film thickness of 25 microns. This coating shall overlap the rigid polyurethane coating by 20mm.

PCS5.5 Application of Coating

i) Heating

The surface shall be heated using an induction heating coil, radiant heaters or hot air to a temperature as recommended by the coating material manufacturer and in accordance with this specification.

The use of propane torches or gas burners for pre-heating and post-heating is expressly prohibited. Infrared heaters may be used for post-heating.

The temperature of the bare steel shall be monitored using temperature-indicating crayons. The amount of crayon used shall be the minimum amount required for accurate measurement. Crayon markings shall be removed with a wire brush.

Care shall be taken to ensure a uniform heating pattern.

ii) Method of Application

The liquid coating shall be applied to the blast cleaned surfaces using the method and equipment recommended by the coating manufacturer.

If a second layer is required to reach the prescribed thickness, this shall be applied in accordance with the over-coating time prescribed by the coating manufacturer.

Particular care should be taken in the handling of the coated pipes before the coating has reached the minimum value of hardness recommended by the manufacturer.

iii) Thickness of Coating

The applied coating thickness shall be between 1,2 and 1,8 mm.

iv) Cut Back of Coating

The coating shall be cut back in accordance with clause A.5.1.5.

v) Repairs

Repairs shall be carried out with repair grade materials of the same grade as the spray-applied, and tested in accordance with the approved procedures.

PCS5.6 Performance Criteria

The coating material shall comply with all the requirements given in TABLE PCS5.1. The applied coating shall comply with all the requirements given in TABLE PCS5.2.

PCS5.7 Frequency of Testing

Tests 1 to 4 of TABLE PCS5.2 shall be carried out on every pipe. Test 5 shall be carried out once per day (or shift). Test 6 shall be carried out at the start of each new contract. Test 7 shall be carried out on each new batch of coating material, and compared with the qualification results.

TABLE PCS5.1: QUALIFICATION REQUIREMENTS FOR RIGID POLYURETHANE COATING

PROPERTY	REQUIREMENT	TEST METHOD
1. Composition	FTIR Fingerprint	
2. Hardness Shore "D"	≥75	ASTM D2240
3. Adhesion, pull-off at 23°C	>15 MPa at 1000 micron DFT	ASTM D 4541/ISO4624
4. Cathodic disbondment, 23 °C, 28 days, 1.5V	<18mm	ASTM G8, Method B only, ECD Group A compliant
5. Cathodic disbondment, 66 ± 3°C, 24 hrs, 3.5V	<6mm	NACE RP 0394
6. Adhesion to steel after hot water soak, 70 ±3°C, 30 days and 60 days	≥7MPa	ISO 4624
7. Impact resistance	3J/mm	ASTM G14, 23°C

TABLE PCS5.2: REQUIREMENTS FOR APPLIED RIGID POLYURETHANE COATING

PROPERTY	REQUIREMENT	TEST METHOD	FREQUENCY
1. Visual	Smooth finish, free from visible defects	Visual	Every pipe
2. Coating Thickness	1,2 to 1,8 mm	ISO 2820	Every pipe
3. Holiday test	Nil defects (test voltage as per manufacturer's specification)	ASTM D 5162-01	Every pipe
4. Hardness Shore "D"	≥75	ASTM D2240	1 test per day's production
5. Adhesion, pull-off at 23°C	>7 MPa at 1000 micron DFT	ASTM D 4541 /ISO4624	1 test per day's production
6. Cathodic disbondment, 23 °C, 28 days, 1.5V	<18mm	ASTM G8	1 test per contract
7. Composition	FTIR Fingerprint	Check against manufacturer's qualification scan	1 test per material batch

PCS 6: Polyamide 11 (Nylon 11) Thermoplastic Lining and Coating for 100 to 300mm Piping

PCS6.1 Approval of Supplier

The polyamide 11 (Nylon 11) thermoplastic coating and lining shall be Rilsan or similar approved. The approved supplier shall be ISO 9001 certificated.

The brand type or grade, and the supplier of thermoplastic coating to be used shall be approved in writing by eThekwini Water and Sanitation. To obtain approval, the supplier shall provide independent test results in writing that demonstrate that the proposed material is capable of meeting the requirements specified in Table PCS6.1.

To maintain their approved status, suppliers will carry out the above tests on an annual basis and submit their results to eThekwini Water and Sanitation for approval.

PCS6.2 Approval of Batches

Each batch of thermoplastic coating to be used by the applicator shall be approved by eThekwini Water and Sanitation before use. No change in formulation of the coating is permitted without prior approval of eThekwini Water and Sanitation. Such approval shall not exonerate the Contractor from the due performance of the coating systems in terms of this specification.

The manufacturer shall supply Quality Control Certificates for each batch of material supplied. The Quality Control Certificates shall include results of tests carried out in accordance with the manufacturer's approved procedures.

Pipes lined or coated with thermoplastic powder products that have not been approved by eThekwini Water and Sanitation may be rejected.

PCS6.3 Polyamide 11 (Nylon 11) Thermoplastic Lining and Coating

The polyamide 11 (Nylon 11) thermoplastic coating and lining shall be Rilsan or similar approved.

PCS6.4 Preparation And Cleaning Of Pipe

i) Degreasing

Prior to blast cleaning, all surfaces shall be inspected and any oil or grease shall be removed by means of solvent cleaning in accordance with the manufacturer's recommendations using water dispersible cleaners. The solvent shall leave no residue.

ii) Blast Cleaning

The surface of the pipe shall be blast cleaned by centrifugal or air blast cleaning methods, then vacuum cleaned or blown off to achieve the following standards:

a) Cleanliness shall be equal to Sa3 of ISO 8501-1 when tested in accordance with S.A.N.S. 5767.

b) The profile produced by blast cleaning shall be angular and shall have an average peak to valley height of 40 to 90 micron or as recommended by the approved supplier, when tested in accordance with S.A.N.S. 5772. When recycling abrasives, daily additions of new grit are required to retain the angularity of the profile.

Hackles shall be removed with coarse abrasive paper.

c) Residual dust and debris shall not exceed 0,2% when tested in accordance with S.A.N.S. 5769.

d) Water soluble salts shall not exceed 100mg/m^2 at any point when tested with the Weber-Reilly Reagent.

e) Any laminations revealed by blast cleaning shall be ground out and reblast cleaned to meet the requirements given in (a) to (d) above. If grinding penetrates the steel to a depth greater than 8% of the nominal wall thickness, the pipe shall be rejected.

iii) Handling of Cleaned Pipe

After cleaning, the pipe surface shall not be contaminated in any way. Operators shall wear clean gloves and all surfaces in contact with the pipe surface shall be clean and free from oil, grease, grit, dirt and other contamination.

iv) Cut Back of Coating

The blast cleaned surface shall be stopped off or cut back by suitable masking which shall not contaminate the cleaned surface as follows:

a) All pipes up to and including 250 mm nominal diameter – 100 mm from both ends of the pipe.

b) All pipes from 300 mm nominal diameter up to and including 600 mm nominal diameter - 50mm from the belled end of the pipe and 100mm from the plain end of the pipe. (See Fig. 1).

v) Protection of Uncoated Pipe Ends

All pipe surfaces left uncoated due to cut back of the thermoplastic powder coating shall be painted with an approved weldable vinyl butyral etch primer to a dry film thickness of 25 microns. This coating shall overlap the rigid polyurethane coating by 20 mm.

PCS6.5 Application of Coating

i) Primer Application

The cleaned pipe shall be primed with the approved primer to a nominal thickness of 8 to 12 micron.

ii) Heating

Within 8 hours of priming the pipe shall be pre-heated to the temperature recommended by the coating material manufacturer for the pipe wall thickness being coated. This temperature is typically some 350 ^oC.

The temperature of the bare steel shall be monitored using temperature-indicating crayons. The amount of crayon used shall be the minimum amount required for accurate measurement. Crayon markings shall be removed with a wire brush.

Care shall be taken to ensure a uniform heating pattern.

iii) Method of Application

Following preheating the thermoplastic powder coating shall be applied by the fluidized bed process as recommended by the coating manufacturer and application equipment supplier.

iv) Thickness of Coating

The optimal applied coating thickness is 350 micron. The minimum acceptable thickness is 250 micron.

v) Cut Back of Coating

The coating shall be cut back in accordance with clause A.5.6.1.(iv).

vi) Repairs

Repairs shall be carried out with either an approved two pack solvent free epoxy or an approved hot melt compound and tested in accordance with the specified procedures.

PCS6.6 Performance Criteria

The coating material shall comply with all the requirements given in TABLE PCS6.1. The applied coating shall comply with all the requirements given in TABLE PCS6.2.

PSC6.7 Frequency of Testing

Tests 1 to 4 of TABLE PCS6.2 shall be carried out on every pipe. Test 5 shall be carried out once per day (or shift). Test 6 shall be carried out at the start of each new contract.

TABLE PCS6.1: QUALIFICATION REQUIREMENTS FOR POLYAMIDE 11 (NYLON 11) THERMOPLASTIC LINING AND COATING

PROPERTY	REQUIREMENT	TEST METHOD
1. Hardness Shore "D"	75 - 85	ASTM D2240
2. 28 d cathodic disbonding at 20°C.	12 mm maximum radius	CSA Z245.21, Clause 12.3
3. Impact resistance	> 2J/mm	ASTM G14, 23°C

TABLE PCS6.2: REQUIREMENTS FOR APPLIED POLYAMIDE 11 (NYLON 11) THERMOPLASTIC LINING AND COATING

PROPERTY	REQUIREMENT	TEST METHOD	FREQUENCY
1. Visual (Lining and coating)	Smooth finish, free from visible defects	Visual	Every pipe
2. Coating Thickness (Lining and coating)	250 micron minimum	ISO 2820	Every pipe
3. Electrical Insulation Defects (Lining and coating)	Nil defects at 90 Volts, 2 Mega Ohm	S.A.N.S. 1217 Section 8.12.1	Every pipe
4. Hardness Shore "D" (Lining and coating)	75 - 85	ASTM D2240	Every pipe
5. Adhesion, pull-off at 23°C (on test panel coated with a pipe)	>7 MPa at 1000 micron DFT	ASTM D 4541 /ISO4624	1 test per day's production
6. 28 d cathodic disbonding at 20ºC. (on test panel coated with a pipe)	12 mm maximum radius	CSA Z245.21, Clause 12.3	1 test per contract

PCS 7: Two Layer Polyethylene / Visco-elastic Polyisobutene Pipe Coating System (2LPE)

A factory applied double sided non crystalline, prefab monolithic viscous polymer wrap coating with cold flow, self-healing, visco-elastic properties for corrosion prevention.

PCS7.1 Approval of Supplier

The 2-layer polyethylene pipe coating system comprises of a visco-elastic polyisobutene based coating and a polyethylene outer sheath classified as System B1 in terms of the Canadian Standards Association Specification Z245.21-02. The respective layers of the 2-layer system shall comprise of the following materials:

Visco-elastic Polyisobutene Corrosion Protection Layer:

Stopaq	Stopaq Basecoat DS (or similar approved)

High Density Polyethylene Outer Sheath:

Application Method 1:

Stopaq	Stopaq HSS Heat Shrinkable material (or similar approved)

Application Methods 2 & 3:

Borealis	Borcoat HE3450 – Extrusion material (or similar approved)

PCS7.2 Approval of Batches

Each batch of materials supplied to the applicator shall be approved by eThekwini Water and Sanitation before use. No change in product type of the material is permitted without prior approval from eThekwini Water and Sanitation. Such approval shall not exonerate the Contractor from the due performance of the coating system in terms of this specification.

The manufacturers shall supply Batch Conformance Certificates for each batch, which shall include results of all tests listed in Table 7.1.

Pipes coated with material that has not been approved by eThekwini Water and Sanitation will be rejected.

PSC7.3 Two Layer Polyethylene Pipe Coating System

The 2-layer polyethylene pipe coating system shall be applied generally in accordance with the Canadian Standards Association Specification Z245.21-02.

PCS7.4.1 Preparation and Cleaning of Pipe

i) Degreasing

Pipes shall be degreased externally by the use of an approved water rinsable solvent degreaser to remove all oils and lubricants present on the surface prior to blasting.

ii) Blast Cleaning

Pipes shall be blast cleaned to a clean finish removing all mill scale.
No surface profile is required.
No salt test is required.

iii) Handling of Cleaned Pipe

After cleaning, the pipe surface shall not be contaminated in any way. Operators shall wear clean gloves and all surfaces in contact with the pipe surface shall be kept clean and

free from oil, grease, grit, dirt and other contamination.

iv) Cut Back of Coating

The coating shall be cut back by 100mm from the pipe ends.

v) Protection of Uncoated Pipe Ends

Uncoated pipe ends shall be wrapped with a protective PVC tape and have a protective end cap placed at each pipe end.

PCS7.4.2 Application Methods

PCS7.4.2.1. Application method 1

PCS7.4.2.1. (a) Application of the Visco Elastic (Stopaq) Basecoat corrosion preventative layer:

i) The abraded line pipe will be protected by a visco-elastic basecoat material holding an overlap of 10mm on each round.

ii) The width of the Basecoat Material shall be as follows:

Pipe OD (mm)	Basecoat Material Width (mm)
< 200	100
200 to 1100	200
>1100	300

PCS7.4.2.1. (b) Application Mechanical Protection PE layer to the Visco-elastic Basecoat:

i) A polyethylene shrink material is applied on top of the visco-elastic basecoat coated pipe to act as the mechanical protective layer. After the application of the polyethylene shrink materials this material shall be heated to allow shrinking and adherence to the visco-elastic material.

ii) The thickness of the Mechanical Protection PE layer shall be a minimum of 1,5mm and a maximum of 2mm on the pipe with a minimum of 2mm on the weld seam.

PCS7.4.2.2 Application method 2

PCS7.4.2.2 (a) Application of the Visco-elastic (Stopaq) Basecoat corrosion preventative layer:

i) The abraded line pipe will be protected by a visco-elastic basecoat material with an overlap of 10mm on each round.

ii) The width of the Basecoat Material shall be as specified in Clause PSC7.4.2.1. (a) ii) above

PCS7.4.2.2 (b) Application Mechanical Protection PE layer to the Visco-elastic (Stopaq) Basecoat:

i) The Visco-elastic Basecoat coated pipe will pass by a side or overhead polyethylene extruder. The process delivering sufficient HDPE material to the surface of the rotating line pipe and forming a uniform mechanical

protective layer, as per thickness required by the consulting engineer, a minimum of 2mm on the weld seam.

ii) The polyethylene shall be applied immediately following the application of the visco-elastic material to the pipe. The coating application shall be a continuous process in order to provide an outer sheath of uniform thickness, free from pinholes, cracks and visible defects.

No adhesives are required between the layers; visco-elastic material is applied cold.

PCS7.4.2.3. Application method 3

PCS7.4.2.3 (a) Application of the Visco-elastic (Stopaq) Basecoat corrosion prevention layer

i) The abraded line pipe will be protected by a visco-elastic basecoat material holding an overlap of 10mm on each round.

ii) The width of the Basecoat Material shall be as specified in Clause PSC7.4.2.1. (a) ii) above

PCS7.4.2.3. (b) Application Mechanical Protection PE layer to the Stopaq Basecoat

i) The Visco-elastic Basecoat coated pipe will pass through a crosshead polyethylene extruder. The process delivering sufficient polyethylene material to the surface of the line pipe and forming a uniform mechanical protective layer at a minimum thickness of 1,5mm and a maximum of 2mm on the pipe with a minimum of 2mm on the weld seam.

ii) The polyethylene shall be applied immediately following the application of the visco-elastic material to the pipe. The coating application shall be a continuous process in order to provide an outer sheath of uniform thickness, free from pinholes, cracks and visible defects.

No adhesives are required between the layers. Visco-elastic material is applied cold.

PCS7.5 Repairs

Any damage to the coating system occurring during manufacturing, storage or transportation of the coated pipes shall be repaired in accordance with the relevant repair procedure as follows utilizing the following materials:

Corrosion Protection Layer :	Stopaq CZH Paste and CZH Wrapping band (or similar approved)
Mechanical Protection Layer – Option 1:	Stopaq Outerwrap PVC (or similar approved)
Mechanical Protection Layer – Option 2:	Stopaq Outerwrap PE (or similar approved)
Mechanical Protection Layer – Option 3:	Stopaq PE Patch Repair Material (or similar approved)

Repair Procedure:

a) Remove damaged coating with a razor knife; sand grinder, power wire brush or equivalent.

b) Care should be taken not to expose the steel surface during the repair procedure.

c) Eliminate all sharp edges.

d) Clean the damaged area and adjacent pipe coating with a dry clean cloth to remove the presence of dust, dirt and any foreign material.

e) Abrade (using sandpaper) the adjacent polyethylene coating extending 100mm beyond the damage.

f) Clean damage area again.

g) Fill voids and crevices in damaged coatings with Visco-elastic paste material prior to the application of repair patches.

h) Unroll the filler material and cut off the required amount, leaving the release paper in place.

i) Firmly press the material into the damaged area by hand and remove the release paper.

j) After filling the damaged area, remove the excess filler to create a smooth surface.

k) Patch Preparation:

- Cut a patch of visco-elastic material large enough to extend a minimum of 50mm beyond the edge of the repair zone
- Trim each corner of the patch about 10-25mm at a 45° angle.

l) Assist adhesion by removal of moisture with the use of a dry rag.

m) Remove oil with the use of isopropanol.

n) Remove the release liner from the cut repair patch.

o) Place the repair patch on the damage point and smooth down by hand.

p) Holiday detection shall be performed on each repair using a maximum voltage of 15kV.

q) Cover the coating with the relevant mechanical protection layer which has been specified on the project.

PCS7.6 Performance Criteria

The coating material shall comply with all the requirements given in TABLES 7.1 and 7.2. The applied coating shall comply with all the requirements given in TABLE 7.3.

PCS7.7 Frequency of Testing

The tests of TABLE 7.1 shall be carried out on each batch of supplied materials.

The tests of TABLE 7.2 shall be carried out for each pipe diameter for each contract.

Tests 1 to 3 of TABLE 7.3 shall be carried out on every pipe.

Tests 4 and 5 of TABLE 7.3 shall be carried out at a frequency of one per shift.

Tests 6 and 7 of TABLE 7.3 shall be carried out once per week.

Additional tests may be required at the discretion of Engineer.

TABLE 7.1: MATERIAL BATCH TEST REQUIREMENTS FOR OUTER SHEATH OF 2 LAYER POLYETHYLENE COATING

PROPERTY	REQUIREMENT	TEST METHOD
POLYETHYLENE OUTER SHEATH		
1. Density (g/cm³)	>0,940	ASTM D 792 or ASTM D 1505
2. Elongation at break (%)	600 minimum	ASTM D 638 Type IV sample: crosshead speed 50mm/min
3. Flow rate (g/10min)	0,15 – 0,80	ASTM D 1238 190°C/2.16kg
4. Hardness (Shore D)	60 minimum	ASTM D 2240
5. Heat aging (MPa,%)	At least 65% of original tensile stress at yield; minimum elongation of 150%	CSA Z245.21, Clause 12.6
6. Tensile stress at yield	18,5 minimum	ASTM D 638 Type IV sample: crosshead speed 50mm/min
7. Oxidative-induction time in oxygen at 220°C, aluminum pan, no screen (minute)	10 minimum	ASTM D 3895
8. Brittleness temperature (°C)	-70 or lower (for F20)	ASTM D 746
9. Environmental stress cracking resistance condition (h)	300 minimum (for F50) Condition "B"	ASTM D 1693 100%Igepal
10. Vicat softening point (°C)	120 minimum	ASTM D 1525

TABLE 7.2: QUALIFICATION REQUIREMENTS FOR 2 LAYER POLYETHYLENE COATING

PROPERTY	REQUIREMENT	TEST METHOD
1) 28 d cathodic disbonding at 20°C	0 mm maximum radius	CSA Z245.21, Clause 12.3*
2) Impact resistance (J/mm)	3,0 minimum	ASTM G14, 23°C
3) Flexibility	No cracking of polyethylene	CSA Z245.20, Clause 12.11; bend of 2,5°
4) Peel adhesion	Cohesive fraction of the corrosion coating	CSA Z245.21, Clause 12.14 or 12.15
5) Polyethylene tensile stress at yield	17.0 MPa minimum	ASTM D 638 Type IV sample: crosshead speed 50mm/min
6) Polyethylene elongation at break	300% minimum	ASTM D 638 Type IV sample: crosshead speed 50mm/min

*In Clause 12.3.3.6 the radial cuts may be replaced by circumferential chiseling to remove the test area circle.

TABLE 7.3: REQUIREMENTS OF APPLIED 2 LAYER POLYETHYLENE COATING

PROPERTY	REQUIREMENT	TEST METHOD	FREQUENCY
1. Visual	Smooth finish, free from visible defects	Visual	Every pipe
2. Coating Thickness	Minimum of 2mm	ISO 2808	Every Pipe
3. Holiday test	Nil defects at 15kV	CSA Z245.21, Clause 7.4.2. 10 V per µm thickness up to a maximum of 15 000 V	Every pipe
4. Peel adhesion	Cohesive fracture	CSA Z245.21, Clause 12.14 or 12.15	1 test per shift
5. 24 h cathodic disbondment	0 mm maximum radius	CSA Z245.21, Clause 12.3*	1 test per shift
6. Tensile stress at yield	17,0 MPa minimum	ASTM D 638 Type IV sample: crosshead speed 50mm/min	1 test per week
7. Elongation at break	300% minimum	ASTM D 638 Type IV sample: crosshead speed 50mm/min	1 test per week

*In Clause 12.3.3.6 the radial cuts may be replaced by circumferential chiseling to remove the test area circle.

PCS 8: Two Layer Glass-fibre Reinforced Epoxy (GRE)/Visco-elastic Polyisobutene Coating System (2LGRE)

A factory applied double sided non crystalline, prefab monolithic viscous polymer wrap coating with cold flow, self-healing, visco-elastic properties for corrosion prevention covered by a glass-fibre reinforced epoxy mechanical protection layer.

PCS8.1 Approval of Supplier

The 2 layer GRE pipe coating system comprises of a visco-elastic polyisobutene based coating and a GRE epoxy resin. The respective layers of the 2-layer system shall comprise of the following materials:

Visco-elastic Polyisobutene Corrosion Protection Layer:

Stopaq	Stopaq Fast Basecoat GRE (or similar approved)

Glass Reinforced Epoxy Resin Mechanical Protection Outer Layer:

Stopaq	Stopaq Fast GRE (or similar approved)

PCS8.2 Approval of Batches

Each batch of materials supplied to the applicator shall be approved by eThekwini Water and Sanitation before use. No change in product type of the material is permitted without prior approval from eThekwini Water and Sanitation. Such approval shall not exonerate the Contractor from the due performance of the coating system in terms of this specification.

The manufacturers shall supply Batch Conformance Certificates for each batch, which shall include results of all tests listed in Table 8.1

Pipes coated with material that has not been approved by eThekwini Water and Sanitation will be rejected.

PCS8.3 Two Layer GRE Coating System

The 2 layer GRE pipe coating system shall be applied generally as follows:

i) Load the Line pipe onto the rotation unit.
ii) Apply (viscoelastic) coating wrapping to the surface of the pipe, overlapping at 10mm.
iii) Wrap to each end leaving 100mm cut back on all pipe ends.
iv) Holiday Test the corrosion coating as per PSC8.5.1.(a).(viii) below.
v) Begin the mechanical protection - the second layer.
vi) The saturated 600 Glass layer/resin and tissue is to be rotated onto the pipe at 50% overlap - cold application.
vii) Complete the process to each end leaving 150mm cut back on all pipe ends.

PCS8.4 Preparation and Cleaning of Pipe

i) Degreasing

Pipes shall be degreased externally by the use of Isopropanol (or a similar approved water rinsable solvent degreaser) to remove all oils and lubricants present on the surface prior to blasting.

ii) Blast Cleaning

a) Remove loose corrosion, loose mill scale, dust or other loosely adherent contaminates to cleanliness St-2 / St-3 (hand tool / machine tool cleaning) or by means of abrasive blasting to cleanliness Sa-1 ("brush-off" blasting) in accordance with ISO 8501-01.

b) Mechanically remove all weld spatters, laminations, slivers, sharp edges, high points, and other visual roughness, which might penetrate into the corrosion protective coating layer.

c) No specific surface profile is required.

d) No salt test is required.

e) Residual dust and debris shall not exceed 0,2% when tested in accordance with S.A.N.S. 5769

iii) Handling of Cleaned Pipe

After cleaning, the pipe surface shall not be contaminated in any way. Operators shall wear clean gloves and all surfaces in contact with the pipe surface shall be kept clean and free from oil, grease, grit, dirt and other contamination.

iv) Cut Back of Coating

The coating shall be cut back by 100mm from the pipe ends.

v) Protection of Uncoated Pipe Ends

All pipe surfaces left uncoated due to cut back of the fusion bonded epoxy powder coating shall be painted with an approved weldable vinyl butyral etch primer to a dry film thickness of 25 microns. This coating shall overlap the Stopaq coating by 20mm.

PCS8.5 Application Method

PSC8.5.1. (a) Application of the Visco Elastic (Stopaq) Basecoat corrosion preventative layer:

i) The width of the Basecoat Material shall be as follows:

Pipe OD (mm)	Basecoat Material Width (mm)
< 200	100
200 - 1100	200
>1100	300

ii) Prior and during application, pipe surface shall be maintained at a temperature at least +3°C above the dew-point temperature and between -30°C and +70°C

iii) Before and during application, wrapping band shall be maintained within the temperature range +5°C to + 70°C

iv) Wrapping Band shall be applied with the sticky side in contact to the substrate, wrapped without tension, avoiding air entrapment and without tape creases and wrinkling

v) Wrapping Band overlaps shall be 10mm with itself and at least 50mm on adjacent existing epoxy coated piping. Overlaps between the end of a tape roll and the tape of a new roll shall be at least 100mm.

vi) At terminations (start and end points) one, full straight wrapping shall be applied onto substrate, following with wraps from "straight to spiral", and then continue with spiral wrapping, with 10mm minimum overlap. End with one straight, circumferential wrapping.

vii) The nominal thickness of the Wrapping Band shall not be lower than 0.85mm

viii) After wrapping and prior to application of the mechanical protective layer the Wrapping Band shall be subject to a high spark holiday test at 5 kV per mm coating thickness plus 5 kV. The Wrapping Band has a constant minimum thickness between 0.85mm and 1.2mm, therefore the testing voltage should be (1 x 5kV) + 5 kV = 10 kV. A clean, copper-brush probe is recommended for the high spark testing. Where a ring-probe is used it is recommended that the test voltage be increased by 5 kV in order to compensate the less efficient ring probe.

ix) All defects (holidays) shall be repaired with the addition of new materials and re-tested.

PCS8.5.1. (b) Application of GRE Mechanical Protection layer to the Visco-elastic Basecoat:

i) No adhesive is required between the visco-elastic basecoat corrosion protection layer and the glass reinforced epoxy mechanical protection layer.

ii) Saturate the 600 grams per m^2 glass fibre membrane with resin mix at 400 grams per m^2 and wind onto the surface of the pipe over the viscoelastic basecoat ensuring a 50% overlap of the cloth to itself.

iii) Follow this with a 30 grams per m^2 layer of fibre tissue on the same application run ensuring a 50% overlap of the cloth to itself and beginning and ending with a straight wrap covering over the glass completely.

PCS8.6 Repairs

Any damage to the coating system occurring during manufacturing, storage or transportation of the coated pipes shall be repaired in accordance with the relevant repair procedure as specified by the product supplier as follows utilizing the following materials:

Corrosion Protection Layer:	Stopaq CZH Paste and CZH Wrapping Band (or similar approved)
Mechanical Protection Layer:	Stopaq Fast GRE (or similar approved)

Repair procedure:

a) Small defects (< 20mm x 20mm) to bare steel:

i. Remove damaged coating
ii. Eliminate all sharp edges
iii. Clean the damaged area and adjacent pipe coating with a dry clean cloth to remove the presence of dust, dirt and any foreign material.
iv. Fill voids and crevices in damaged corrosion protection coating with Visco-elastic paste material
v. Fill remaining void in damaged mechanical protection layer with resin mix
vi. After filling the damaged area, remove the excess filler to create a smooth surface.
vii. Cut a patch of visco-elastic material large enough to extend a minimum of 50mm beyond the edge of the repair zone
viii. Trim each corner of the patch about 10-25mm at a 45° angle.

ix. Place the repair patch on the damage point and smooth down by hand.
x. Holiday detection shall be performed on each repair using a maximum voltage of 15kV.

b) Large defects (> 20mm x 20mm) to bare steel:

i. Remove damaged coating
ii. Eliminate all sharp edges
iii. Clean the damaged area and adjacent pipe coating with a dry clean cloth to remove the presence of dust, dirt and any foreign material.
iv. Cut and apply patch from Visco-elastic corrosion protection material
v. Fill remaining void in damaged mechanical protection layer with grass fiber mesh and brush in resin mix
vi. After filling the damaged area, remove the excess filler to create a smooth surface.
vii. Cut a patch of visco-elastic material large enough to extend a minimum of 50mm beyond the edge of the repair zone
viii. Trim each corner of the patch about 10-25mm at a 45° angle.
ix. Place the repair patch on the damage point and smooth down by hand.
x. Holiday detection shall be performed on each repair using a maximum voltage of 15kV.

PCS8.6 Performance Criteria

The coating materials shall comply with all the requirements given in TABLES 8.1 and 8.2. The applied coating shall comply with all the requirements given in TABLE 8.3.

PCS8.7 Frequency of Testing

The tests of TABLE 8.1 shall be carried out on each batch of supplied materials.

The tests of TABLE 8.2 shall be carried out for each pipe diameter for each contract.

Tests 1 to 3 of TABLE 8.3 shall be carried out on every pipe.

Tests 4,5 and 6 of TABLE 8.3 shall be carried out at a frequency of one per shift.

Test 7 of TABLE 8.3 shall be carried out once per 100 pipes.

Additional tests may be required at the discretion of Engineer.

TABLE 8.1: MATERIAL BATCH TEST REQUIREMENTS

PROPERTY	REQUIREMENT	TEST METHOD
CORROSION PROTECTION LAYER:		
1. Density (g/cm^2)	≥ 1.40	ISO 1183-1
2. Elongation at break (%)	> 100	ASTM D1000
3. Water absorption (%)	< 0.03	ASTM D570
4. Permeability (g/m^2/24 hrs)	< 0.20	ASTM E96
5. Glass transition temp. (°C)	≤ -65	ISO 21809-3:2008 Amendment1:2001
6. Drip resistance	No dripping of compound	Tested 72 hrs @ +130°C
MECHANICAL PROTECTION LAYER:		
7. Glass transition temp. (°C)	76	ISO 21809-3:2008 Amendment1:2001
8. Elongation at break (%)	8.2	
9. Hardness (Shore D)	≥ 70	ASTM D2240

TABLE 8.2: QUALIFICATION REQUIREMENTS FOR 2 LAYER GRE COATING

PROPERTY	REQUIREMENT	TEST METHOD
1. 24 hr cathodic disbonding at 23°C and 70°C	0 mm maximum radius	Artificial defect 6mm dia. self-healed after 24 hrs
2. Impact resistance (J/mm)	40 min	ISO 21809-3 Amendment 1(2011) Tested at 20°C
3. Compressive Strength (N/mm^2)	85 min	
4. Flexural strength (N/mm^2)	80 min	
5. Tensile strength (N/mm^2)	70 min	
6. Peel adhesion	Cohesive failure	CSA Z245.21, Clause 12.14 or 12.15
7. Hardness (Shore D)	≥ 70	ASTM D2240

TABLE 8.3: REQUIREMENTS OF APPLIED 2 LAYER GRE COATING

PROPERTY	REQUIREMENT	TEST METHOD	
1. Visual	Smooth finish, free from visible defects	Visual	Every pipe
2. Coating Thickness	2.5 to 3.0mm	ISO 2808	Every pipe
3. Holiday test	Nil defects	CSA Z245.21, Clause 7.4.2. (5 kV per mm thickness plus 5Kv)	Every pipe
4. Peel adhesion	Cohesive fracture	CSA Z245.21, Clause 12.14 or 12.15	1 test per shift
5. Impact resistance (J/mm)	40 min	ISO 21809-3 Amendment 1(2011) Tested at 20°C	1 test per shift
6. Hardness (Shore D)	≥ 70	ASTM D2240	1 test per shift
7. 24 h cathodic disbondment	0 mm maximum radius	CSA Z245.21, Clause 12.3*	1 test per 100 pipes

PARTICULAR SPECIFICATION – CORROSION PROTECTION

01 - CORROSION PROTECTION – GENERAL

TABLE OF CONTENTS

PREAMBLE

This Particular Specification deals with general corrosion protection principles and serves as an introduction to the suite of corrosion protection specifications not dealing with cathodic protection.

The following summarises the index and broadly define the contents for the corrosion protection Particular Specifications.

The numbering system for this suite of corrosion specifications follows the following layout:

PA CXX Y

PA – Indicating that this specification is part of the Particular Specifications
C – Indicating that it is a "corrosion" specification.
XX – This shows the number of the specific specification compared to the full suite of corrosion specifications contained in the Particular Specifications.
Y – Shows the paragraph number within the particular specification.

Example:

PA C01 1 – In this case indicates that it is a Particular Specification, from the corrosion suite of specifications and in the example, the first in the series named Corrosion Protection_General, referring to paragraph 01 which is the INTRODUCTION.

PA Spec_01_Corrosion Protection_General

The general requirements for corrosion protection and corrosion protection mechanisms are detailed.

PA Spec_02_Linings and Coatings

This Particular Specification deals with coatings and linings in general, including all types of linings.

Linings and coating are detailed with specific reference to the different coatings and linings applicable to the contract.

Linings listed are
- cement mortar
- epoxy
- Rilsan
- galvanising

Coating listed are
- FBMDPE
- Sintakote
- 3 layer
- Rilsan
- Galvanising
- Epoxy for pipe specials and pipework and specials in chambers

The mixing of twin pack epoxy is detailed.
Coating and Lining repair is addressed.
Technical requirements for coating and lining is stated.

PA Spec_03_Surface Preparation of steel surfaces for coating and lining rehabilitation

Bare Metal Surfaces_Degreasing
Wire Brushing
Sand Blasting

External surface preparation for tape wrapping – Wire Brushing
External surface for epoxy coating – Sand Blasting
Internal surface for epoxy coating – Sand Blasting
Internal surface for cement mortar lining – Wire Brushing

PA Spec_04_Holiday Testing

Holiday testing - general

Before and during Construction
Spark Detection of lining and coatings
On Tape Wrap Systems
On epoxy coating systems
On pipe linings (internal)
On fittings and manufactured specials

Upon completion of Construction
Wet Sponge testing
DCVG testing

PA Spec_05_Application of Tape Wrap systems

Application of tape wrap systems to ensure effective corrosion protection.

1. Rehabilitation of externally welded joints
2. Rehabilitation of shop manufactured segmented bends to be backfilled with bedding
3. Rehabilitation of external pipe coating where a tape wrap application is required
4. Rehabilitation/corrosion protection of bolted connections

PA Spec_06_Corrosion Protection of buried joints, couplings and flanges

This Particular Specification deals with corrosion protection of buried flanges, bolted connections, couplings, joints, fittings and adaptors. These components need to be protected from corrosion and special requirements are applicable if buried.

Mastics and rock shields are detailed.

PA Spec _07_Transition Zone Repairs

This Particular Specification deals with transition zones and the complications of ensuring a continuous corrosion protection mechanism over these zones.

PA Spec_08_ Internal Lining and External Coating repair on pipe

This Particular Specification deals with the repair of internal linings and external coatings where such linings and coatings have been damaged as a result of construction or manufacturing processes and activities.

Internal lining repair
- Cement Mortar Lining
- Epoxy Lining

External coating repair
- Epoxy
- Sintakote/3 layer/MDPE

PA Spec_09_Pipe Specials_Lining and Coating Repair

This Particular Specification deals with the repair of internal linings and external coatings on pipe specials where such linings and coatings have been damaged as a result of construction or manufacturing processes and activities.

Segmented Bends
- Internal
- External

Tie piece and Y branch specials

Air collector pipes

PA Spec_10_Cathodic Protection_Project Specific

Cathodic Protection_Project Specific

PA Spec_11_Free issue pipe material_Management of coating and lining defects

This Particular Specification deals with managing coating and lining defects in free issue pipe materials.

At pipe yards

At work fronts

PA C01 1 INTRODUCTION

The tendered rates for the laying of pipe, effecting of butt, fillet and collar welds of pipe joints, the manufacturing of pipe specials and the fitment of all fittings to the pipe line system, or any activity during the construction process which could damage corrosion protection coatings and linings, or activities which result in the bare pipe surfaces to be included into the permanent Works, are deemed to include for all the corrosion protection mechanisms required to reinstate the pipe work with a fully functional corrosion protection coating and lining, outside and inside.

Holiday detection is specified for the coatings and linings at different phases of the work in order to ensure that the pipeline is laid and commissioned without any holidays in its external coating or internal lining.

A control test will be done on the pipeline, once constructed, in order to verify that the pipeline coating is holiday free.

No section of pipe, pipe special, pipeline component and or fittings and equipment shall be allowed to be introduced into the pipeline without effective corrosion protection mechanisms.

The corrosion protection suite of particular specifications deal swith the different aspects of corrosion protection and corrosion mechanisms to repair damaged systems/mechanisms and in the case of cathodic protection, to continuously protect constructed pipelines.

Various specific products are specified with a caveat of “similar approved”. Similar approved means that approval of a product needs to be sought well in advance and rejection of the request, on technical basis does not entitle a contractor to dispute declaration. Rates applied to items where “similar approved” is an option implies that the tendered rates will be applicable, regardless of whether the item is “approved” or not.

PA C01 2 INDEX FOR SUITE OF CORROSION PROTECTION PARTICULAR SPECIFICATIONS

- PA Spec_01_Corrosion Protection _ General
- PA Spec_02_Linings and Coatings
- PA Spec_03_Surface Preparation of steel surfaces for coating and lining rehabilitation
- PA Spec_04_Holiday Testing
- PA Spec_05_Tape Wrap Systems application
- PA Spec_06_Corrosion Protection of buried joints and couplings
- PA Spec_07_Transition Zone repairs
- PA Spec_08_Internal Lining and External Coating repair for pipelines
- PA Spec_09_Pipe Specials_Lining and Coating Repair
- PA Spec_10_Cathodic Protection_Project Specific
- PA_Spec_11_Free issue pipe material_Management of coating and lining defects

PA C01 3 DEFINITIONS APPLICABLE TO THE CORROSION PROTECTION SUITE OF DOCUMENTS

The following terminology and descriptions are utilised in the corrosion protection suite of particular specifications:

“corrosion protection” collectively refers to protection of steel surfaces from corrosion.

"corrosion protection mechanisms" collectively refers to any action taken, application made or equipment fitted to assist with corrosion protection for example a tape wrap fitted on a welded joint, a lining fitted to the inside of a pipe, a repair done on a pipe coating that was damaged, etc.

"cathodic protection" is a mechanism used for corrosion protection but specifically deploying the science of cathodic protection to curb corrosion on constructed pipelines.

"DCVG testing" and "PCM testing" refers to the methods of testing for holidays in pipe coatings after the pipe has been laid and backfilled. DCVG testing is normally specified.

PA C01 4 RATE OF INTERNAL JOINT REINSTATEMENT

The Contractor shall ensure that internal joints are reinstated and rehabilitated soonest and under no circumstances shall internal joint reinstatement lag behind the pipe laying front by more than 100 metres. (This distance may be further restricted in the project specifications)

Should the Engineer, at any stage, note that the mentioned reinstatement rate is lagging behind the specified rate, work will be stopped at that specific front until the internal reinstatement has been completed to satisfaction, in order to comply with the required progress rate.

PA C01 5 QUALITY CONTROL

The Contractor shall make provision in his Quality Control Plan, for the necessary hold points for inspection of each and every repair to internal and external lining or coating effected to pipe surfaces as a result of damage, manufacturing, fitting of specials or any other process which could inflict damage to linings and coatings.
The tendered rates for pipe laying shall be deemed to include for all eventualities regarding the Quality Control Plan.

PARTICULAR SPECIFICATION – CORROSION PROTECTION

02 – LININGS AND COATINGS

TABLE OF CONTENTS

PREAMBLE

This Particular Specification deals with coatings and linings in general, including all types of linings.

Linings and coating are detailed with specific reference to the different coatings and linings applicable to the contract.

Linings listed are
- cement mortar
- epoxy
- Rilsan
- galvanising

Coating listed are
- FBMDPE
- Sintakote
- 3 layer
- Rilsan
- Galvanising
- Epoxy for pipe sections and pipe specials located in chambers

The mixing of twin pack epoxy is detailed.
Coating and Lining repair is addressed.
Technical requirements for coating and lining is stated.

PA C02 1 THE TYPES OF LININGS AND COATINGS

This specification deals with the following linings:

Cement mortar
Epoxy (Solvent free)
Rilsan
Galvanising

The following coatings are being dealt with:

FBMDPE
Sintakote
3 layer
Rilsan
Galvanising
Epoxy for pipe and pipe specials located in chambers

PA C02 2 ACCESS TO THE INSIDE OF A LINED PIPE (LARGE DIAMETER PIPE)

In order to avoid damage to the pipe lining occurring as a result of construction activities, all possible care shall be exercised during construction. The following procedures are required:

- Wet sacking or rubber matting shall be placed on the pipe invert at areas where welding or flame cutting operations are in progress to prevent damage to coating from weld spatter or molten metal. This requirement shall be strictly enforced.
- Foam shall be provided for the placing of tools etc on the internal pipe surface.
- Soft-soled shoes shall be worn by all personnel working inside the pipe.

PA C02 3 INSPECTION OF PIPE WITH SMALL DIAMETERS

All pipe sections with a diameter too small to allow internal access for inspection by the Engineer upon completion of lining shall be required to be video graphed for inspection. The rates for the laying of the pipe and manufacturing of pipe specials shall be deemed to include for all the video footage required for complete internal inspections.

PA C02 4 REPAIRS TO COATINGS AND LININGS

PA C02 4.1 EXTERNAL REPAIRS – FBMDPE/3 LAYER COATING/SINTAKOTE

Detection of defects in coating is to be done by holiday testing or visible assessment.

Surface Preparation of steel surfaces shall be in accordance to specification PA C03.

Cleaning of Area to be Repaired shall be in accordance to specification PA C03.

Where the repair area is less than 400 mm², the application of a hot spatula shall be used to repair the defect, provided there is a residual layer of polyethylene still adhering strongly to the steel surface. If inadequate virgin material is available to complete the hotwork patch repair with an adequate thickness, virgin material shall be required from an external; source.

The length of a repair shall not exceed the nominal pipe diameter in the circumferential direction, nor twice the nominal pipe diameter in the longitudinal direction.

Where the repair is larger than 400mm2 it will be required to melt virgin coating material into the damaged area after which a tape wrap shall be applied over the repaired area.

All patched areas shall be wrapped after effecting of repair.

Joint repairs (including bends) on pipes that are to be buried shall be wrapped before backfilling.

Scour and air valve tees and crotch plates

Scour and air valve tees and crotch plates that are to be buried shall be protected in accordance with the requirements of the particular corrosion specification.

PA C02 5 EXTERNAL REPAIRS TO EPOXY COATINGS

Defects in epoxy are to be located by holiday testing, alternatively shall by isolated through visual inspection.

Where epoxy of exposed pipe in chambers need to be repaired, the required epoxy repair kit will be utilised to effect repair.

The requirements of epoxy repair and the preparation of the repair area shall conform to the requirements for internal repairs of epoxy lined pipes.

PA C02 5.1 INTERNAL REPAIRS – EPOXY LINED PIPES

Defects in epoxy coating detected by holiday testing if not visually presented.

Refer to section discussion of epoxy repairs

PA C02 5.2 INTERNAL REPAIRS – CEMENT MORTAR LINED PIPES

Surface Preparation of bare steel to be in terms of PA C04.

Refer to section on cement mortar linings.

PA C02 6 THERMOPASTIC POWDER COATING AND LINING

Where a thermoplastic powder coating and lining is to be used the coating shall be similar and approved of by the Engineer to “Plascoat PPA 571 Aqua”. The requirements for the “Plascoat PPA 571 Aqua” thermoplastic powder coating system are identical to the requirements for the thermoplastic powder lining system.

The preferred means of application of the coating and lining is by either Electrostatic Spray (ES) or Fluidised Bed Coating (FB) and Flame Spraying (FLS) to be used for field repairs.

Where pipe specials fitted with flanges are to be coated with “Plascoat PPA 571 Aqua” special methods shall be utilized to ensure that “Plascoat PPA 571 Aqua” is not applied to the flange face. Under no circumstances shall scraping or grinding of “Plascoat PPA 571 Aqua” on flange faces be allowed.

PA C02 7 RILSAN COATING AND LINING

Rilsan or similar approved fusion bonded powder products shall be applied to a minimum DFT of 300 micrometres, on prepared surfaces, where specified. The surface preparation of the substrate, the application and curing of the product shall be in terms of the supplier's specifications and recommendations.

All steel pipes of nominal bore up to and including DN300, to be used for the manufacture of pipe specials and fittings, shall be coated and lined with Rilsan or similar approved. In special cases a galvanised coating might be specified.

Where pipe specials fitted with flanges are to be coated with Rilsan, special methods shall be utilized to ensure that Rilsan is not applied to the flange face. Under no circumstances shall scraping or grinding of Rilsan on flange faces be allowed.

Repair work to Rilsan coated pipes and pipe specials shall be limited to the absolute minimum. Should Rilsan be affected by welding which in turn requires repairs to be effected, the Rilsan shall be removed by grinding up to a point where the Rilsan coating is sound and adheres to the pipe material without traces of disbonding, spalling or flaking. The 25mm edge of Rilsan, onto which repair epoxy is to be applied, will be abraded with 80 or 100 grit emery paper to ensure adhesion of repair epoxy in the area. The bare metal, where repair epoxy has to be applied shall be grit blasted to render a surface finish of St2 before the application of the epoxy. Feathering from bare metal to sound Rilsan shall be done.

The requirements for the "Rilsan" or similar approved fusion bonded powder system are identical to the requirements for the "Rilsan" lining system.

Damaged epoxy/Rilsan as a result of heat transfer shall be removed by means of mechanical wire brushing.

Bare metal surfaces shall be prepared as specified.

Once surface preparation has been completed, an EPOXY repair kit shall be applied to the pipe as per specification. (NORDBAK 1 or similar approved)

Once the flanged joint is completed, it shall be protected as required .

PA C02 8 PROTECTIVE UV COATING AND COATING OF PERMANENTLY EXPOSED PIPE

All pipes and specials coated which are to be permanently exposed or above ground shall be over-coated with three or more coats of "Carboline, Carbothane 134 Clear Coat" or similar approved light coloured UV protection acrylic polyurethane resistant coating to a total minimum dry film thickness of 300 microns for UV protection. The pipe surface shall be prepared and the coating applied in strict accordance with the manufactures instructions or shall be protected with the "Denso Acrylic Pipeline Tape (Steelcoat 500)" system or similar approved UV Resistant coating.

PA C02 9 GALVANISING

In certain instances galvanising might be specified as a coating and or lining. Galvanised coatings and linings shall under all circumstances consist of application through hot dipped processes.

Galvanised coatings and lining for pipe work may not be damaged as no repair to galvanised coatings and linings will be allowed.

PA C02 10 EPOXIES INCLUDING TWIN PACK EPOXIES

Only solvent free Epoxy repair kits shall be utilized to repair the internal linings of pipe lines.

Two part Epoxy as an epoxy repair kit which consists of any epoxy repair kit made up of a base and an activator approved by the Engineer, could be products similar to DENSO ST100, SIGMA SF 523, NORDBAK, etc. The Contractor's attention is drawn to the fact that the Employer might have specific preferences in this regard and that specific kits might be specified. For the repair of cement mortar linings, Epidermix 338 or similar approved will be required.

The Contractor's tendered rates for the laying of the pipe shall be deemed to include for all the Two Part Epoxy repairs that have to be applied in order to deliver a serviceable and acceptable pipe line. (This costing arrangement excludes such repairs as instructed by the Engineer as a result of manufacturing defects)

The requirements for a solvent free epoxy coating system are identical to the requirements for a solvent free epoxy lining system.

Pipes and fitting to be externally coated and internally lined with a two component cross linked epoxy shall comply with the requirements of SANS 1217.

The cure rate of liquid epoxy coating is very dependent on temperature with the rate of cure being very slow below 10ºC and the reaction generally ceasing below 5ºC. Contractors tendering for this type of coating are therefore expected to have a heated shop or warm air blowers with suitable heat insulating tunnels to enable the temperature of the coating to be maintained at not less than 15ºC from the time of application until full cure has taken place where applicable, for example shop manufactured specials. Adverse weather conditions will not be accepted as a reason for delay in the programme or for solvent retention in multi-coat solvent borne systems.

Application of liquid epoxy coating inside a constructed pipe is applicable to internal joint rehabilitation after welding of an epoxy lined pipe. The Contractor shall ensure that he can maintain the optimum required conditions inside the pipe when epoxy is applied in order to ensure proper curing of the epoxy.

Application shall be by means of two component hot airless equipment or by single component airless equipment, as appropriate and as recommended by the material manufacturer. The coating shall be applied in a uniform manner and, when cured, shall comply with all the appropriate requirements of the specification.

In the application of the epoxy the following shall be strictly in compliance with the manufacturer's instructions:

a) Method of application (Type of Brush or roller.)

b) Over coating time.

c) Temperature range for application.

d) Method of mixing base and activator.

e) Number of coats to achieve the specified thickness.

f) Safety aspects e.g. Eye and hand protection, ventilation, fire precautions, etc.

g) Note that roller and brush applicators shall be replaced once the product application expiry time has been reached on any specific applicator tool.

The specified thickness shall be achieved in one application for solvent free epoxies. In the event of the thickness being less than the minimum specified the coating shall be removed and the pipe length shall be re-blasted and re-coated to comply with the specification.

The Contractor's tendered rates for the laying of the pipe and fabrication of specials shall be deemed to include for all the Two Part Epoxy repair systems that have to be applied in order to deliver a serviceable and acceptable pipe line.

PA C02 10.1 MIXING OF TWO PART (TWIN PACK) EPOXY

The two components shall be thoroughly and completely mixed in the proportions specified by the manufacturer, according to his specifications.

Mixing in the original container will only be permitted by means of methods that ensure full integration of different parts of the compound into a homogeneous compound with the characteristics as intended by the manufacturer.

The different parts of the compound shall not be diluted.

Mixing shall only be allowed with full batches and reduction of volumes from mixing packs by means of weight or volume measurement, which will result in smaller portions to be mixed, will not be allowed.

The Contractor shall ensure that the correct paddle is utilised for mixing. Utilisation of off cut lengths of re bar will not be allowed, neither will pieces of wood picked up from the scrap heaps be allowed,

The Contractor shall ensure that the bottom corners of containers containing the materials are well scraped in order to ensure total removal of the decanted part and total mixing of the two parts in containers.

PA C02 10.2 THICKNESS OF EPOXY LAYER

The thickness of lining and coating for pipes and pipe specials for fusion bonded lining and coatings shall be a minimum of 300 microns DFT. No deviation from this will be allowed at any location.

The thickness of lining and coating for pipes and pipe specials for solvent free epoxy lining and coatings shall be a minimum of 300 microns DFT.

PA C02 10.3 SUPRFACE PREPARATION BEFORE EPOXY APPLICATION

Two part Epoxy repair kits shall only be applied on prepared steel surfaces in terms of the Particular Specification for surface preparation of steel surfaces for coating and lining rehabilitation.

Transition areas from Epoxy internal lining, to bare metal which have been grit blasted, shall be smooth without rough edges or flaking appearances.

PA C02 10.4 EPOXY REPAIRS

At each pinhole detected by the holiday test, the surrounding area shall be abraded to 25 mm beyond the defective area. It is noted that any cluster of pinholes within a radius of 25 mm shall be regarded as one defect. The abrasion shall be carried out with clean emery paper of 80 to 100 mesh so as to provide a suitably rough surface profile without causing the removal of excessive amounts of coating material.
The damaged and abraded area shall be covered with the approved epoxy repair kit to the specified thickness.

All damaged and blistered epoxy lining shall be removed back to sound epoxy by mechanical grinding or other approved means.

The roughened area of lining and the defect shall be repaired by the application of a solvent free epoxy repair material (such as “Copon Hycote 151”, “Arc 982”, “Arc 855”, or similar approved) to a minimum dry thickness of 300 microns.

A “halo” of 1 to 2 mm of the abraded material shall be left uncovered around the repair.

The patch material shall be of a different colour to the pipe lining material.

In the application of the epoxy the following shall be strictly in compliance with the manufacturer’s instructions:

- Method of application (type of brush or roller.)
- Over coating time
- Temperature range for application
- Mix proportions of activator to base. This shall be strictly enforced, and splitting of manufacturer-supplied packs shall be allowed only if subsequent bending is carried out strictly by mass to the correct proportions.
- Method of mixing base and activator.
- Number of coats to achieve the specified thickness.
- Safety aspects eg: eye and hand protection, ventilation, fire precautions, etc.

After the repair has been adequately cured, the repair and the surrounding 250 mm of epoxy lining shall be tested for electrical insulation defects. No defects will be permitted.

The repair of EPOXY internal linings on manufactured pipe specials, welded joints where a flange has been welded to the pipe, crotch plates, collar plates, or where pipe specials have been welded to the pipe, the internal lining shall be repaired by means described above and with the relevant two part EPOXY repair kit, according to the manufacturer’s specification, after suitable surface preparation of the steel surface in terms of the specification.

PA C02 10.4.1 REPAIR OF EPOXY LININGS (SMALL AREAS)

A small area repair will be represented by a defect up to 100mm2 in area.

At each pinhole detected by the Wet Sponge test, the surrounding area shall be abraded to 25mm beyond the defective area. It is to be noted that any cluster of pinholes within a radius of 25mm shall be regarded as one defect. The abrasion shall be carried out with clean emery paper of 80 to 100 mesh so as to provide a suitably rough surface profile without causing the removal of excessive amounts of lining material. Feathering of sound lining material shall be done from bare metal to full thickness epoxy.
All damaged and blistered epoxy lining shall be removed back to sound epoxy by mechanical grinding.
Exposed steel surfaces shall be prepared as required in the specifications.
The roughened area of lining and the defect shall then be repaired by the application of a solvent free epoxy repair kit as detailed in this specification (for example NORDBAK 1 or similar approved) to a minimum dry film thickness of 300 micrometres.
The repair area shall be masked in order to limit the area of repair and to allow for a "halo" of not less than 5mm of the abraded material to be left uncovered around the repair.
Application of the repair epoxy material shall be by means of spatula or brush application.
The patch material shall be of a different colour to the pipe lining material.
After the repair has been adequately cured, the repair and the surrounding 250mm of epoxy lining shall be tested for electrical insulation defects by means of the "wet sponge" detector set at 90 Volts.
Any pinhole defects found are to be repaired in terms of the specification.

Any burning effect noticed visually on the lining, but which have not been tested

positively for holidays, shall be repaired in terms of this specification.

Once an internal lining has been repaired, nobody will be allowed to enter the pipe, except for cleaning purposes and the final inspection by the Engineer.

PA C02 10.4.2 REPAIR OF EPOXY LININGS (LARGE AREAS)

Application of the repair kit shall be by means of roller application or air blast equipment as previously described.
Repair to large areas of damaged Epoxy linings or areas of Epoxy which has to be reinstated at joints where Epoxy was removed in order to facilitate jointing by welding, shall follow the following the same procedure as for small repairs with the exception that the repair area shall not be masked.

The exposed steel surface shall be degreased in terms of the specification.
The exposed steel surface shall be grit blasted in terms of the specification.

All damaged and blistered epoxy lining shall be removed back to sound epoxy by mechanical grinding.
The surrounding area of sound epoxy shall be abraded to 25mm beyond the defective area and shall be feathered back.
The abraded area of lining and the defect shall be repaired by the application of a solvent free epoxy repair epoxy (such as NORDBAK 1 or similar approved) to a minimum dry film thickness of 300 micrometres.
After the repair has been adequately cured, the repair and the surrounding 250mm of epoxy lining shall be tested for electrical insulation defects by means of the "wet sponge" detector set at 90 Volts.

All pinhole defects found are to be repaired.
Once an internal lining has been repaired, nobody will be allowed to enter the pipe, except for cleaning purposes and for inspections required by the Engineer.

PA C02 10.4.3 REPAIR TO EPOXY INTERNAL LINING ON MANUFACTURED PIPE SPECIALS (NOT SEGMENTED BENDS)

The repair of Epoxy internal linings on manufactured pipe specials shall be in terms of this specification by means of the relevant Epoxy repair kit, after suitable surface preparation of the steel surface has been undertaken.
The cost of the reinstatement shall be deemed to be included in the rates for the manufacturing, laying, bedding and jointing of the shop fabricated specials

PA C02 11 CEMENT MORTAR LINING (CML)

PA C02 11.1 CML – GENERAL

Cement mortar linings are either repaired with an Epidermix type or similar approved to the same thickness of the CML or it is replaced with an epoxy lining in total, in which case attention is to paid to the transition zone repair.

Cement mortar linings in pipelines are normally delivered as per manufacturers specifications for the pipe with CML lining.

As a result of handling and storage, CML can crack and deteriorate.

Damage to CML lining is a regular occurrence, although it is not supposed to take place. CML lining also get damaged or removed as a result of the manufacturing of pipe specials.

CML lining repair is required where such lining should be in place but have spalled, broken, deteriorated, etc.

PA C02 11.2 MAKING GOOD OF CML AT WELDED JOINT

Where the steel pipe is supplied with cement mortar lining cut back 50mm from each end, this entire void shall be filled with Epidermix 338 (or similar approved) and rendered smooth and flush with the surrounding lining as described below when internal lining is repaired.

Where the spigot and socket steel pipe is supplied with cement mortar lining flush with the plain end of the pipe, the pipe is to be joined with a minimum of 5mm and a maximum of 10mm gap (for pipe DN500mm and larger) in the cement mortar linings which shall be filled with Epidermix 338 (or similar approved) and rendered smooth and flush with the surrounding lining as described below.

Where small diamterer plain ended pipe has to be joined (access for rehabilitation not possible) by means of butt welding a collar shall be welded onto the one pipe to allow for spigot and socket type fitment. The requirements for spigot and socket CML lining repair then applies.

Once the spigot has been inserted into the socket and the pipes have been welded into position, the excess epoxy (Epidermix 338) shall be smoothed off with pig being pulled through the pipe where the pig is 5mm smaller than the internal diameter of the pipe.

Where access into the pipe for joint rehabilitation is possible, the Epidermix or similar approved material shall be applied with spatula and smoothed off to match surrounding CML thicknesses.

Bare metal surfaces shall be prepared as specified.

The internal surface of the bellmouth is to be power or hand wire brushed from the pipe end to the cement mortar lining to remove dirt, scale, rust and other foreign matter. An Epidermix 338 sausage shall be applied in the beel after surface preparation.
The plain end of the adjoining pipe shall be pushed into the bellmouth in such a way that the Epidermix band is compressed and makes contact with the transverse face of the concrete lining of both pipes. The excess lining material which is squeezed into the pipe shall be removed by drawing a plug which is 5 mm smaller in diameter than the bore of the pipe, across the joint. The plug shall be so shaped as to apply a smooth even surface to the lining material at the joint.

When fabricating steel specials (e.g. gusseted bends, tees, etc.), any cement mortar lining which de bonds or spalls from the internal steel surface shall be removed back to sound mortar and made good with "Epidermix 338", or similar approved, neatly formed to meet the adjacent cement mortar.

For accessible pipes larger than DN700 the joint shall then be made good with “Epidermix 338” or similar approved, neatly formed to meet the adjacent cement mortar.

If cement mortar lined pipe of small diameters are supplied with plain ended conditions, the jointing shall be effected by means of a collar welded to one end of the pipe in order to simulate the spigot and socket condition. Repair of the CML shall be similar to that used when spigot and socket pipes are welded and CML repaired.

PA C02 11.3 MAKING GOOD OF CML IN STRAIGHT PIPE WHERE LINING IS DAMAGED (NOT AS RESULT OF WELDING AT JOINTS OR SPECIAL MANUFACTURING)

The damage to be repaired can be either a crack or a large spalled area with a resultant effect similar to CML removal and repair at a welded joint. (large area). The repair method should follow the methodology specified in this specification for either crack repair or CML reinstatement for shop manufactured pipe specials.

Damaged CML in small diameter pipe which does not allow access into the pipe will result in the pipe being rejected.

PA C02 11.4 REPAIR PROCEDURE FOR CRACKS IN CML

The crack shall be ground out using a mechanical grinder down to the steel wall to form a “dove-tail” groove with a minimum width of 8 mm. The groove shall be filled with Epidermix 338 (or equal approved), mixed and applied in accordance with the manufacturers specifications.

PA C02 11.5 REINSTATEMENT OF CML IN SHOP FABRICATED SPECIALS

Where shop fabricated specials are manufactured from cement mortar lined steel pipe, the mortar lining shall be reinstated after fabrication of the special.

In order to manufacture the pipe special, the CML will be chipped away to allow for welding and grinding.

Depending on the size and shape of area of CML to be reinstated, the CML needs to be re instated to similar thickness of existing CML, alternatively transition zone repair is required. (repair with epoxy that joins with CML)

Any cement mortar lining which disbonds or spalls, or shows signs of hairline cracks in the vicinity of the repair area, shall be removed by approved means.

Bare steel is to be prepared as required, for either an epoxy repair or a CML/Epidermix repair.

Any transition zones where cement mortar lining joins Epoxy lining shall be treated in a manner specified under “TRANSITION ZONE REPAIR“.

The cost of the reinstatement shall be deemed to be included in the rates for the manufacturing, laying, bedding and jointing of the shop fabricated specials.

In general, a typical segmented bend fabricated form a CML pipe will see all the CML removed internally and reinstatement of internal lining shall be with an epoxy linier.

PA C02 12 MAKING GOOD OF FIELD WELDED JOINTS, REPAIRS AND PUDDLE FLANGES

This specification is based on “Denso” products. Alternative products may be accepted at the discretion of the Employer’s Representative. Once welding is complete and all weld splatter and burnt coatings have been removed, all welded pipe joints shall be prepared and wrapped in the following manner:

Surface Preparation

The bare metal shall be cleaned and wire brushed to St.2 standard and, if necessary, degreased with white spirit. The adjacent coating shall be cleaned to a minimum of 300mm either side of the joint.

Primer

The pipe barrel at the joint shall be degreased with white spirit and primed with “Denso Primer D” (or equal approved) extending 200mm onto sound coating. The primer shall cure for 30 minutes prior to the application of a tape system.

Profiling Tape

Apply 1,0mm x 75mm wide “Ultraflex sealing tape (yellow)” to the full circumference of the weld bead and steel interfaces. Care shall be taken to ensure a smooth profile and to avoid air bubbles being trapped beneath the tape. The tape shall not be stretched.

Tape System

Tape joint shall be wrapped with “Denso Ultraflex 1250/300 (Blue)” (or equal approved) (55% overlap) extending 150mm onto sound coating. Even tension shall be applied throughout the wrapping procedure and care shall be taken to prevent air bubbles from being trapped beneath the tape, regardless of profile being wrapped.

Repairs

Damaged pipe coating shall be repaired in the same manner with the repair extending at least 150mm either side beyond the edge of the damaged coating. “Spot” tape repairs will not be acceptable. Damage caused by the Contractor shall be repaired at the Contractor’s expense. Damage caused prior to the Contractor accepting responsibility for the pipes shall be repaired under this contract.

Puddle Pipes

All puddle pipes shall be primed and wrapped in accordance with the above procedure. The wrapping shall extend from (but shall not include) the puddle flange to 150mm beyond the concrete surface.

Hot- Dip Galvanizing

Hot-dipped galvanizing shall be done in accordance with the requirements of SANS 763 – 1977, as amended. On site fabrication processes such as welding, drilling, threading, etc. are to be avoided. All hot-dipped galvanized items shall be passivated immediately after hot dipping.

PA C02 12.1 EXTERNAL COATINGS – FBMDPE/SINTAKOTE/3 LAYER

PA C02 12.1.1 REPAIR OF FBMDPE/3 LAYER COATING/SINTAKOTE (LARGE AREAS)

A large area repair is defined as an area larger than 400mm2.
All damaged and blistered FBMDPE/3 layer coating caused by welding or other mechanical means shall be removed back to sound coating by mechanical grinding or other approved means.
The exposed steel surface shall be power wire brushed to remove dirt, scale, rust and other foreign matter to a surface profile equivalent to a Class St 2 finish. Weld spatter shall be removed by chipping or grinding to a smooth surface flush with the surrounding steel. Welds shall have a smooth contour free from sharp edges, protrusions and undercut. Sharp edges and protrusions shall be removed by grinding to a smooth radius of curvature of not less than 3mm. Degreasing of the exposed steel surface shall be done.
The surrounding sound FBMDPE/3 layer surface shall be feathered from steel surface to maximum thickness and then abraded to a distance of 100mm beyond the defective area. The abrasion shall be carried out with clean emery paper of 80 to 100 mesh so as to produce a suitably rough surface profile without causing the removal of excessive amounts of protective material.
Virgin Sintakote powder is to be melted into the defect to ensure proper mechanical bonding with the steel surface and chemical bonding with the existing Sintakote. The melting of the virgin material shall be such that melting is not effected with an open flame. The melted powder shall be shaped with a hot spatula to form a smooth surface over the repair area.

Under no circumstances will patching of damaged areas by means of pieces of tape wrap, be allowed.

PA C02 12.1.2 REPAIR OF FBMDPE/3 LAYER COATING/SINTAKOTE (SMALL AREAS)

A small area repair is defined as an area less than 400mm2.
A small area repair is effected by means of the application of a hot spatula to repair the defect, provided that there is a residual layer of polyethylene adhering strongly to the steel surface. Alternatively, virgin pipe coating powder material may be melted with heated spatula over the damaged area, to fill the mechanical damages in the coating and fuse with the surrounding coating material, all as per the manufacturer's recommendations.
At each pinhole detected by the Holiday test, the surrounding area shall be abraded to 25mm beyond the defective area. The abrasion shall be carried out with clean emery paper of 80 to 100 mesh so as to provide a suitably rough surface profile without causing the removal of excessive amounts of coating material. A hot spatula shall be utilized to work pipe coating material into the pinhole defects.
It is noted that any cluster of pinholes within a radius of 25mm shall be regarded as one defect.

PA C02 12.1.3 REPAIR TO FBMDPE/3 LAYER COATING/SINTAKOTE ON MANUFACTURED PIPE SPECIALS (NOT SEGMENTED BENDS)

The repair to FBMDPE/3 Layer coating or Sintakote on the outside of manufactured pipe specials shall either be by means of external tape wrap in accordance with the tape wrapping specification or by fusing virgin pipe coating material to the damaged areas or by means of the application of an approved Epoxy repair kit.
The cost of the reinstatement shall be deemed to be included in the rates for the manufacturing, laying, bedding and jointing of the shop fabricated specials
The surface preparation of the steel surfaces before repair shall be in accordance with the requirements of the contract specification.

PA C02 13 COATING OF PERMANENTLY EXPOSED PIPE

All pipe which is to be permanently exposed shall, in addition to corrosion protection at joints, be protected with the "Denso Acrylic Pipeline Tape (Steelcoat 500)" system or similar approved UV Resistant coating. The pipe surface shall be prepared and the coating applied in strict accordance with the manufacturer's instructions.

PA C02 14 COATING AND LINING THICKNESS

The following table lists the materials and corrosion protection system to be applied to various components of a pipeline system:

Environment	Material	Corrosion Protection System	Min DFT (µm)
Pipe specials * ≤ DN500 or <=1500mm long	Mild Steel Grade X42, X52 and X65	Coating: Plascoat PPA 571 Aqua or similar approved Lining: Plascoat PPA 571 Aqua or similar approved	300
Pipe specials * ≤ DN500 or >1500mm long	Mild Steel Grade X42, X52 and X65	Coating: Two Pack Epoxy Lining: Two Pack Epoxy	500 **

Environment	Material	Corrosion Protection System	Min DFT (µm)
Pipe specials * > DN500 or <=1000 mm long	Mild Steel Grade X42, X52 and X65	Coating: Two Pack Epoxy Lining: Two Pack Epoxy	500 **
Pipe specials * > DN500 or >1500mm long	Mild Steel Grade X42, X52 and X65	Coating: Two Pack Epoxy Lining: Two Pack Epoxy	500 **
Valves and Water Meters	Manufacturers Standard	Fusion Bonded Epoxy (FBE)	Manufacturers standard
Flange adaptors and couplings	Low Carbon Steel	FBE or Two Pack Epoxy	Manufacturers standard
Weld on flanges	Mild Steel	Two Pack Epoxy (excluding flange face)	500 **
Nuts, bolts and washers Anchor bolts	Mild Steel	Hot dipped galvanised carbon steel to SANS 1461	65
Buried Bolted connections and couplings		Petrolatum tape wrapping (Denso or similar approved)	N/A

(*) Pipe specials include internal lining rehabilitation of welded joints with two pack epoxy lining repair kits.
(**) Overcoat time to be according to manufacturers specification with particular care to be taken to ensure that under coats dryness is adequate to ensure that final curing in not hampered as a result of overcoat application.

PA C02 15 REQUIREMENTS FOR COATINGS AND LININGS

PA C02 15.1 REQUIREMENTS FOR SOLVENT FREE EPOXY LININGS AND COATINGS

Performance Criteria

Applied coatings and linings shall comply with all the requirements given in Table 1 below:

Table 1: Requirements of Solvent Free Epoxy

TEST	PROPERTY	REQUIREMENT	TEST METHOD
1	Visual	Smooth glossy or semi glossy finish, free from excessive runs, sags, orange peel, occlusions or other visible defects.	Use an experienced observer.
2	Coating Thickness	See table under section 14 above.	SANS Method 141. Take a minimum of 2 readings per m^2 of surface up to 300mm nominal bore, or 1 per m^2 over 300mm nominal bore.
3	Electrical Insulation Defects	Solvent-free: Nil defects at 90 Volts, 10 Mega-ohm.	SANS 1217, Section 8.12.1
4	Impact Resistance	No defect at 1 Joules	SANS 1217, Section 8.7 but modified as given in Note 1.

5a 5b	Degree of cure: Static Test Dynamic Test	No softening or discolouration when fully cured. No softening or discolouration when fully cured.	SANS 1217, Section 8.9. Cure time shall be in accordance with the manufacturer's data. 50 Double rubs with cotton wool swab soaked in MEK. Cure time shall be in accordance with the manufacturer's data.
6	Adhesion (Hot water soak)	Not more than 15mm disbonding from point of V.	Immerse in water at 75ºC for 48 hrs. Make V cut at 30º angle. Test adhesion when panel has cooled to 25ºC.
7	Cathodic Disbonding	Total disbonded area not to exceed 40mm diameter after 30 days. Current flow not to exceed 5mA.	ASTM G8 Method B - Magnesium Anode - 20ºC - 7mm holiday.
8	Cathodic Disbonding (Accelerated)	Total disbonded area (including holiday) not to exceed 20mm diameter.	Impressed current - 3,5 volts potential at 75ºC for 48 hrs. 3mm artificial holiday.

NOTE 1: Impact resistance shall be carried out on a sample of production pipe firmly clamped and choked (to be rebound free) to a rigid base. No electrical insulation defects shall be detected at the point of impact when tested at 1 Joule.

PA C02 15.2 REQUIREMENTS FOR FUSION BONDED AND THERMOPLASTIC POWDER LININGS AND COATINGS

Performance Criteria

Applied coatings and linings shall comply with all the requirements given in Table 2 below:

Table 2: Requirements of Fusion Bonded and Thermoplastic Powered

TEST	PROPERTY	REQUIREMENT	TEST METHOD
1	Visual	Smooth glossy or semi-glossy finish, free from excessive runs, sags, orange peel, occlusions or other visible defects	Use an experienced observer.
2	Coating Thickness	See table under section 14 above.	SANS Method 141. Take a minimum of 2 readings per m^2 of surface up to 300mm nominal bore, or 1 per m^2 over 300mm nominal bore.
3	Electrical Insulation Defects	Nil defects at 3 500 volts. For conditions for repair see Clause 3.9.2.3	SANS 1217, Section 8.12.2
4	Impact Resistance	No defect at 2 Joules	SANS 1217, Section 8.7 but modified as given in Note 2.
5a 5b	Degree of cure: a) Static Test b) Dynamic test c) Thermal characteristics	No softening or discolouration when fully cured. No softening or discolouration when fully cured. Chemical conversion shall be not less than 90%	SANS 1217, Section 8.9. Cure time shall be in accordance with the manufacturer's data. 50 Double rubs with cotton wool swab soaked in MEK. Cure time shall be in accordance with the manufacturer's data.
6	Adhesion (Hot water soak)	Not more than 5mm disbonding from point of V.	Immerse in water at 75ºC for 48 hrs. Make V cut at 30º angle. Test adhesion when panel has cooled to 25ºC.
7	Cathodic Disbonding	Total disbonded area not to exceed 40mm diameter after 30 days. Current flow not to exceed 5mA.	ASTM G8 Method B - Magnesium Anode - 20ºC - 7mm holiday.

8	Cathodic Disbonding (Accelerated)	Total disbonded area (including holiday) not to exceed 10mm diameter.	Impressed current - 3,5 volts potential at 75ºC for 48 hrs. 3mm artificial holiday.

NOTE 2: Impact resistance shall be carried out on a production pipe. The inside of the pipe shall be supported by a wooden block fitted vertically across the internal pipe diameter and chocked so as to fit tightly and immediately beneath the point of impact. Damage to the coating shall be assessed by measuring electrical insulation defects at the point of impact. No defect Is permitted after impact at 2 joules. Alternatively, the test may be carried out on a sample cut from the pipe and rigidly supported beneath the point of impact.

PA C02 16 FREQUENCY OF TESTING OF LININGS AND COATINGS

Tests 1 to 3 of TABLE 1 shall be applied to each and every pipe or pipe special.

Tests 4, 5(a) and 5(b) of TABLE 1 shall be applied to at least one pipe selected at random from the first day's production or from each batch of liquid epoxy, whichever is more frequent.

Tests 6, 7 and 8 of TABLE 1 shall be applied to at least one pipe or pipe special selected at random from the first day's production of each item.

Tests to be conducted on internal lining repair shall be on 3 tests per joint for every 10 pipe joints.

Should the Contractor experience difficulties in achieving this specification, additional tests may be required by the Employer until the problem(s) has been identified and rectified.

Such additional tests shall be to the Contractor's account.

PARTICULAR SPECIFICATION FOR BRICKWORK

TABLE OF CONTENTS

PRE AMBLE TO PARTICUALR SPECIFICATION BRICKWORK

Any reference to “the Engineer” in this specification needs to be read in against the relevant General Conditions of Contract terminology.

For this contract the General Conditions of Contract 2015 applies and “the Engineer” referred to here in is the “Employer’s Agent”.

PABR 1 SCOPE

This section of the Specification covers all aspects of brickwork including building in of various items, reinforcing of brickwork etc as well as the supply of all materials and labour.

PABR 2 MATERIALS

PABR 2.1 Standards

All materials used shall comply with the following standard specifications, the latest of which shall be held to apply:

Specification	Year	Title	Referred to in:
SANS 28	2010	Metal ties for cavity walls	PA_Brickwork
SANS 227	2007	Burnt clay masonry units	PA_Brickwork
SANS 1090	2009	Aggregates from natural resources - Fine aggregates for plaster and mortar	PA_Brickwork
SANS 50196		Portland cement	PA_Brickwork PSG

PABR 2.2 Masonry Units

PABR 2.2.1 General

Bricks shall be free from cracks, chips or other defects and at least one end of 20% of the bricks shall have the same general colour and texture as the faces.

Special care shall be exercised in loading, stacking and handling face bricks as no damaged bricks shall be used and bats may only be used where required to obtain bond.

General-purpose stock bricks or common bricks shall have a minimum average compressive strength of 7 MPa unless otherwise specified. Where stock bricks are required for load bearing walls or foundations then the compressive strength shall be 28 MPa.

Facing bricks shall be of the type, origin and colour specified in the Schedule of Quantities or on the drawings and shall be selected for uniformity of dimension and colour.

Satisfactory proof of load bearing capacity of bricks offered shall be submitted before deliveries are made to the site.

For samples, 6 units of each type of brick shall be submitted to the Engineer for approval. All subsequent deliveries shall be to the standard of the approved samples.

All bricks which, in the opinion of the Engineer, do not comply with the abovementioned requirements, shall be removed from the site forthwith at the Contractor's cost.

PABR 2.2.2 Burnt Clay Bricks

Burnt clay bricks shall comply with SANS 227 and:

Engineering bricks shall be of high compressive strength and durability, with 49 MPa

minimum average compressive strength and selected for their uniformity of dimension and shape. Bricks shall be clay and pressed or wire cut. Water absorption after a 24-hour test shall not exceed 12% by mass.

Facing bricks shall have a minimum average compressive strength of 28 MPa. Bricks shall be clay and pressed to wire cut. Water absorption after a 24-hour test shall not exceed 12% by mass. Bricks shall have sharp, clean and well defined arises.

General purpose stock bricks or common bricks suitable for general building work shall be clay, pressed or wire cut, even in size, smooth in texture and with sharp well defined arises. Water absorption after a 24-hour test shall not exceed 14% by mass.

PABR 2.3 Cement

Cement used in masonry shall comply with the requirements of SANS 50196.

PABR 2.4 Fine Aggregate (Sand)

Fine aggregates used in mortar shall be naturally occurring sand or consist of crushed rock or gravel, or a combination thereof with naturally occurring sand being hard, clean and free from dust, shale, clay, loam roots and other impurities.

Fine mortar aggregates shall comply in all respect with SANS 1090.

PABR 2.5 Water

Water shall be clean and free from injurious amounts of acids, alkalis, sugar and other organic substances. Water suitable for drinking purposes shall be acceptable. Where required by the Engineer, the suitability of water shall be proved by tests carried out by an approved laboratory.

PABR 2.6 Mortar

Mortar shall unless otherwise specified, be Class II mortar and shall consist of 1-part Portland cement, 1-part hydrated lime and 5-parts of sand by volume for normal brickwork. Mortar for foundations, lintels and for all load bearing walls higher than 3000 mm shall be Class I mortar and shall consist of 1-part Portland cement, ¼ part hydrated lime and 4-parts sand. The ingredients shall be measured in proper gauge boxes on a timber or steel-mixing platform with water added and thoroughly mixed in to obtain a uniform consistency throughout. As an alternative, mixing may be by means of an approved mechanical batch mixer.

In the case of a cement-milled slag mortar, the sand and slag shall be mixed first and then the cement added.

Cement mortar shall be used within two hours of the first contact of the cement with water. No mortar which is older than two hours or has begun to set shall be used.

PABR 2.7 Wall Ties

Metal wall ties in brickwork and blockwork shall be galvanised crimped steel, single wire type, 4 mm diameter minimum, complying in all respects with SANS 28.

Ties cavity walls shall be PWD butterfly type formed of 4mm diameter steel wire galvanised class A for coastal conditions and to such lengths that no less than 75mm can be built in at each end.

PABR 2.8 Reinforcement

Wall reinforcement shall consist of two 3.15 mm diameter longitudinal wires are appropriate

centres for the thickness of the wall and with 2.80 mm diameter cross wires welded to the longitudinal wires at 300 mm centres. All wire used shall be of high tensile steel.

There shall be 4 rows of brick without reinforcement for lifts.

PABR 2.10 Concrete to Brickwork Ties

End of junctions of brick walling to concrete are to be tied to the concrete by means of 1.6 x 32 x 500 mm galvanised hoop iron ties.

Brick linings to concrete are to be tied with 4 mm diameter crimped galvanised wire ties to SANS 28.

PABR 2.14 Storage of Materials

Cement and aggregates shall be stored in such a manner as to prevent deterioration or contamination by foreign matter, damp and chemicals spilled on the ground or which may settle out of the atmosphere.

Perishable materials likely to be damaged by exposure shall be stored under cover.

PABR 3 EQUIPMENT

The Contractor shall provide and maintain in good working order, adequate equipment for carrying out the required work in accordance with this specification in a sage efficient manner.

PABR 4 CONSTRUCTION

PABR 4.1 Brickwork Generally

All brickwork shall be laid in stretcher bond, plumb and true to line. Mortar beds shall be 10 mm thickness, unless otherwise described, and are not to exceed 12 mm in thickness, and no four successive joints shall rise more than 40 mm (for 10 mm joints). Clay bricks are to be well wetted (saturated in hot weather) with water before being laid and the course of bricks laid last shall be well wetted before fresh bricks are bedded upon it. Bricks shall be well buttered and laid on a full bed of mortar and joints shall be flushed up. Bricks in foundation walling are to be extra hard. Beam filling is to be built to waves 106 mm thick and the space between beam filling and roof covering shall be filled with a stiff mixture of 1 to 3-cement mortar tightly pressed in. The brickwork shall be carried up in a uniform manner, no one section being raised more than 1 200 mm above another section at one time and no brickwork is to be carried more than 4 courses above immediately adjoining or intersecting brickwork. Block bonding or toothed and keyed construction will only be allowed in alterations to existing work.

One-brick walls (230 mm) built stretcher bond in two skins shall be tied together with galvanised wall ties staggered not more than 1 m apart horizontally and every fourth course vertically with extra ties at reveals and openings etc. as may be necessary. Brick linings to concrete walls shall similarly be tied together, while galvanised hoop iron ties cast into concrete columns, shall be built into the joints of butting brick walls as specified. Where specifically required the outer face of the inner skin of all external one-brick walls above damp course level shall be waterproofed before the outer skin is built up. The face to be treated shall be bagged over until all crevices are filled. When thoroughly dry the face shall be twice coated with an approved liquid bituminous compound and worked around wire ties to produce an unbroken waterproof coating.

Where called for on the drawings, wall and concrete ceiling surfaces shall be bag washed with a wet sack dipped in liquid cement grout whilst the mortar in the brickwork joints is still soft until all joints and crevices are eventually filled. Projections of concrete shall be rubbed off and any defects shall be made good in cement mortar.

PABR 4.2 Reinforced Brickwork

Brickwork over door and window openings shall be reinforced with welded wall reinforcement placed in each course of brickwork over openings for a minimum of 4 courses or as shown on the drawings. Reinforced brickwork shall continue at least one and a half bricks on either side of the opening. Where two of more openings are less than 675 mm apart, the reinforced brick lintels shall be continuous over all such openings and their dividing piers, plus 1½ brick bearing at both extreme ends.

Brick lintels in cavity walls, which are exposed to the weather, shall have a continuous damp-proof bourse built into the outer skin of the wall immediately above the lintel to cover the top of the lintel, raked up one course and carried through the inner skin.

Where called for on the drawings, brickwork shall be reinforced with wall reinforcement laid in every fourth course of all brick walling or as directed by the Engineer. The reinforcement shall be built in truly central to the wall and all longitudinal laps shall not be less than 450 mm. Reinforcement in half-brick walls shall be built 106 mm into main cross walls.

PABR 4.3 Face Brickwork

All facings shall be kept clean during the progress of the work and face-brick surfaces with mortar spattering will not be accepted. Unless otherwise specified, the horizontal and vertical joints shall be pointed and finished with a round key joint and both rubbed smooth as the building work proceeds.

The various colours of the face bricks shall be selected and mixed at random to prevent portions of the face work showing a preponderance of one colour. Where sufficient storage is available on site the full quantity of face bricks required for the works (or such quantity as to keep supply well advanced of construction) shall be delivered to site.

PABR 4.4 Fairface Brickwork

Where called for on the drawings and in the Schedule of Quantities, internal walls shall be of smooth stock-bricks, built fair and kept clean during construction and jointed as in Clause PABR 4.3.

PABR 4.5 Precast Prestressed Concrete Lintels

Approved precast prestressed concrete lintels of suitable size of the thickness of the wall and the width of the opening shall be used over openings in plastered and bagged walls.

Wherever possible, the minimum bearing for precast prestressed lintels, at their ends and over intermediate supports, shall be:

a)	for openings not exceeding 600 mm	-	1 brick (230 mm)
b)	for openings exceeding 600 mm	-	1 1/2 brick (340 mm)

Where this requirement necessitates a total lintel length exceeding 6.6 m, a joint may be introduced centrally over an intermediate pier in a position to be approved by the Engineer. Such joints shall be stiffened by the introduction of welded wall reinforcement as specified in PABR 4.2 and extending a minimum of 300 mm on either side of the joint, i.e. 600 mm minimum total length.

PABR 4.6 Concrete/Brick Ties

At end on junction of brick walls with concrete columns or walls brickwork is to have galvanised hoop iron ties built into the joints for:

½ brick skin (110mm walls) at maximum 8 course height intervals

1 brick skin at maximum 4 course height intervals

Ties are to be cast into concrete at course heights by tacking L-shaped ties to inside face of shutters and bending down ends for building in after shutters are stripped, or shot fixed to concrete with approved nails and strength of shot top provide adequate fixing.

Galvanised crimped wire ties for fixing of brick linings to concrete are to be cast a minimum 75 mm deep into concrete at brick course eights (four per square metre staggered), bent down after shutters are stripped and built into brickwork.

PABR 4.7 Doors

Timber for doors shall be selected, well-seasoned kiln dried Red Meranti and shall be treated with an approved oil soluble preservative. The following preservative is recommended: 5% Pentachlorophenol in a vessel consisting of 50% white spirits and 50% power paraffin or 100% white spirits. The Contractor shall obtain and submit to the Engineer a certificate from the merchant supplying the timber or doors to the effect that the timber has been treated as required.

After erection doors shall be well sanded and prepared and then coated with two coats of an approved penetrating sealer compatible with the treatment applied to the timber.

Hollow core doors are not allowed.

PABR 4.8 Louvres

Louvres and frames shall be manufactured from pre painted galvanised steel sheet coated on both sides. The coating shall comply with the manufacturers' specifications for 'Chromadek' with PVC Plastisol coating or 'Colomet' and 'Versacor' base and SMP weathering coat, or similar coating approved by the Engineer.

PABR 4.9 Brick Cladding to Exposed Face of concrete structures

The brick cladding to the outlet chamber and to the exposed faces of the reservoir wall shall consist of a single skin of face bricks as obtained from Independent Brick Supplies (or similar approved) and laid in bands as directed from the Engineer. This skin is to be fastened to the concrete as specified elsewhere.

The brickwork shall be in stretcher bond 4:1 cement mortar. The brickwork shall be supported on suitably staggered concrete ledges with cross-sectional dimensions of 150 mm by 150 mm. R10 reinforcing starter bars will be used to tie the ledges into the concrete structure wall and two Y10 bars shall be sued in the longitudinal direction. The slope of the bank against the wall is to be indicated on the drawings.

Payment for the formwork for reinforced concrete ledges shall be per metre and shall include the following:

- the positioning and staggering of the brickwork support ledges to keep a minimum depth to the top of the ledges of 150 mm below finished ground level;
- supply erection and stripping the necessary shuttering and temporary supports.

PABR 4.10 Sundries

- Rough and fair cutting shall be performed as required and the brickwork fitted around structural steelwork. Face brickwork shall be carefully cut and fitted when next to the finishings.
- Chases shall be left or formed in brickwork for edges of concrete floors, roofs, staircases, etc. Vertical chases shall be provided in brickwork and blockwork wherever required for pipes, conduits, switch boxes, distribution boards, etc.

- Oversailing courses, corbels, etc, shall be built where required.
- Ends of cills, thresholds, separation joints etc shall be built in, cut, or pinned in cement mortar where required.
- Steel windows to be built into walls shall be set plumb and true with the cill bar resting on wedges to ensure that it is perfectly level. All lugs shall be bolted up tight and built in solid as walling proceeds, the channel frame of the window being caulked tight with Class B (1-¼-4) cement mortar, pointed up neatly all round and made watertight.
- Passed steel doorframes shall be securely strutted when placed in position to prevent distortion of any kind during building. The frame shall be built solid into the walls and grouted solid at the back with 12:3 cement mortar as the work proceeds and properly pointed all round.
- Timber doorframes and windows to be built into walls shall be primed before building in and set plumb and true. The underside of each vertical to the doorframes shall be provided with a 12 mm diameter steel peg projecting 75 mm from the bottom of the frame and these pegs shall be securely grouted into the floor threshold. 2 mm thick hoop iron cramps 40 mm wide, screwed to frames shall be built 450 mm into walls with ends turned up, four cramps to each jamb. At flush junctions of walls and frames a V-joint shall be ruled between frame and wall rendering. The junctions between timber frames or windows and face brickwork or un-rendered concrete on external faces shall be sealed by pointing around the timber frames with an approved polysulphide based waterproofing compound finished off in a neat and workmanlike manner.
- All necessary openings for ends of timber, gratings, cramps, holdfasts, dowels, wood plugs and slips for fixing jointer's work, hoop iron ties, etc, shall be formed built in with 1:3 cement mortar, and made good with properly performed rough and fair cuttings.
- Damp proof courses shall be formed in the walls as described by building three consecutive bedding joints and all vertical joints between solid walls in 2:1 cement mortar with an approved waterproofing compound added in accordance with the manufacturer's instructions.

PABR 5 TOLERANCES

PABR 5.1 Tolerances

Tolerances for clay brick dimensions, strength, warpage and efflorescence shall be as per SANS 227.

PABR 5.2 Degree of Accuracy

Permissible deviations in the final finished surfaces to the degree of accuracy required will be applied to linear dimensions, position, verticality, level, squareness and bow.

The degree of accuracy may be one of the following:

Degree of accuracy III for use where a high degree of accuracy is unnecessary e.g. mass storage warehouse walls and floors.

Degree of accuracy II for what is commonly called "good work".

Degree of accuracy I where the use of special, as opposed to normal, methods and/or materials is required.

PABR 5.3 Table of Permissible Deviations

Classification	Permissible Deviation Degree of Accuracy	Corobrick Brick

	Item Finish	III mm	II mm	I mm	Guide
5.3.1	Stock brickwork				
	- against earth	20	15	10	NFX
	- to receive plaster	17	10	7	NFP
	- to be bagged	13	8	5	NFP
	- fairface	8	5	3	FBS
5.3.2	Faced brickwork with bricks				
	- generally uniform in shape and size	8	5	3	FBS
	- high degree of uniformity in shape & size	5	3	2	FBX
	- non-uniform in shape	13	8	5	FBA
5.3.3	Out of alignment with				
	Adjoining finishes on	4	3.0	15	FBS
	projecting items	3.5	2.5	1	FBX
	(windows & door frames)	5	3.5	2	FBA
5.3.4	Out of verticality of perps (dependent on bond)	40	15	5	
5.3.5	Out of alignment	2.5	2.0	1.5	FBS
	horizontally top edge to	2.0	1.5	1	FBX
	top edge adjoining bricks	3.0	2.5	2	FBA
5.3.6	Out of trueness vertically	2.5	2	1.5	FBS
	(top edge to lower edge	2.0	1.5	1	FBX
	Of next course)	3.0	2.5	2	FBA
5.3.7	Squareness of rooms - measured on the diagonals*	20	10	5	
5.3.8	Out of square or true of a corner or angle measured 300 mm from the angle*	7	4	2	

*A similar degree of accuracy will be required to irregular shaped rooms. The governing factor shall be the general appearance and it may be necessary or acceptable to depart from the above guidelines if required.

PABR 6 TESTING

PABR 6.1 Compressive Strength

Determination of the minimum average compressive strength of clay bricks shall be in accordance with SANS 227 at a frequency of 1 test per 5 000 bricks delivered to site. Should small quantities of brick be used for chambers and headwalls and the delivery rate is less than 5 000 bricks per batch, the Engineer may require one test per batch..

PABR 6.2 Costs of Tests

Costs of Tests described above shall be borne by the Contractor who shall be deemed to have included these costs in the scheduled rates for brickwork.

PABR 7 MEASUREMENT AND PAYMENT

PABR 7.1 Brickwork

Unit of measurement m²

The unit of measurement for all brickwork shall be the square metre of the specified type and thickness laid. The measurement of the work will be taken net, with door and window openings deducted, but will include for lintels, airbricks, etc.

The rates tendered for ordinary brickwork shall be inclusive of supply of bricks, brick force, lintels, airbricks, wall ties, damp proof course, mortar and everything necessary to erect the brick work shown on the drawings, and for testing, all plumbing of corners and faces, linings, levelling, ruling of joints, forming reveals and openings, cutting where necessary but not specially scheduled, supply and building in wall plugs, wall ties, etc, hoisting to various levels, soaking all bricks in water before laying, any selecting of face-bricks on site to maintain an even texture when laid and for cleaning down with spirits of salts all facework on completion.

Where lintels are not specified for bridging gaps, the rate provided shall include for shuttering/support of row of bricks constructed to form the “lintel”. No additional payment will be considered for this work.

PABR 7.2 Cills

Unit of measurement m

The unit of measurement for internal and external cills be the linear metre of cill installed. The rate shall include for all materials and work required to construct cills complete in accordance with the drawings and the schedules.

PABR 7.3 Door frames

Unit of measurement No

The unit of measurement for door frames shall be by number supplied and installed complete. The rate shall include for supply, delivery, storage and building into brickwork.

PABR 7.4 Doors

Unit of measurement No

Where doors are not measured under the carpentry section of the building portion of the BOQ, the following shall apply:
Doors shall be installed complete with hinges and locking mechanisms as specified, including preparation for corrosion protection or wood sealant and application of corrosion protection paint and wood sealant.

PABR 7.5 Louvres

Unit of measurement No

The unit of measurement for louvres shall be the number supplied and installed complete in accordance with the specifications and the drawings. The rate shall include for supply, delivery, storage, erection and installation in accordance with the specifications and the drawings.

ELECTRICAL INSTALLATION SPECIFICATION

PSEL 1 GENERAL SPECIFICATIONS

PSEL 1.1 Tests

After completion of the works and before first delivery is taken, a full test will be carried out on the installation, for a period of 30 days, to determine the satisfactory working thereof. During this period the installations will be inspected and the contractor shall make good, to the satisfaction of the Engineer, any defects which may arise.

The contractor shall provide all instruments and equipment required for testing and any water, power and fuel required for the commissioning and testing of the installations at completion.

Tests as stipulated in the " Occupational Health and Safety Act no. 85 of 1993, as amended, and in the "Code of Practice for the Wiring of Premises" SANS 10142-1 (as amended), must be done. These test report forms must be filled in fully and correctly in ink, signed by the installation electrician and handed to the Engineer or its representative.

Tests must be conducted on site after the whole installation is complete, unless written the Engineer to the contrary grants permission. The tests must include a full-load test for an adequate period to ensure the satisfactory working of the installation. If negative test results are obtained, faults must be rectified and tests again done.

The contractor must supply all testing apparatus, correctly calibrated.

All tests shall be carried out in conjunction with and to the satisfaction of the Supply Authority and in the presence of the Engineer or his representative. The contractor shall make all arrangements for testing and inspection, the costs thereof being included in the Tender Price.

Each length of cable shall be tested for insulation and polarity by means of a 1000 Volt insulation tester designed for that purpose. In the case of underground cables this shall be done before back filling. In addition, the earth-loop impedance of each conductor earth electrode shall be measured. The earth resistance shall be tested by means of an approved instrument.

"Danger" notices shall be displayed at remote ends of cables under test.
The contractor shall ensure that the installation is completed in every respect and that there are no major defects prior to notifying the Engineer (in writing) for a first delivery inspection.

The Engineer will accept zero minor defects during the final inspection. Should the number of defects be exceeded at the final inspection then the Engineer will terminate that inspection and request that the contractor arrange an additional final inspection.

PSEL 1.2 Maintenance of Installations

With effect from the date of the First Delivery Certificate the contractor shall at his own expense undertake the regular servicing of the installation during the Defects Liability Period and guarantee period and shall make all adjustments necessary for the correct operation thereof.

If during the said period the installation is not in working order for any reason for which the contractor is responsible, or if the installation develops defects, the contractor shall immediately, upon being notified thereof, take steps to remedy the defects and make any necessary adjustments.

Should such stoppages however be so frequent as to become troublesome, or should the installation otherwise prove unsatisfactory during the said period the contractor shall, if called upon by the Engineer or the Employer, at his own expense replace the whole of the installation or such parts thereof as the Engineer or the Employer may deem necessary, with apparatus specified by the Engineer or the Employer.

PSEL 1.3 Regulations

The installation shall be erected and tested in accordance with the Acts and Regulations as indicated in the scope of works.

The supply and installation of the work shall be in agreement with the Conditions of the Contract with special attention to the following in particular:

a) The Occupational Health and Safety Act no. 85 of 1993, as revised,

b) SANS 10142-1, "The Wiring of Premises Part 1: Low Voltage Installations".

c) SANS 10098-1 and 10098-2, "Public Lighting".

d) Government notices.

e) The local Municipal By-laws and any special requirements of the local supply authorities.

f) The local Fire Office Regulations.

g) Telkom Regulations

h) Any special conditions specified in this specification.

It must be clearly understood that, where differences in the Generals occur as stated in (a), (b), (c), (d), (e) and (f) or where additional requirements are required, the higher General requirements shall apply.

In the event of any contradiction between (a), (b), (c), (d), (e) and (f), then (f) shall be accepted above the rest.

Where any required by-law or regulation, which applies or becomes applicable during the execution of the electrical installation, is in conflict with the stipulation of the document, the former must have preference in all cases. The contractor must immediately notify the Engineer of such discrepancies.
The contractor may not make any alterations to the installation before written sanction to do so is received from the Engineer or its representative.

PSEL 1.4 Notices and Fees

The Contractor shall give all notices required by and pay all necessary fees, including any inspection fees, which may be due to the local Supply Authority.

On production of the official account, only the net amount of the fee charged by the Supply Authority for connection of the installation to the supply mains will be refunded to the Contractor by the Client.

The Contractor shall issue all notices and make the necessary arrangements with the Supply Authority, the local municipality, SANRAL and any other authority as may be required with respect to the installation.

PSEL 1.5 Schedule of Fittings

In all instances where schedule of light, socket outlet and power points are attached to or included on the drawings, these schedules are to be regarded as forming part of the specification.

PSEL 1.6 Quality of Materials

Only materials of first class quality shall be used and all materials shall be subject to the approval of the Employer. Specifications for various materials to be used on this Contract are attached to and form part of this specification.

Wherever applicable the material is to comply with the relevant South African National Standards, specifications, or to British Standard Specifications, where no SANS Specifications exist.

Materials wherever possible, must be of South African manufacture.

PSEL 1.7 Workmanship and Staff

Except in the case of electrical installations supplied by a single-phase electricity supply at the point of supply, an accredited person shall exercise general control over all electrical installation work being carried out.

The workmanship shall be of the highest grade and to the satisfaction of the Employer.

All inferior work shall, on indication by the Employer's inspecting officers, immediately be removed and rectified by and at the expense of the Contractor.

PSEL 1.8 Certificate of Compliance

On completion of the service, a certificate of compliance must be issued to the Employer's Representative/Agent per installation in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).

PSEL 1.9 Cable Sleeve Pipes

Where cables cross under roadways, other services and where cables enter buildings, the cables shall be installed in high-density polyethylene pipes or heavy duty class 34 uPVC sleeves with a wall thickness of not less than 1,5mm thick and a smooth finish inside.

The ends of all sleeves shall be sealed with a non-hardening watertight compound after the installation of cables. All sleeves intended for future use shall likewise be sealed with a draw wire inserted.

Cable sleeves shall be provided where shown on the drawings and wherever necessitated by installation conditions. Sleeves shall be of steel water pipe when traversing railways sidings, heavy duty tarmac, loading areas, etc.; they shall be of other approved materials where traffic loading is lighter. Cable sleeves shall not be less than 100mm internal diameter unless specifically noted otherwise in the Project Specification; they shall be of continuously smooth bore with no snags or hitches en route and shall encompass only easy sweeping bends permitting the easy passage of the heaviest cable involved. No cable sleeve shall exceed **100** meters without a manhole draw position, unless authorized in writing by the Engineer.

Cable sleeves entering a floor cable duct shall be swept gently to the level of the bottom of the trench so that cables do not kink at entry to the trench. Cable sleeves brought to switchboards or distribution boards having no associated floor cable ducts, or brought to rising cable ducts shall be swept up easily so that the cable emerges vertically from the floor. In cases where the emerging cable is exposed to view, wooden dams shall be fitted round the cable at the top of the sleeve, and the floor screeded completely round the cable. The outer ends of cable sleeves entering buildings shall, after drawing in the cables, be water proofed with cable compound of low melting point.

Sweeping bends shall be installed where sleeves enter distribution boards. Sharp sleeve bends are not acceptable.
Cables attached to external walls must be placed in a recessed galvanized pipe from 300mm below ground level into the meter box or into roof spaces complete with brass bushes at both ends.

The ends of all sleeves shall be sealed with a non-hardening watertight compound after the installation of cables. All sleeves intended for future use shall likewise be sealed.

PSEL 1.10. Electrical Equipment

All equipment and fittings supplied must be in accordance with the specifications, suitable for the relevant supply voltage and frequency, and must be approved by the Employer's representative.

PSEL 1.11. Drawings

The drawings generally show the scope and extent of the proposed work and shall not be held as showing every minute detail of the work to be executed.

The position of power points, switches and light points that may be influenced by built-in furniture must be established on site, prior to these items being built in.

PSEL 1.12. Balancing of Load

The Contractor is required to balance the load as equally as possible over the multiphase supply.

PSEL 1.13. Service Conditions

All plant and equipment shall be designed for the climatic conditions appertaining to the service.

PSEL 1.14. Instrumentation & Associated Equipment

The installation and mounting of instrumentation must conform to the manufacturer's requirements.

All fittings to be supplied by the Contractor shall have the approval of the Engineer / Employer.

The instrumentation and equipment must be of the type listed in the Equipment Schedule.

PSEL 1.15. Earthing and Bonding

The Contractor will be responsible for all earthing and bonding of the building and installation. The earthing and bonding is to be carried out strictly as described in this specification and to the satisfaction of the Employer's representative.

PSEL 1.16. Maintenance of Electrical Supply

All interruptions of the electrical supply that may be necessary for the execution of the work will be subject to prior arrangement between the Contractor and the user Employer and the Employer's representative.

PSEL 1.17. Supply and Connection

The supply will be at 230 Volt 50Hz.

The Contractor must arrange with the employer for the installation of the feeder circuit breaker into the existing DB.

The Contractor will be responsible for the supply and installation of the circuit breaker and the supply cable from the existing DB to the LV distribution board (DB-A) housed within the kiosk. The circuit breaker size is shown on the schematic diagram and measured in the Bills of Quantities. The size and length of the cable is shown in the single line diagram and measured in the Bills of Quantities.

PSEL 1.18 Cables

The Contractor shall supply and completely install all distribution cables as indicated on the drawings, and listed in the Schedule of Cables.

The storage, transportation, handling and laying of the cables shall be according to first class practice, and the contractor shall have adequate and suitable equipment and labour to ensure that no damage is done to cables during such operations.

The cable-trenches shall be excavated to a depth of 1m deep below ground level and shall be 300mm wide for one to three cables, and the width shall be increased where more than three cables are laid together so that the cables may be placed at least two cable diameters apart throughout the run. The bottom of the trench shall be level and clean and the bottom and sites free from rocks or stones liable to cause damage to the cable.

The Contractor must take all necessary precautions to prevent the trenching work being in any way a hazard to the personnel and public and to safeguard all structures, roads, sewage works or other property on the site from any risk of subsidence and damage.
In the trenches the cables shall be laid on a 50mm thick bed of earth and be covered with a 150-mm layer of earth before the trench is filled in.

All joints in underground cables and terminations shall be made by means of approved epoxy-resin pressure type jointing kits. Epoxy-resign joints must be made entirely in accordance with the manufacturer's instructions and with materials stipulated in such instructions. Low voltage PVC cables are to be made off with sealing glands and materials designed for this purpose which must be of an approved make. Where cables are cut and not immediately made off, the ends are to be sealed without delay.

The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused and must be adequately supported at intervals during the whole operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed to approval after drawing in of the cables.

Backfilling (after bedding) of the trenches is to be carried out with a proper grading of the material to ensure settling without voids, and the material is to be tamped down after the addition of every 150mm. The surface is to be made good as required.

On each completed section of the laid and jointed cable, the insulation resistance shall be tested to approval with an approved type instrument of not less than 500 V for low tension cables.

Earth continuity conductors are to be run with all underground cables constituting part of a low voltage distribution system. Such continuity conductors are to be

stranded bare copper of a cross-sectional area equal to at least half that of one live conductor of the cable, but shall not be less than 4mm² or more than 70mm². A single earth wire may be used as earth continuity conductor for two or more cables run together, branch earth wires being brazed on where required.

The size of low voltage cabling is to be as per single line diagram and the routes to be determined on site.

Low voltage cables shall be PVC SWA PVC type with Copper conductors which shall comply with the requirements of SANS 1507 and those of the Quality Specification in all respects.

Tenderers must base their cost for trenching in earth. Payment for cable trenching having a greater volume than that specified for the purpose will not be considered except where extra excavations are necessary to by-pass obstacles such as water pipes, drains, large boulders etc. In all such instances the amount of the extra excavations must be agreed upon on site between the Engineer or his representative/agent and the contractor.
Cables shall be labelled, cable routes marked and terminated as per the requirements of the Quality Specification (Labels and Notices).

The electrical contractor shall determine the present cable routes of all existing underground cables as and when required for the contract work and shall allow for this requirement as part of his tender sum.

The dielectric shall consist of PVC suitable for general use, 600/1000V grade. It shall be distinctly coloured as detailed in Table I of SANS 1507 so as to identify the phase, neutral and earth conductors with the phase conductors being coloured red, white or blue, the neutral conductor black and the earth conductor green/yellow or green.
The whole of the dielectric shall be coloured - surface painting or a longitudinal coloured stripe is not acceptable.

PSEL 1.19. Tape Above Cable

For all cables, a coloured plastic-marking tape shall be installed 200mm above the cable. The tape shall be yellow, with red skull and crossbones with the words "ELECTRIC CABLE ". These markings shall not be more than 1m apart from centre to centre.

Low voltage cables, cable terminations and cable joints shall comply with the requirements of the Quality and Particular Specification.

PSEL 1.20. Excavation

The contractor shall be responsible for all trenching excavations unless specified to the contrary.

PSEL 1.21. Laying, Jointing And Making Off Of Electrical Cables

1. The use of the term “Inspector” includes the engineer or inspector of the Employer or an empowered person of the concerned supervising consulting engineer’s firm.
2. No cable is to be laid before the cable trench is approved and the soil qualification of the excavation is agreed upon by the Contractor and inspector.
3. After the cable has been laid and before the cable trench is back-filled the inspector must ensure that the cable is properly bedded and that there is no undesirable material included in the bedding layer.

4. All cable jointing and the making off of the cables must only be carried out by qualified experienced cable jointers. Helpers of the jointers may not saw, strip, cut, solder, etc. The cable and other work undertaken by them must be carried out under the strict and constant supervision of the jointer.
5. Before the Contractor allows the jointer to commence with the jointing work or making off of the cable (making off is recognized as half a joint) he must take care and ensure:
6. That he has adequate and suitable material available to complete the joint properly and efficiently. Special attention must be given to ensure the cable ferrules and cable lugs are of tinned copper and of sufficient size. The length of the jointing lugs must be at least six times the diameter of the conductor,
7. That the joint pit is dry and that all loose stones and material are removed,
8. That the walls and banks of the joint pit are reasonable firm and free from loose material which can fall into the pit,
9. That the necessary coffer-dams or retaining walls are made to stop the flow of water into the joint pit,
10. That the joint pit is provided with suitable groundsheets so that the jointing work is carried out in clean conditions,
11. That the necessary tents or sails are installed over the joint pit to effectively avert unexpected rainfall and that sufficient light or lighting is provided,
12. That the necessary means are available to efficiently seal the jointing or cable end when an unexpected storm or cloudburst occurs, regardless of how far the work has progressed,
13. That the cables and other materials are dry, undamaged and in all respects are suitable for the joint work or making off,
14. The jointer must ensure that the material and his tools are dry at all times, reasonably clean and absolutely free from soil.
15. Relating to the jointing of the cable the following requirements apply:
16. All jointing must be carried out in accordance with recognized and tried techniques and comply strictly with the instructions given by the supplier of the jointing kit.
17. As far as cable end boxes are concerned the requirements as set out above are valid where applicable.

PSEL 1.22. Low Voltage Kiosks

All low voltage kiosks and equipment shall comply with the requirements of the General Specification with project specific requirements in the Particular Specification.

Before the commencement of manufacture, detailed drawings of the proposed panels and boards are to be submitted to the Engineer or his representative/ agent for approval. Full schematic details of the layout and wiring of the boards are to be provided with these drawings.

Kiosks, constructed of 30mPa re-enforced concrete, shall be waterproof and spacious enough to accommodate all equipment as described in the schedules. Any sheet metal shall be galvanized. Welding materials shall be of the same quality as the base metal.

The standard door shall be cold rolled mild steel plate of 5mm thickness, hot

dipped galvanised, with Cross arm strategically placed to stiffen the inside of the door. Doors shall open 120° and shall be fitted with locking mechanisms. The locking mechanisms shall be of the double throw dead bolt type and shall be keyed alike or as per the client's requirements.

The gland plate shall be manufactured of 3CR12 stainless steel of 1.6mm thickness. Sufficient holes shall be pre-punched for the number and sizes of cables specified.

The finish of all kiosks on the interior and exterior and on the panels on which switch gear is to be mounted shall be of a high quality and shall be suitable for exterior use. All Galvanising shall be applied to surfaces prepared in accordance with SANS 121/ISO1461.
Mounting shall be on a concrete plinth of adequate size to provide a skirt of at least 100mm around the unit. The plinth shall be of adequate thickness to protrude 100mm above ground while installed to a minimum depth of 300mm below ground level. The earth shall be properly compacted to prevent the unit from tiling or subsiding.

All equipment in the kiosk shall be surface mounted onto a 3CR12 stainless steel mounting plate of 1.6mm thickness. This mounting plate shall be fixed by means of fixings at the bottom and top of the plate.

A solid copper bus bar shall be provided for each phase and neutral and shall be mounted on appropriately coloured ceramic or similar insulators. The colours of insulators shall correspond with the phase colours that are red, yellow, blue and black for the neutral. Bus bars shall be easily reachable. Bus bars shall be suitably rated for the full load capacity as indicated on the single line diagrams.

A 200mm x 50mm x 4mm solid copper-earthed bus bar shall be installed with a minimum of five, 4mm bolts, complete with spring washers, brass washers and nuts. The bus bar shall be provided with internal thread and the heads of the bolts shall be soldered in position at the back.

The gland plate shall be bonded to the earth bar through a 35mm² stranded copper conductor.

The LV cables shall rise into the unit from below through a plinth opening and shall be fitted to the gland plate with suitable glands. The individual cores of the cables shall be equipped with lugs and connected to the bus bars.

Services shall be connected to the three phases to provide a balanced load as far as possible.

All wiring shall be neatly bundled with nylon ties and shall be arranged in horizontal and vertical directions only.

All meters and circuit breakers shall be labelled with engraved plastic labels at least 1mm thick with 12mm letter size labels and shall be fitted to slide in frames.

All kiosks shall be clearly marked to indicate the name and/or number of the kiosk and from where the kiosk is fed and the size of the feeder cable.

Danger notices type WS7 to SANS 1186 manufactured from plate aluminium, measuring approximately 150mm x 150mm, shall be fitted to each door in a central easily visible position.

Brass bolts and nuts shall be used to mount all ancillaries.

Full particulars consisting of informal drawings, indicating size, construction and material used shall, however, be provided for approval before manufacture of the kiosk.

PSEL 1.23 Labelling

All Luminaires, poles, Mini subs and Distribution kiosks shall be labelled as specified in the Particular Specification (Labels and Notices).

Labels must indicate the functions of equipment and components in the distribution boxes and/or distribution boards.

The terminology on the identification labels must be in English.

The contractor shall arrange for the labelling of all equipment, instruments, meters, relays, cables, etc., as indicated below.

All labels shall be of a non-corrosive material or other back engraved white on black labels of the sizes indicated. They are to be located in purpose made holders or otherwise are to be screwed or riveted into position. "Dymo" tape or similar labels will not be accepted nor will labels, which are glued in position only.

Under no circumstances is equipment to be labelled in accordance with the tender drawings since any description thereon is for identification purposed during construction only and is unlikely to apply to the completed Works.

The following list indicates the general labelling requirements but does not limit the extent of labelling required, which shall encompass the full extent of the equipment supplied, or in the case of existing equipment, any such which is affected by this Contract.

50mm high lettering: -

- Distribution kiosk

20mm high lettering: -

- Main or sub-main board designation.

12mm high lettering: -

- Distribution kiosk feeder breakers and isolators.
- Feeder Cables

This label shall be used to designate the conductor size and number of cores of each cable installed under this Contract. In addition, all feeder cables shall be labelled at both ends indicating from where/to cables are feeding.

All kiosks shall be provided with a label in both official languages reading "In case of leakage or accidental contact, put off main switch immediately".

All kiosks shall be provided with notices as required by the Occupational Health and Safety Act. All doors to such locations shall be fitted with the appropriate notices.

PSEL 1.24. Liaison

The electrical contractor shall, in each case, provide the main contractor with all necessary information, dimensions, materials, etc., as called for in the specification, in good time.

It is essential that the electrical contractor work in close collaboration with the principal contractor to ensure that where his services run in proximity with other services, there are no clashes.

Failure to comply with the above may mean that corrective measures will have to

be taken to correctly position the equipment. Any abortive work resulting will be entirely to the electrical contractor's account.

Where the electrical contractor is to provide electrical supplies to control panels forming part of other contract works, it is essential that the electrical contractor liaise fully with the particular contractor who must provide the electrical contractor with all information necessary so as to ensure that the supply cable terminates in the correct position and that the phase rotation complies with the equipment installed.

Failure to do so may result in the electrical contractor being held responsible for the cost of removing and replacing not only his own but also the equipment of the main contractor and other contractors.

PSEL 1.25. Supervisory Staff and Identification

All work done on site shall at all times be under the direct and full-time supervision of a contract manager who shall be a qualified installation electrician who will sign the certificate of compliance.

Full particulars of the site organisation, complete with names of officials the Tenderer proposes to allocate to this project are to be submitted with this tender. For the duration of this contract the above detailed officials will be permanently assigned to this project and may only be relieved of their duties after prior agreement by the Engineer or his representative/agent.

Whilst on the site all staff and labourers employed by the electrical contractor shall wear distinctively marked clothing bearing the name of the electrical contractor or his identification logo.

PSEL 1.26. Setting Out of Works

The electrical contractor shall be responsible for marking out and setting out of all equipment and plant.

The position of items of electrical equipment and plant indicated on the drawings are to be taken as approximate. The exact position for fixing shall be obtained by site measurements.

In case of doubt, decisions shall be obtained from the Engineer or his representative/agent.

PSEL 1.27 Erection of Equipment

The contractor shall be responsible for the erection and installation of all equipment supplied by him under this contract.

In addition, the contractor shall be responsible for the care and maintenance of all electrical equipment after erection is completed until the first delivery of the specific section of the works. He shall ensure that the proper enclosure of all equipment is maintained at all times, that access doors and covers are opened only when necessary to work on the equipment and replaced afterwards, that the paint finish on all items is effectively protected and that all unused cable and conduit entries are effectively sealed.

PSEL 1.28. Certificate of Compliance by an Accredited Person

On completion of the electrical installation the contractor shall complete the Certificate of Compliance for the electrical Installation in the form of Annexure 1 as described in the Occupational Health and Safety Act no. 85 of 1993, as amended, and obtainable from the Department of Labour of South Africa. This form must be

handed to the Engineer or its representative.

PSEL 1.29. Material

Materials and equipment used in this installation must be of the best quality of their respective types, must meet the relative SANS or BSS specifications and must be installed to the satisfaction of the electrical Engineer or his representative.

The contractor will be informed in writing if any material or workmanship is not of the required quality. In such a case, the contractor must replace the material concerned or repair the installation to the satisfaction of the Engineer or its representative.

If requested to do so, the contractor must provide samples of materials or equipment, for the approval by the electrical Engineer, before it may be installed. The samples will be kept for comparison with materials and equipment actually installed and will be returned after the contract has been satisfactorily completed.

PSEL 1.30. Delivery and Completion

All contract materials shall be ordered timeously and delivered to site at dates suited to the agreed construction program.

The successful Tenderer for the installation will be required to commence work immediately following notification of tender acceptance, and shall thereafter at all times maintain the progress required by the agreed completion program.

PSEL 1.31. Drawings

On completion of the project update the drawings with any changes made during the course of the contract works and furnish the Engineer / client with the necessary prints for record purposes.

PSEL 1.32. Levelling and Plumbing

All equipment shall be carefully levelled and plumbed, checked with a spirit level. Should any equipment be unsatisfactorily installed in this respect it shall be dismantled and reinstalled, the costs of making good to damaged structures, plaster and paint will be for the account of the contractor.

It must be noted that boxes for imported accessories must be levelled and plumbed when installed, since the inserts cannot be levelled independently of the boxes.

PSEL 1.33. Installation of Cables

PSEL 1.33.1 General

All cable sleeves, manholes and cable markers are to be provided by the contractor unless otherwise specified. Others will provide cable ducts in the floors of buildings unless otherwise specified.

Cable run indoors shall be supported on cable trays or cable rack, secured thereto by heavy duty plastic strapping. The cables shall be fixed at intervals not greater than those stipulated in SANS 10142 and shall be spaced sufficiently to avoid de-rating in terms of SANS 10142 – 1. Cables shall be individually fixed so that any one may be removed from a group without disturbing the others.

Cables installed in trenches shall be installed at a depth of 1000mm below final ground level. All cable depth measurements shall be made to the top of the cable when laid directly in ground or to the top of the duct or sleeve where these are provided.

The contractor may only deviate from the above depth provided prior authority in writing has been obtained from the Engineer.

Every run of cable shall be a single length without joints. Say that where a run exceeds the general drum length of where the length of a run is increased after the cable is delivered on site, a through box will be permitted. Such through boxes shall be so placed as to afford easy access for maintenance and repair; when they are required in underground cable runs the contractor shall provide special cable markers to locate them.

All cable tails shall be provided with either cable lugs or ferrules as may be appropriate. At each sealing end straps-on cable markers shall be fixed, showing clearly and indelibly the number and size of cable cores and the destination of the cable.

PSEL1.33.2 Cable routes

Cables shall follow the routes shown on the drawings; the routes shall only be varied with the written permission of the Engineer. Where no routes are defined on the drawings the contractor may select routes to his reasonable preference but shall obtain written approval of them before installing the cables.

The contractor shall, before trenching commences, familiarizes him with the routes and site conditions and the procedure and order of doing the work shall be planned in conjunction with the general construction program for other services and building requirements.

The contractor shall acquaint himself with the position of all the existing services such as storm water pipes, water mains, sewer mains, gas pipes, telephone cables, etc. before any excavations are commenced. For this purpose, he shall approach the Engineer's representative, the local municipal authority and any other authority which may be involved, in writing.

The Engineer reserves the right to alter any cable route or portion thereof in advance of cable laying. Payment in respect of any additional or wasted work involved shall be at the documented rates.

PSEL1.33.3 Trenching

Trenching shall be programmed in advance and the approved program shall not be departed from except with the consent of the Engineer.

The contractor will be held responsible for damage to any existing services brought to his attention by the relevant authorities and shall be responsible for the cost of repairs.
The contractor shall take all the necessary precautions and provide the necessary barriers, warning signs and/or lights to ensure that the public and/or employees on site are not endangered.

The contractor shall ensure that the excavations will not endanger existing structures, roads, railways, other site constructions or other property.

Trenches shall connect the points shown on the drawings in a straight line. The Engineer beforehand shall approve any deviations due to obstructions or existing services.

Trenches shall be as straight as possible and shall be excavated to a depth of **1000mm x 300mm wide.**

The bottom of the trench shall be of smooth contour, and shall have no sharp dips or rises, which may cause tensile forces in the cable during back filling.

The excavated material shall be placed adjacent to each trench in such a manner as to prevent nuisance, interference or damage to adjacent drains, gateways, trenches, water furrows, other works, properties or traffic. Where this is not possible the excavated materials shall be removed from site and returned for back filling on completion of cable lying.

Trenches across roads, access ways or footpaths shall not be left open. If cables cannot be laid immediately the contractor shall install temporary “bridges” or cover plates of sufficient strength to accommodate the traffic concerned.

In the event of damage to other services or structures during trenching operations the contractor shall immediately notify the Engineer and institute repairs.
Prior to cable laying the trench shall be inspected thoroughly and all objects likely to cause damage to the cables either during or after lying shall be removed.

Where ground conditions are likely to reduce maximum current carrying capacities of cables or where the cables are likely to be subjected to chemical or other damage or electrolytic action, the Engineer shall be notified before installing the cables. The Engineer will advise on the course of action to be taken.

Extreme care shall be taken not to disturb surveyor's pegs. These pegs shall not be covered with excavated material. If the surveyor's pegs are disturbed, a person qualified to do so shall replace them.

PSEL1.33.4 Backfilling

The contractor shall not commence with the backfilling of trenches without prior notification to the Engineer so that the cable installation may be inspected. Should the contractor fail to give a timeous notification, the trenches shall be re-opened at the contractor's cost. Such an inspection will not be unreasonably delayed.

For all cables, a coloured plastic-marking tape shall be installed 200mm above the cable. The tape shall be yellow, with red skull and crossbones with the words "ELECTRIC CABLE". These markings shall not be more than 1m apart from centre to centre.

Back filling shall be undertaken with soil suitable to ensure settling without voids. The maximum allowable diameter of stones present in the back fill material is 75mm.

The contractor shall have allowed in his tender for the importation of suitable backfill material if required.

The backfill shall be compacted in layers of 150mm and sufficient allowance shall be made for final settlement. The contractor shall maintain the refilled trench at his expense for the duration of the contract. Surplus material shall be removed from site and suitably disposed of.

On completion, the surface shall be made good to match the surrounding area.
In the case of roadways or paved areas the excavations shall be consolidated to the original density of the surrounding material and the surface finish reinstated.

PSEL 1.34. Electrical Cables

PSEL 1.34.1 General

All low voltage underground cables shall be stranded copper-core, 600/1000 Volt grade, multi-cored, PVC insulated, PVC covered, wire armoured (PVC/PVC/SWA). All cables shall comply with SANS 1507 as amended, where applicable. Cables shall be of new stock and must still be sealed when brought on site. If these conditions are not met it may lead to the cables being removed from the site and

their being replaced with the correct type all at the contractor's expense.

The contractor must do all measuring on site himself in respect of lengths of cable, earth wires and trenches required. The lengths given in the schedules are only allowed for tender purposes. Payments will only be made for the lengths of cable actually installed and at the tendered tariffs. In their tenders, Tenderers must allow for cut-off lengths of cables and bends.

The storage, transport, handling and laying of cables must conform to approved and acceptable practice and must meet the requirements of SANS 10198 as amended. Cables which are cut and left open for a period of time before being coupled must be sealed in the prescribed manner. When such cable ends are flooded by water they must be subjected to the tests prescribed by the Engineer.

The contractor shall have adequate suitable equipment and labour available to prevent damage to cables.
Before the cable is installed, the cable trenches must be carefully inspected and any objects, which may damage the cable during or after installation, must be removed.

PSEL 1.34.2 Sealing glands for PVC insulated cables

The sealing glands must consist of a sleeve in which a conical bush screws into one side and a nickel-brass or galvanized steel lock nut is situated on the other side. The galvanizing must meet SANS 763 as amended standards. The sleeve must have a hollow groove on the side on which the cable enters the sleeve to house the top ring of the waterproofing mantle.

The waterproofing mantle must be manufactured from non-weathering neoprene or other synthetic rubber and must be proof against water, oil and sunlight. These mantles must fit snugly over the sealing glands and the cables.

Sealing glands must have a 150-screw thread and must be suitable for the specified cable sizes.

PSEL 1.34.3 Cable joints

Cable joints are not permissible except where specifically approved. No joints will be allowed where the specified length of cable appears on a drum.

PSEL 1.35. Kiosk

The technical specifications of the kiosk shall comply with all relevant SANS standards.
The Kiosk to be suitable for outdoor use, and shall be of concrete construction. Vandal resistant locking mechanism shall be included as part of the kiosk.

The kiosk shall be earthed by means of an earth spike/s and 35mm² earth wire. Earthing to be carried out and tested in terms of SANS 10142. If earth resistivity is not achieved, further earth spikes and or earth wire to be installed to achieve the specified minimum readings.

Kiosk to be provided with 2 x locks. All Locks provided for kiosks under this package to be of the Master lock and key type or as per client requirements.
Each kiosk shall include equipment as per details shown on the drawings and schematic diagram.

PSEL 1.36. Shop Drawings

As soon as is possible after the contract has been awarded to him, the contractor must submit the following drawings to the Engineer for approval:

Design and construction drawings of all:

- Electrical equipment
- Electronic equipment
- Distribution Boards
- Distribution kiosks

The following information must appear on the drawings:

a) A full layout with the arrangement of the equipment and the distribution boards or kiosks, and on which all measurements of the equipment and the construction is indicated.

b) The position, fastening method and current rating of the bus bars.

c) The make, catalogue number and capacity of insulators, circuit breakers, fuses, contactors, etc.

d) Workshop drawings of the distribution board layout that is mounted on the inside of the kiosk.

The Engineer's approval of these drawings does not release the contractor from his responsibility to supply the correct equipment in terms of this contract.

PSEL 2 PARTICULAR SPECIFICATION

PSEL 2.1. Scope of Works

This sub-contract is for the supply & installation of electrical infrastructure for the EThekwini Water & Sanitation Emona Reservoir project.

The scope of works includes the supply and installation of:

- Electrical infrastructure at the reservoir site.

The installation shall be to the following codes and standards:

- SANS 10142-The wiring of premises Part 1: Low-voltage installations
- EThekwini Water & Sanitation

The Electrical work shall include inter alia:

- Supply & install main supply circuit breaker and cabling to the metering kiosk
- Supply & install the kiosk and all associated electrical equipment within it.
- Test & Commission the entire system.
- As-built drawings and documentation on changes to the installation
- Maintain the system for the duration of the latent defects period.

These aspects should be seen only as a brief summary of the scope of the work and not as a complete record. Quantities and volume of work shall also be read or obtained from the drawings, bills of quantities and the rest of the specification.

PSEL 2.2 Cable Installations

PSEL 2.2.1 General

Trench excavations must comply with the requirements of SANS 1200 LC and SANS 1200 DA.

Every trench must be kept as straight as possible and must be dug to approved levels and measurements. The bottom must have an even contour.

Trenches dug close to railway lines, walls, roads, drains, pipes, cables, structures and on similar places where the danger of sagging exists, must be secured against such dangers and it must be done in such a way as to prevent possible injuries to construction personnel and the public. All these excavations must be done to the satisfaction of the Engineer and the public authorities concerned.

Bedding materials may not be laid until the trench has been approved by the Engineer. The Engineer might expect proof from the contractor that the minimum depth of bedding material is provided before giving authority for the cables to be laid.

PSEL 2.2.2 Safety

The contractor must at all times provide proper and adequate precaution and safety arrangements on site. Should the contractor fail to comply with this requirement, the Engineer will take the necessary steps to ensure that this requirement is met and any costs incurred will be for the contractor's account. Complying with this requirement does not exonerate the contractor of his responsibilities and duties in accordance with the Occupational Health and Safety Act (Act 85: 1993) and mines and Industries Act of 1956, (Act 27: 1956). Symbolic safety signs must comply with the applicable requirements of SANS 1186.

PSEL 2.2.3 Minimum Base Width of Trenches

Each trench must be excavated in a way that half the specified width will be left on both sides of the designated centre line of the cable or group of cables. The trench width must be adequate for the proper compacting of the fill materials when backfilling is done. (In the case of trenches for cable sleeves or ducts, see sub clause 5.1.1 of SANS 1200 LC).

PSEL 2.2.4 Cleaning of Route

The contractor must clean an area wide enough to ensure that his inspection is not obstructed along the cable trench as specified in SANS 1200 C. In cases where the cable trench falls within a servitude or passage-way of specified width, the damage to the vegetation of the named servitude or passage-way must be limited.

PSEL 2.3 Backfilling

PSEL 2.3.1 LV Cables

In trenches containing one or more low voltage cables, the approved fill material must be cautiously placed, in layers of 100mm un-compacted depth, throughout the width of the trench and then compacted to a minimum compacted depth of 150mm as specified in the Particular specifications.

PSEL 2.3.2 Compaction

In areas which is specified in the project specifications the trenches must be refilled in layers of maximum 150mm depth (after compaction) and in case of soil sticking together (clay material) it must be compacted up to 93% of the modified AASHTO-density or in the case of non-sticky soil (sandy material) up to 98% of the modified AASHTO-density.

Machine compaction will not be permitted directly above the cable(s) or sleeve(s) before a layer of 300mm depth fill material has been placed on top of the cable(s) or sleeve(s). The machine compaction must be conducted in such a way that the forces superimposed on the cable(s) or sleeve(s) does not exceed that superimposed by ordinary pedestrians or light vehicle traffic when the cover is already 1 m deep. If road traffic is involved, the cable(s) must be protected by a

cable-way or -sleeve of at least 100mm in diameter, through which the cable(s) can be drawn at any time. Cable-ways beneath subways must be cast in concrete in a suitable way, if it is required by the project specifications.

PSEL 2.3.3 Cables at Different Depths

In situations where cables are laid at different depths in a common trench, the same procedure for placing and compaction of the approved fill material beneath and on top of the upper cable applies as for the lower cable.

In situations where cables have to be laid on top of each other the high voltage cables must be laid under the low voltage cables. (See drawing LC-1 in SANS 1200 LC).

PSEL 2.3.4 Conduct with respect to Obstructions

In cases where obstructions are encountered during excavation that demands changes to the trench or a special kind of trench, the contractor must have the Engineer's approval to implement such changes before laying the cable(s).

PSEL 2.4 Excavated Material

PSEL 2.4.1 Stacking

The excavated material must be placed along the trench in such a way that it does not obstruct or damage adjacent fences, trees, drains, gate openings and other properties and must be heaped up in such a way that traffic is not obstructed. Should this not be possible, the material must be removed from site, with the Engineer's approval and brought back later to backfill the trench after the cable(s) has been laid.

Surplus material must be removed by the contractor and on the contractors own expense.

PSEL 2.4.2 Admittance to Properties on Cable Routes

Unless otherwise specified in the project specifications, the contractor must (on his own expense) provide owners, inhabitant and their vehicles with reasonable access to their properties which may be situated adjacent or near the cable route(s).

PSEL 2.4.3 Transport of Cable Drums

Cable drums must be carefully transported to prevent damage to the cables and to prevent disturbing the cables. Damaged cables will be rejected. Drums may not be off-loaded by simply allowing them to roll off the back of the truck onto the ground. Drums may only be rolled in the direction as indicated by the arrow painted on the drum by the manufacturer. (This will ensure that the correct tension is maintained and prevent the cable from damage later). Every drum may only have one cable length on it. Proper attention must be given to where the drums are to be off-loaded in order to prevent unnecessary moving thereof, eg. at joint locations.

PSEL 2.4.4 Handling of Drums on Site

Note: It is recommended that a correctly designed spreader must be used to load and unload the drums with a crane.

Every drum must be mounted on jacks or on a cable-drum trailer with a horizontal supporting beam of suitable size and strength to handle the width and weight of the drum. The drum may not be allowed to rotate freely when the cable is rolled off. (Free rotation causes the cable to twist and loosen the windings, which can

cause the inside armouring/insulation of the cable to be stretched). The cable must enter the trench from the top of the reel. All cables ends including that left on the drum or in a trench must be sealed to prevent the penetration of moisture into the cable. The free cable end on the drum must be fastened to the side of the drum.

PSEL 2.4.5 Rollers

Rollers must be used when each cable is layed and must be carefully placed in the trenches to make sure the cable only lies on the rollers when it is pulled in.

PSEL 2.4.6 Communication

The contractor must ensure good communication between the operators at the pulling end and at the reel end of the cable while laying the cable(s).

PSEL 2.4.7 Pulling of Cable

The cable may be pulled by hand or by a wrench, but the maximum tension in the cable as specified by the manufacturer, may not be exceeded. A cable grip must be used to pull the cable, but if specified by the project specification, a loop connected to the cable cores and sheathing must be used. A twist connection must be used between the loop and the rope used to pull the cable. In cases where cables have to be drawn around corners, well lubricated skid-plates or special corner rollers must be used. Skid-plates and rollers must be firmly secured and must be inspected regularly throughout the cable laying process to ensure that they work properly.

PSEL 2.5 Cable Bends

No cable bend may have a smaller radius than the minimum radius specified by the cable manufacturer. This radius shall never be less than the radius prescribed by the relevant SANS specification.

PSEL 2.6 Cables Laid in Sleeves, Cable Ways, Etc

Cables laid under hardened areas must be laid through sleeves or cable-ways that are strong enough to withstand the expected shock loads applied by traffic. The laying of cable-ways and sleeves must comply with the applicable requirements of SANS 1200 LB and SANS 1200 LC. After the cable-ways and sleeves had been laid, they must be cleaned thoroughly to remove roughness and sharp edges that can damage the cable. The ends of spare sleeves and cable-ways must be properly sealed and if the project specification requires a pull wire, this must be installed. The position of these sleeves and cable-ways must be identified in the project specifications.

PSEL 2.7 Spacing Between Cables And Other Services

The minimum spacing between electrical cables and other services must be in accordance with the project specifications.
In case of trenches used for a number of electrical cables the minimum horizontal free space required to prevent de-rating of the cables, are as follows:

a) In the case of cables with a conductor size of not more than 70mm2: 75mm

b) In the case of cables with a conductor size of at least 70mm2: 150mm

PSEL 2.8 Kiosk

All distribution kiosks and equipment shall comply with the requirements of the General Specification with project specific requirements in the Particular Specification.

General Requirements
Before the commencement of manufacture, detailed drawings of the proposed kiosk and boards are to be submitted to the Engineer or his representative/ agent for approval. Full schematic details of the layout and wiring of the boards are to be provided with these drawings.

PSEL 3 CONSTRUCTION MATERIAL

Enclosure Material (shell & roof)	30mpa 10mm Re-enforced 42,5N Power Crete
Door	4.6mm 3CR12
Gland Plate	1.6mm 3CR12
Inner equipment mounting plate	1.6mm 3CR12

Kiosks, constructed of 30mPa re-enforced concrete, shall be waterproof and spacious enough to accommodate all equipment as described in the schedules.

Any sheet metal shall be galvanized. Welding materials shall be of the same quality as the base metal.

The door shall be 3CR12 stainless steel with thickness of 4.6mm with cross arm strategically placed to stiffen the inside of the door. The door shall be powder coated to a colour approved by the Engineer. Doors shall open minimum 90° and shall be fitted with locking mechanisms. The locking mechanisms shall be of the double throw dead bolt type and shall be keyed alike or as per the client's requirements.

The kiosk shell must be bolted onto the concrete plinth from the inside of the enclosure.

Nothing must obstruct the operator from operating the switchgear when doors are opened. The enclosure shall be weather proof and safe to operate in any weather condition

The enclosure shall be robust enough to prevent tampering.

The kiosk shall have on the roof, 4 x threaded slots to receive M16 lifting hooks,

Enclosures shall be properly prepared in the correct manner and and stainless steel to be powder coated for protection against corrosion.

The Enclosures shall be adequately protected against rust, dust and corrosion both from inside and outside.

The fabrication of material shall be done in such a way that there is a good finish of fabricated/moulded material. The material shall be fabricated/moulded accurately to adhere to dimensions as per the drawings

The enclosure shall be fabricated / welded such that the rain water does not enter the enclosure.

The Enclosure shall be constructed to allow adequate dissipation of heat. Ventilation of the enclosure shall not compromise the security of the enclosure and the equipment housed there-in. Ventilation shall be adequate to allow that all installed equipment inside the enclosure shall operate normally in temperatures between -10ºC and 60ºC.

The gland plate shall be manufactured of 3CR12 stainless steel of 1.6mm thickness. Sufficient holes shall be pre-punched for the number and sizes of cables specified.

PSEL 3.1 Mounting

The finish of all kiosks on the interior and exterior and on the panels on which switch gear is to be mounted shall be of a high quality and shall be suitable for exterior use. All Galvanising shall be applied to surfaces prepared in accordance with SANS 121/ISO1461.

Mounting shall be on a concrete plinth of adequate size to provide a skirt of at least 100mm around the unit. The plinth shall be of adequate thickness to protrude 75mm above ground while installed to a minimum depth of 300mm below ground level. The earth shall be properly compacted to prevent the unit from tiling or subsiding.

All equipment in the kiosk shall be surface mounted onto a 3CR12 stainless steel mounting plate of 1.6mm thickness. This mounting plate shall be fixed by means of fixings at the bottom and top of the plate.

A solid copper bus bar shall be provided for each phase and neutral and shall be mounted on appropriately coloured ceramic or similar insulators. The colours of insulators shall correspond with the phase colours that are red, yellow, blue and black for the neutral. Bus bars shall be easily reachable. Bus bars shall be suitably rated for the full load capacity as indicated on the single line diagrams.

PSEL 3.2 Earthing

A 200mm x 50mm x 4mm solid copper-earthed bus bar shall be installed with a minimum of five, 4mm bolts, complete with spring washers, brass washers and nuts. The bus bar shall be provided with internal thread and the heads of the bolts shall be soldered in position at the back.

The gland plate shall be bonded to the earth bar through a 35mm² stranded copper conductor.

PSEL 3.3 Wiring

The LV cables shall rise into the unit from below through a plinth opening and shall be fitted to the gland plate with suitable glands. The individual cores of the cables shall be equipped with lugs and connected to the bus bars.

All internal cabling and wiring shall be neatly bundled with nylon ties, be housed within suitable PVC trunking and shall be arranged in horizontal and vertical directions only.

PSEL 3.4 Labelling

All meters and circuit breakers shall be labelled with engraved plastic labels at least 1mm thick with 12mm letter size labels and shall be fitted to slide in frames.

All kiosks shall be clearly marked to indicate the name and/or number of the kiosk and from where the kiosk is fed and the size of the feeder cable.

Danger notices type WS7 to SANS 1186 manufactured from plate aluminium, measuring approximately 150mm x 150mm, shall be fitted to the door in a central easily visible position.

PSEL 3.5 Fixings

All set screws, nuts and spring washers for fitment of different parts or equipment inside the enclosure shall be stainless steel.

PSEL 3.6 Documentation

Full particulars consisting of informal drawings, indicating size, construction and material used shall, however, be provided for approval to the Engineer before manufacture of the kiosk.

PSEL 3.7 Distribution Board

The Kiosk shall house DB-A

DB-A to be a 12-way Distribution board and is to be in a PVC, surface mounted IP65 enclosure, standardised and manufactured for single phase supply.

DB-A shall include the following equipment as per details on the drawings and schematic:

1 x 40A Double pole switch-disconnector
2 x 20A Circuit breaker
1 x 63A 30mA Earth Leakage unit (no overload protection)
1 x 1P+N Fuses
1 x 1P+N Surge Arrestor

Each Kiosk shall be fitted with, on it's mounting plate, the following equipment as per details on the drawings and schematic:

1 x Weatherproof, IP65 16A double switched socket outlet
1 x Weatherproof, IP65 20A Double Pole isolator
1 x 5.5A, 150W Power Supply Unit (Meanwell AD-155B)
1 x 12V 45Ah Sealed Battery
1 x Free-issue IP 67 Flow Transmitter (Endress and Hauser Prosonic 93C or similar)
Spare Space for 1 x IP 67 Flow Transmitter (Endress and Hauser Prosonic 93C or similar)

PSEL 4 SYSTEM AND SERVICE CONDITIONS

The equipment and installation shall be for outdoor use in Greater EThekwini Municipal area of supply and shall be suitable for:

(a) Climate:	Coastal
(b) Altitude:	from sea-level to 50m
(c) Ambient temperature:	from -5°C to 40°C
(d) Pollution level and type:	Coastal & Industrial
(e) Maximum relative humidity:	60 %
(f) Mean annual value of solar radiation:	1, 0 kW/m2
(g) Average total annual rainfall:	1 000 mm

PSEL 5 SCHEDULE OF DRAWINGS

The following drawings are part of the tender and should be priced accordingly.

Drawing No.	Title
DNA-ELE-1000-01	Typical Metering Kiosk Detail
DNA-ELE-1000-02	Typical Trench Details

From	To	Cable Size / Type	Cable Length	By who
Existing DB	Kiosk	4mm² 3 Core	100m	Electrical

	DB-A	Cu PVC/PVC/SW A		Subcontractor
FlowMeter01	Flow Sensor	Flow Meter sensor cable	≤ 30m	Instrumentation Specialist

PSEL 6 CABLE SCHEDULE

PSEL 7 EQUIPMENT SCHEDULE

Item	**Make**	**Model**
Distribution Board	CBI or Equivalent	12-Way, 230V, 5kA
Isolator	Allbro	20A, 2-Pole, WP
Socket Outlet	Allbro	PSO2/A
Ultrasonic Flow Transmitter (Free-Issue)	Endress & Hauser or similar	Proline Prosonic Flow 93C Transmitter or similar
Ultrasonic Flow Sensor (Free-issue)	Endress & Hauser or similar	Proline Prosonic Flow 93C Sensors or similar
Power Supply	Meanwell	AD155B
Battery		12V 45Ah

PSMA METER SPECIFICATIONS

All meters that are to be installed must be registered with customer services.

PSMA 1 ULTRASONIC FLOW METER SPECIFICATION

a) The flow meter shall be the in-line ultrasonic type comprising of a minimum of 2 pair of sensors and either remote or integral microprocessor based converter unit. The system shall be inherently bi-directional with separate isolated analogue (4-20mA) and pulse outputs (volt free) for forward and reverse flow.

b) The flow meter shall have no moving parts to ensure that there is no damage from particulate matter e.g., stones etc.

c) The meter and transmitter shall be suitable for 24 volts D.C. without the need for link setting or voltage selection.

d) The system accuracy shall be equal to or better than +/- 0.5% of measured value under reference conditions irrespective of flow direction with a flow range of 0.01 m/s to 20 m/s full scale (i.e. 2000:1 turndown). Repeatability shall be equal to or better than +/-0.1%.

e) The meters shall be suitable for a maximum working temperature of 180^0C at pressures up to 16 bars or as limited by the flange rating.

f) Tenderers must provide full details of the minimum lengths of straight pipe required upstream and downstream from each type of perturbance, so that the accuracy of the meters remains within the specified accuracies.

g) The specification is based off minimum installation of straight pipe requirement of 5 x meter diameter upstream from the flow meter and 3 x meter diameter downstream from the flow meter. No additional item has been allowed for in the Bill of Quantities to increase the minimum straight pipe requirements for the supply of meters by the Contractor and the cost of any additional straight pipe required for the supply meter will be deemed inclusive of the meter rate.

h) The meter performance shall have been verified using wetted calibration with potable water on a fully traceable test facility that is internationally accepted. Laboratory traceability packs shall be available on request.

i) The meter shall be designed and manufactured under the ISO 9000 series of quality standards. It shall also have a meter body length to current ISO standard for in-line ultrasonic flow meters to facilitate interchangeability of product.

j) The wetted materials shall be compatible with, and suitable for, use on potable water. The liner shall be certified by an internationally recognised body such as AWWA or equivalent.

k) The transmitter unit shall be protected to a minimum IP67 and must be of remote version type to be wall mounted.

l) Cabling between the signal transmitter shall be by one 6 core screened cable providing both power and measurement signal from the flowmeter sensor to the flow meter transmitter.

m) Cabling between the signal transmitter and meter shall be maximum length of 10 metres.

n) The signal transmitter must be fitted with built it communication interface with the integral MODBUS protocols. No converters will be accepted.

o) The signal transmitter display shall indicate user-defined flowrate, flow total and sonic velocity units. The device shall incorporate a menu selection allowing range, unit's etc to be made. Data shall be stored in a non-volatile memory.

p) There shall be independent totaliser displays to give forward total, reverse total, nett totals, time and date.

q) The meter software shall incorporate multi password protection to prevent inadvertent or fraudulent programming or units of measurement changes.

r) The meter supplier must have a proven traceable track record of providing the backup service to the meters should the need arise to minimise down times as

well as have the necessary repair facilities locally to have the meters repaired.

s) All inputs and outputs to be galvanically isolated from the power supply. All pulse/status outputs and Analogue 4-20 mA output to be fully galvanically separated.

t) The flow sensor shall be rated to IP68 and be suitable to indefinite submergence to a depth of up to 10m. The sensor shall also be suitable for installation in underground pipes without the need for a metering chamber, vault or pit (i.e., it shall be capable of direct burial). The Tenderer shall, on request, provide evidence of satisfactory operation of similar sensors for a minimum period of 5 years in buried installations.

u) The flow meter shall have an additioanl burial coating to the standard meter coating for protection of the meter for all buried/ sub soil installations.

v) Be suitable for use under a maximum pressure of 1600kPa and flanged to SANS 1123 PN16 or EN 1092-1;

PSMA 2 MECHANICAL FLOW METER SPECIFICATION

Meters of a particular type and size shall comply with the flow requirements specified in Table PSMA 2.1 below. In this regard the following definitions shall apply:

a) Q p – Permanent/ Continuous Flow Rate: the flow rate for which the meter is designed and at which the meter is required to give indication within the permissible tolerances which for this Contract is 2% and under normal conditions of use eg: Under steady or intermittent flow conditions.

b) Q min – Minimum Flow Rate: the lowest flow rate at which the meter is required to give indications within the permissible tolerances which for this Contract is 5%. It is determined in terms of Q p.

c) Q t – Transitional Flow Rate: A flow rate that occurs between the overload flow rate and the minimum flow rate and at which the flow rate range is divided into two zones, the upper zone (which for this Contract is 2%) and lower zone (which for this Contract is 5%), each characterized by a specific permissible tolerance on flow rate indication.

d) Q s – Overload Flow Rate: A flow rate that represents the highest flow rate at which the meter is required to operate in a satisfactory manner for a short period of time without sustaining any damage to an accuracy of 2%. (Q max)

Table PSMA 2.1: Meter Performance for Mechanical Meters

METER SIZE (mm)	Qp >= (m^3/hr)	Qt <= (m^3/hr)	Qmin <= (m^3/hr)	Qs >= (m^3/hr)
40	30	0.15	0.10	50
50	35	0.40	0.15	55
80	120	0.51	0.20	200
100	230	0.81	0.30	300
150	450	1.60	0.80	600

Meters of all sizes shall:

a) Contain a minimum of wearing parts; be capable of correctly recording low rates of flow and withstanding flows in excess of the maximum rated capacity for short periods without damage to the mechanism;

b) Record through flow in cubic meters;

c) Be suitable for operation in water at all temperatures between 2ºC and 40ºC;

d) Have straight reading pattern cyclometer counters indicating completed m^3, having a reading sequence from left to right, with one colouring system to indicate m^3 and another colouring system or multi-pointer counters for sub multiples;

e) Have inlets and outlets to each meter supplied sealed against ingress of foreign matter with rigid metal or plastic blanking caps;

f) Have robust hinged covers of adequate strength to protect the meter counters;

g) Have a body free of blow holes and other flaws and be accurately machined;

h) Be suitable for use under a maximum pressure of 1600kPa;

i) Have underwater fittings manufactured from DZR brass (complying with SANS 6509) or other approved non-corrosive materials;

j) Have all threads other than inlets and outlets compatible with I.S.O. metric sizes; and

k) Have no screwed connecting pieces;

l) Be flanged in-line through-flow type, mechanical turbine bulk water meters and shall comply with the requirements of SANS 1529;

m) The meter bodies must be coated with a high quality sintered epoxy powder coating, both internally and externally, to provide maximum protection against corrosion. The coating dry film thickness is to be a minimum of 200 microns so to permit installation above ground without further protection. The cover bolts must be stainless steel to facilitate easy removal of mechanisms and must be installed with stainless steel washers;

n) Meters shall be fitted with hermetically sealed, copper can, dry dial, glass faced registers sealed to IP68 protection to prevent ingress of dirt or moisture. These meters must be equipped with registers, which comprise 6-digit cyclometer-type totalizers, registering in m^3;

o) The meters shall have body lengths that comply with Table PSMA 2.2;

p) The meters shall have flanged inlets and outlets in accordance with SABS 1123 Table 1600 and capable of withstanding a nominal working pressure of at least 1600 kPa;

q) All internal plastic components to be constructed of virgin materials.

r) The meter shall be clearly and indelibly marked with the following information:

    a. Name or trademark of the manufacturer

    b. Meter serial number where first two digits indicate year of manufacture.

    c. Direction of flow on both sides of the body

    d. Unit of measurement

    e. Meter type and size

    f. Maximum admissible pressure

    g. EWS Meter number stamped onto a plate and attached the body/ flange

s) The performance of the meters offered shall not be affected by outside electromagnetic influences;

t) The registers must have HRI pick-up as a standard feature as well as optical pulsers type OD so that the flow can be logged with the data loggers currently used by the Department;

u) Flanged meters are to be supplied complete with gasket sets;

v) Meters up to DN150 shall be able to be installed with 0 x DN unrestricted straight pipe upstream and downstream, Tenderers must provide full details of the minimum lengths of straight pipe required for greater than DN150 meter for upstream and downstream from each type of perturbance, so that the accuracy of the meters remains within the specified accuracies;

w) Meters shall be able to be installed both in the horizontal and vertical position;

Table PSMA 2.2: Body Length of Mechanical Meters

METER SIZE (mm)	Body Length (mm)
40	220
50	200
80	200
100	250
150	300

PS GEO GROUND IMPROVEMENT SPECIFICATION

This section of the Specification covers the aspects of the geotechnical ground improvement.

1.0 INTRODUCTION

Due to poor insitu ground conditions at the location of the proposed Thandokuhle Reservoir, ground improvements were deemed necessary by the Geotechnical PSP.

2.0 SCOPE OF SPECIFICATION

This specification is for the design of the ground improvement solution only and should be read in conjunction with the reports referenced 063-20.R01, 063-20.R02 and the drawing referenced 063-20.R02-001.

All items regarding the design of the proposed reservoir, pipework and bulk earthworks fall outside the scope of this specification.

3.0 REFERENCE SPECIFICATIONS AND DOCUMENTS

The following specifications are applicable to the construction of the proposed ground improvement solution:

Specification	Year	Title
SABS 1200 C:	1980	Site clearance
SABS 1200 D	1988	Earthworks
SABS 1200 LE	1982	Stormwater Drainage
TRH14	1985	Guidelines for Road Construction Materials
SANS 10221	2007	The Testing of Geotextiles;
TMH1 A10a	-	Sand Replacement;
TMH1 A10b	-	Nuclear Density;
SANS 3001 NG5	-	Nuclear Density;
Technical Data Sheet	-	TDS ZA-ParaGrid-Rev02-Feb17.

Where there are discrepancies between this specification and the referenced specification, this specification takes precedence.

Where information is deemed to be absent in this specification, the information given in the relevant referenced specification will take precedence on instruction from the Engineer.

4.0 SITE CLEARANCE

The clearing of the site shall be carried out in accordance to SABS 1200 C.

5.0 MATERIALS

5.1 Backfill Material

All backfill material for the ground improvement design shall comprise of G5 quality material, in terms of TRH14:1985.

5.2 Geotextile

All geotextile materials to be used as reinforcing in the ground improvement design shall comprise of Paragrid® - CMD 150/05 strip bonded geogrids with high tenacity polyester core. The technical data sheet for the Paragrid® - CMD 150/05 is given in TDS ZA-ParaGrid-Rev02-Feb17 prepared by Maccaferri Africa.

6.0 SITE SURVEY AND SETTING OUT

a) The surveying and setting out during construction is to be performed by a professional construction surveyor.

b) The surveyor to provide benchmarks and elevations for excavations for the ground improvement exercise.

c) The layout of all excavations and fill heights to be confirmed by the surveyor during construction.

7.0 SURFACE DRAINAGE

a) Surface drainage shall be constructed as per the Client's specification.

b) All natural drainage is to be maintained where practical.

c) All stormwater to be channelled away from the excavations for the ground improvement exercise.

d) Additional temporary drainage works shall be provided out during construction as required to safeguard the integrity of the works.

8.0 EXCAVATIONS

a) All excavations for the ground improvement exercise are to be taken down to a depth of 1.0m below underside of the reservoir foundation level (650.73msl) or to expose weathered gneiss rock, whichever is shallower.

b) Excavations are likely to classify as SOFT excavations in terms of SANS 1200 D.

c) An allowance is to be made for INTERMEDIATE and HARD excavations due to geological variations.

d) The dimensions of the excavation to be in accordance to Drawing No. 063-20.R02-001.

e) Materials from the excavation should not be stockpiled for use in the ground improvement construction.

f) The stockpiling and re-use of excavated material to be in accordance to the Client's specifications.

g) Excavations are to be battered to a gradient of 1 vertical in 1 horizontal.

h) Excavations shall be carried out so as to limit overbreak as far as is practical.

i) The sidewalls of the excavations are to be monitored regularly for signs of instability. Temporary stormwater drainage systems to be implemented to prevent the scouring of excavation sidewalls.

j) Provision for benching the new fill into the sidewalls of the excavations must be made.

k) All excavations must be barricaded at all times during construction.

9.0 BASE OF EXCAVATION

a) The base of the excavation shall be excavated, parallel to the proposed level shown on Drawing No. 063-20.R02-001.

b) The base shall then be trimmed to a level of not more than 50 mm above or below the designed floor level.

c) Where the Engineer considers that there are any underlying materials unsuitable to support the ground improvement design, the Engineer may instruct that the material be removed.

d) Materials from the base of the excavation must be extracted and subjected to laboratory testing to confirm the California Bearing Ratio (CBR) of the materials. The results of the laboratory tests must be submitted to the Engineer.

e) The bottom of the excavation must be ripped to a depth of 150mm and re-compacted to 95% Modified AASHTO Dry Density.

f) A minimum of 6 No. Nuclear Density Gauge and 3 No. Sand Replacement Tests must be carried out at the base of the excavation at positions determined by the Engineer.

g) The base of the excavation must be inspected and approved by the Engineer.

h) Once the engineer has approved the base of the excavation, the first layer of Paragrid 150/05 must be placed on the base of the excavation.

10.0 BACKFILL AND FILLING

a) The excavation must be backfilled with in layers not exceeding 250mm in thickness.

b) All backfill material to comprise G5 quality material, in terms of TRH14:1985.

c) The backfill shall not contain particles of average dimension exceeding the lesser of 150 mm or two-thirds of the thickness of the layer being compacted.

d) The placement, spreading and compacting of the fill material is be carried out by suitable construction plant with due regard for the size of the excavation footprint.

e) Fill layers are to be compacted, using suitable plant, to achieve a compaction of 95% Modified AASHTO dry density.

f) A minimum of 6 No. Nuclear Density Gauge and 3 No. Sand Replacement Tests must be carried out on each 250mm thick layer of fill at positions determined by the Engineer. The results of the tests are to be submitted to the Engineer.

g) Water shall be added as necessary to aid in achieving the desired compaction. The degree of compaction of each layer shall be such that when trimmed to a smooth surface.

h) Where heaving of material is observed during construction, the material shall be allowed to dry sufficiently before compaction can continue. If heaving cannot be controlled then the wet fill layers must be undercut and replaced with materials at approximately 2% higher or lower than the optimum moisture content.

i) The Surveyor must confirm the elevation of each layer of backfill.

j) The elevation tolerance of the final layer of backfill is to be in accordance with the Client's specifications.

k) The Engineer shall inspect and approve each layer of compacted fill.

11.0 PLACEMENT OF GEOTEXTILE

a) The geotextile is to cover a floor area equal to the floor area of the base of the excavation / fill.

b) Longitudinal spans of the Paragrid 150/05 must be overlapped by 750mm.

c) Paragrid 150/05 to be unrolled within the excavation from end to end of the excavation sidewalls. A single unrolled width of Paragrid 150/05 should not contain any joints or overlaps.

d) When placed, the Paragrid 150/05 should be pulled taught and the ends of the Paragrid 150/05 should be fixed in place to ensure that the length of the Paragrid 150/05 remains taught during the backfilling process.

e) Each subsequent layer of Paragrid 150/05 is placed perpendicular to the previous layer.

f) No construction plant to drive onto the Paragrid 150/05 reinforcement. The fill materials must be end tipped and spread over the Paragrid 150/05. Construction plant to drive over the end tipped material only.

g) The Engineer shall inspect and approve each layer of compacted fill.