NALA LOCAL MUNICIPALITY

CONTRACT NO.

NLM/TS/004/2025-26

THE REFURBISHMENT OF SEWER PUMP STATION AND ERADICATION OF 250 BUCKETS IN EXT. 12 & 13 IN WESSELSBRON

PART C3

SCOPE OF WORK

NALA LOCAL MUNICIPALITY

CONTRACT NO.

NLM/TS/004/2025-26

THE REFURBISHMENT OF SEWER PUMP STATION AND ERADICATION OF 250 BUCKETS IN EXT. 12 & 13 IN WESSELSBRON

PART C3: SCOPE OF WORK

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THE REFURBISHMENT OF SEWER PUMP STATION AND ERADICATION OF 250 BUCKETS IN EXT. 12 & 13 IN WESSELSBRON

SECTION C3.1

DESCRIPTION OF THE WORKS

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NLM/TS/004/2025-26

THE REFURBISHMENT OF SEWER PUMP STATION AND ERADICATION OF 250 BUCKETS IN EXT. 12 & 13 IN WESSELSBRON

SECTION C3.1

DESCRIPTION OF THE WORKS

C3.1.1 Employer's Objectives

Nala Local Municipality plans to honour its commitment to provide services and improve the existing sewer reticulation network in and around Monyakeng and Wesselsbron.

The main objective of this project will be to upgrade the existing infrastructure by refurbishing critical pump station infrastructure and upgrading some of the existing bucket toilets to a waterborne sanitation system.

The primary objective is for the sewer system to be fully functional, therefore, the Golf Course Pump Station in Wesselsbron is considered as a high priority that must be attended to urgently. The pump station is currently non-operational and will require refurbishment and equipping of electrical and mechanical equipment.

The project also aims to address the persistent challenges associated with the bucket sanitation system. Despite some progress in a few projects, the bucket system continues to pose a significant concern in Monyakeng, with the community currently enduring inadequate sanitation facilities. Specifically, it was identified that some erven in Extension 12 and 13 still employ the Ventilated Improved Pit (VIP) toilet system. Although a portion of the erven already have waterborne sanitation systems, the remainder (250) of the erven is required to receive new top structures and be converted into a waterborne sanitation system. These efforts are in alignment with the Bucket Eradication Programme (BEP) and will help to ensure healthier and more dignified living conditions for the people of Monyakeng.

Community and labour development is another key objective of this initiative. Temporary employment opportunities will be provided to local residents during the construction phase, with labour-intensive construction methods being prioritized for suitable tasks. Contractors will be required to document and verify their use of local labour, with specific items in the Bill of Quantities marked as labour-intensive.

Finally, the project seeks to mitigate health risks and environmental impacts by improving the containment of wastewater and reducing spillage incidents. This will safeguard the water sources and surrounding areas from contamination, promoting both environmental protection and public health.

C3.1.2 Scope of the Works

The Project Specifications serve as a vital part of the contract documentation, complementing the Standard Specifications by outlining the precise requirements of this project. While the Standard Specifications provide general guidance for various infrastructure projects, the scope described here specifically addresses the as following:

- Rehabilitation of the Golf Course sewer pump station in Wesselsbron, including major and minor refurbishment works.
- Eradication of 250 bucket toilets in Monyakeng Ext. 12 and 13 and upgrading to a waterborne sanitation system, where the scope of works is limited to top structures and the required erf connection to connect to the main sewer pipeline only.

Detailed quantities for each activity are provided in the Schedule of Quantities, though they do not restrict the work encompassed by this contract.

The Scope of Works includes, but is not limited to, the following:

1. General Construction Activities

- Establishing the site and clearing work areas.
- Performing topographical and cadastral surveys to locate existing services, and for "As-Built" drawings.

2. Golf Course Pump Station Refurbishment

- **Repair/Refurbishment**:
  - Clear vegetation and clean pump station.
  - Repair and waterproofing of broken concrete sections and joints.
  - Supply and installation of guardrails, ladders and handrails.
- **Mechanical Installation:**
  - Supply and installation of inlet screws and associated equipment.
  - Supply and installation of sewer pumps and associated equipment.
  - Supply and installation of sluice gates.
  - Supply and installation of screens.
  - Supply and installation of delivery pipework and valves.
  - Supply and installation of a water supply with garden tap for washing down the pump station and hand cleaning.
- **Electrical Installation:**
  - Supply and installation of electrical transformer.
  - Supply and installation of MCC complete with all pump control equipment.
  - Supply and install new power supply cable from switchgear house near transformer room to MCC.

3. Bucket Eradication:

- Construction of new top structures as per drawings.
- Excavation of trenches, supply, installation, bedding and backfill of new erf connections, and connection to existing water and sewer reticulation.

4. Testing and Commissioning

- Perform hydraulic, air, torch-and-mirror, and water-tightness testing.
- Commission all new and refurbished infrastructure to ensure full functionality and compliance.

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SECTION C3.2

STANDARD SPECIFICATIONS

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SECTION C3.2

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SECTION C3.2.1

STANDARD SPECIFICATIONS

C3.2.1 STANDARD SPECIFICATIONS

APPLICABLE STANDARDIZED SPECIFICATIONS

1. The Standard Specifications on which this contract is based are the latest revisions of the South African Bureau of Standard's Standardized Specifications for Civil Engineering Construction (SABS 1200) and the necessary amendments to the Standard Specifications have been made and included in the Project Specifications contained in this document. Note: "SABS has been changed to "SANS".

2. The South African Standard Code of Practice for the application of the National Building Regulations (SANS 10400:1990, previously SABS 0400:1900), shall also apply on this contract.

3. The terms "Schedule of Quantities", (used throughout the Standard Specifications) and "Bill of Quantities", (used in all other documents forming part of this contract), are synonymous.

4. Although not bound in nor issued with this Document, the relevant sections of the standard specifications shall form part of this Contract. These documents are available at the Contractor's expense from the SA Bureau of Standards, Private Bag X191, PRETORIA, 0001.

5. All relevant SABS 1200 Standardised Specifications for this Contract shall be applicable.

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SECTION C3.2.2

VARIATIONS AND ADDITIONS TO THE STANDARDISED SPECIFICATIONS

C3.2.2 VARIATIONS AND ADDITIONS TO THE STANDARD AND PARTICULAR SPECIFICATIONS

The Clauses under this section are numbered “PS” and refer to the clauses in the Standard or Particular Specifications. New clauses not covered by clauses in the Standard or Particular Specifications, if included here, are also designated “PS” followed by a number.

All material used in the Works shall, where such mark has been awarded for a specific type of material, bear the SABS/SANS mark. Alternatively, the Contractor shall furnish the Engineer with certificates of compliance of materials, which bear the official mark of the appropriate standard.

PSA GENERAL

PSA 1 SCOPE

REPLACE THE CONTENTS OF SUBCLAUSE 1.1, INCLUDING THE NOTES, WITH THE FOLLOWING

"1.1 This specification covers requirements, principles and responsibilities of a general nature which are generally applicable to civil engineering construction and building works contracts, as well as the requirements for the Contractor's establishment on the Site."

PSA 2 INTERPRETATIONS

PSA 2.3 DEFINITIONS

IN THE OPENING PHRASE, INSERT THE WORDS: "the definitions given in the Conditions of Contract and" BETWEEN THE WORDS "specification" AND "the following".

a) General

ADD THE FOLLOWING DEFINITIONS:

"General Conditions' and 'Conditions of Contract': The General Conditions of Contract specified for use with this Contract, together with the Special Conditions of Contract as applicable".

'Specified': As specified in the Standardized Specifications, the Drawings or the Project Specifications. 'Specifications' shall have the corresponding meaning'.

b) Measurement and Payment

REPLACE THE DEFINITIONS FOR "Fixed charge", "Time-related charge" *AND* "Value-related charge" *WITH THE FOLLOWING:*

'Fixed charge': A charge that is not subject to adjustment on account of variations in the value of the Contract Price or the time allowed in the Contract for the completion of the work.

'Time-related charge': A charge, the amount of which varies in accordance with the Time for Completion of the Works, adjusted in accordance with the provisions of the Contract.

'Value-related charge': A charge, the amount of which varies pro rata with the final value of the measured work executed and valued in accordance with the provisions of the Contract.

ADD THE FOLLOWING SUBCLAUSE TO CLAUSE 2.3:

PSA 2.3.1 DELAY DUE TO SUPPLY OF MATERIALS AND ORDERING

The Contractor shall ensure that the work is not delayed, due to the lack of materials on the site of the works, by placing orders with suppliers for the materials required under his contract as soon as possible after the acceptance of this tender.

The Contractor shall, by producing copies of written orders or written enquiries for supplies, prove to the satisfaction of the Engineer that any delay occasioned by the non-availability of materials has been caused by the ability of suppliers to supply and not by his own lack of timely ordering or lack of exhaustive enquiry for supplies before any extensions of the contract time will be allowed due to such delays.

The quantities set out in the Schedule of Quantities have been clearly determined calculations based on data available at the time and should therefore be considered to be approximate quantities only. Before ordering materials of any kind the Contractor shall check with the Engineer whether or not the scope of the work for which the materials are required is likely to change substantially. No liability or responsibility whatsoever shall be attached to the Employer for materials ordered by the Contractor except when ordered in accordance with written confirmation issued by the Engineer.

PSA 2.4 ABBREVIATIONS

a) Abbreviations relating to standard documents

ADD THE FOLLOWING ABBREVIATION:

"CKS: SABS Co-ordinating Specification."

PSA 3 MATERIALS

PSA 3.1 QUALITY OF MATERIALS

ADD THE FOLLOWING AT THE END OF SUBCLAUSE 3.1:

“All materials are to be the best of their respective kinds, new, undamaged, sound and free from defects and shall comply with the relevant clauses of the Specification.

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

Materials bearing the SANS or BS mark will not be subjected to tests to determine whether they comply with the relevant specifications. The Engineer may in his discretion require any material not bearing such mark to be tested in accordance with the relevant specifications; should he do so the Contractor shall arrange for such tests to be carried out to the Contractor’s cost by the South African Bureau of Standards or other approved body.

Whether or not the material bears the mark or is tested, any material found not to be in accordance with the specification shall be rejected and replaced by the Contractor at his own cost.

Tenderers may be required, at their own expense to submit samples of the material offered to the Engineer for his approval and the material supplied under his contract shall be of a standard equal to that of the samples so submitted and approved. Samples will remain the property of the Tenderers, who shall remove them when called upon to do so by the Engineer.”

ADD THE FOLLOWING SUBCLAUSE TO CLAUSE 3:

PSA 3.3 ORDERING OF MATERIALS

The quantities set out in the Schedule of Quantities have been carefully determined from calculations based on data available at the time of its compilation but are to be considered as approximate quantities only. Before ordering materials of any kind, the Contractor shall be solely responsible for determining, from the drawings issued or approved by the Engineer for construction purposes, the actual quantities of materials required for the execution of the Works. No liability or responsibility whatsoever shall be attached to the Employer or the Engineer in respect of materials ordered by the Contractor except when ordered in accordance with the drawings issued or approved by the Engineer for construction purposes.

PSA 4 PLANT

PSA 4.1 SILENCING OF PLANT

REPLACE THE CONTENTS OF SUBCLAUSE 4.1 WITH THE FOLLOWING:

“The Contractor’s attention is drawn to the applicable regulations pertaining to noise and hearing conservation, framed under the Occupational Health and Safety Act (Act No. 85 of 1993) as amended.”

The Contractor shall at all times and at its own cost, be responsible for implementing all necessary steps to ensure full compliance with such regulations, including but not restricted to the provision and use of suitable and effective silencing devices for pneumatic tools and other Plant which would otherwise cause a noise level in excess of that specified in the said regulations.

“Where appropriate, the Contractor shall further, by means of temporary barriers, effectively isolate the source of such noise in order to comply with the said regulations.”

PSA 4.2 CONTRACTOR’S OFFICES, STORES AND SERVICES

ADD THE FOLLOWING PARAGRAPH BEFORE THE EXISTING FIRST PARAGRAPH IN SUBCLAUSE 4.2:

"The Contractor's buildings, sheds and other facilities erected or utilized on the Site for the purposes of the Contract shall be fenced off and shall contain all offices, stores, workshops, testing laboratories, toilet facilities, etc. as may be required by the Contractor. The facilities shall always be kept in a neat and orderly condition.

“A night-watchman may be on the Site after hours.”

DELETE “and first-aid services” IN THE SECOND PARAGRAPH OF SUBCLAUSE 4.2 AND ADD THE FOLLOWING:

"The Contractor shall provide on the Site and in close proximity to the actual locations where the work is being executed, one toilet per 10 workmen, which toilets shall be effectively screened from public view and their use enforced. Such toilets shall be relocated from time to time as the location of the work being executed changes, so as to ensure that easy access to the toilets is maintained.”

“The Contractor shall, where applicable, make all necessary arrangements and pay for the removal of night soil.”

ADD THE FOLLOWING SUBCLAUSE TO CLAUSE 4:

PSA 4.3 CONSTRUCTION PLANT

Construction plant, where the use thereof is permitted, shall be of a suitable type for carrying out the work for which it is required. Its capacity shall be sufficient to meet the requirements of the work within the contract time. It shall be kept at all times in full working order and repair.

PSA 4.4 LABOUR INTENSIVE CONSTRUCTION METHODS

Except where the use of the plant is essential to meet the specified requirements by the Due Completion Date, the Contractor shall use only hand tools and equipment in the construction of those portion(s) of the Works that are required in terms of the Scope of Works to be constructed using labour-intensive construction methods.

PSA 5 CONSTRUCTION

PSA 5.1 SURVEY

PSA 5.1.1 Setting Out of the Works

ADD THE FOLLOWING:

"Benchmarks are available on Site and shall be used for construction purposes. The position of the permanent survey beacons is shown on the Drawings with the relevant position (X/Y coordinates) as well as the elevation (Z coordinate).

The Contractor shall be responsible for the setting out of the works.

If at any time during the progress of the Works, any error shall appear or arise in the position, levels, dimensions or alignment of any part of the Works, the Contractor, on being required to do so by the Engineer, shall at this own expense rectify such error to the satisfaction of the Engineer.

The Contractor shall take special precautions to protect all survey beacons or pegs such as benchmarks, stand boundary pegs and trigonometrical beacons, regardless whether such beacons or pegs were placed before or during the execution of the Contract. If any such beacons or pegs have been disturbed by the Contractor or his employees, the Contractor shall have them replaced by a registered land surveyor at his own cost."

PSA 5.1.2 Preservation and Replacement of Survey Beacons and Pegs Subject to the Land Survey Act

DELETE THE WORDS: "in the vicinity of boundaries" IN THE SECOND SENTENCE OF SUBCLAUSE 5.1.2 AND REPLACE THE WORDS: "under the direction of" IN THE SAME SENTENCE WITH: "in consultation and liaison with".

ADD THE FOLLOWING AFTER THE SECOND SENTENCE OF SUBCLAUSE 5.1.2:

"The Contractor and the Engineer shall record on the said list, their concurrence or disagreement (as the case may be) regarding the completeness and accuracy of the details recorded therein."

REPLACE THE THIRD SENTENCE OF SUBCLAUSE 5.1.2 WITH THE FOLLOWING:

"At the completion of the Contract, the Contractor shall expose all pegs that were listed at the commencement of the construction as being in order and the Contractor shall arrange with a registered Land Surveyor for the checking of the positions of all such pegs and the replacement of any thereof which the Land Surveyor's check reveals have become disturbed or damaged. The Contractor shall, as a precedent to the issue of the Certificate of Completion, provide to the Engineer, a certificate from the Registered Land Surveyor, certifying that all the pegs listed at the commencement of construction in accordance with the provisions of this clause, have been checked and that those found to have been disturbed, damaged or destroyed have been replaced in their correct positions, all in accordance with the provisions of the said Act.

The cost of all checking, replacement and certification as aforesaid shall be entirely for the Contractor's account; provided always that the Contractor shall not be held liable for the cost of replacement of pegs which:

a) cannot reasonably be re-established in their original positions by reason of the finished dimensions of the Permanent Works; and

b) the Contractor can prove beyond a reasonable doubt to the satisfaction of the Engineer, were disturbed, damaged or destroyed by others beyond its control."

PSA 5.3 PROTECTION OF EXISTING STRUCTURES

REPLACE: "Machinery and Occupational Safety Act, 1983, (Act No. 6 of 1983)" WITH: "Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), as amended," AND INSERT THE FOLLOWING AFTER "(Act No. 27 of 1956)": "as amended".

PSA 5.4 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES

REPLACE THE HEADING AND THE CONTENTS OF THIS SUB-CLAUSE WITH THE FOLLOWING:

PSA 5.4 LOCATION AND PROTECTION OF EXISTING SERVICES

PSA 5.4.1 Location of existing services

Before commencing any work in an area, the Contractor shall ascertain the presence and actual position of all services which can reasonably be expected by an experienced and competent Contractor to be present on, under, over or within the Site.

Without in any way limiting its liability in terms of the Conditions of Contract in relation to damage to property and interference with services, the Contractor shall, in collaboration with the Engineer, obtain the most up-to-date plans as are available, showing the positions of services existing in the area where it intends to work. Neither the Employer nor the Engineer offer any warranty as to the accuracy or completeness of such plans and because services can often not be reliably located from plans, the Contractor shall ascertain the actual location of services depicted on such plans by means of careful inspection of Site and the provision and utilization of suitable detecting and testing equipment.

Thereafter, the Contractor shall, by the use of appropriate methodologies carefully expose the services at such positions as are agreed to by the Engineer, for the purposes of verifying the exact location and position of the services. Where the exposure of existing services involves excavation to expose

underground services, the further requirements of Sub-clauses 4.4 and 5.1.2.2 of SANS 1200D (as amended) shall apply.

The aforesaid procedure shall also be followed in respect of services not shown on the plans but which may reasonably be anticipated by an experienced Contractor to be present or potentially present on the site.

All services, the positions of which have been determined as aforesaid at the critical points, shall henceforth be designated as 'Known Services' and their positions shall be indicated by the Contractor on a separate set of Drawings, a copy of which shall be furnished to the Engineer without delay.

As soon as any service which has not been identified and located as described above is encountered on, under, over or within the Site, it shall henceforth be deemed to be a Known Service and the aforesaid provisions pertaining to locating, verifying and recording its position on the balance of the Site shall apply. The Contractor shall notify the Engineer immediately any such service is encountered or discovered on the Site.

Whilst it is in possession of the Site, the Contractor shall be liable for all loss of or damage as may occur to:

a) Known Services, anywhere along the entire lengths of their routes, as may reasonably be deduced from the actual locations at which their positions were verified as aforesaid, due cognizance being taken of such deviations in line and level which may reasonably be anticipated; and

b) any other service which ought reasonably to have been a Known Service in accordance with the provisions of this clause;

as well as for consequential damage, whether caused directly by the Contractor's operators or by the lack of proper protection;

Provided always that the Contractor will not be held liable in respect of damages occurring to services not being Known Services.

No separate payment will be made to the Contractor in respect of its costs of providing, holding available on the Site and utilizing the said detecting and testing equipment, nor for any costs incurred in preparing and submitting to the Engineer, the Drawings as aforesaid and these costs shall be deemed included in the Contractor's other tendered rates and prices included in the Contract.

Payment to the Contractor in respect of exposing services at the positions agreed by the Engineer and as described above will be made under the payment items (if any) as may be provided therefore in the respective sections of the Specifications pertaining to the type of work involved.

PSA 5.4.2 Protection during construction

The Contractor shall take all reasonable precautions and arrange its operations in such a manner as to prevent damage occurring to all Known Services during the period which the Contractor has occupation and/or possession of the Site.

Services left exposed shall be suitably protected from damage and in such a manner as will eliminate any danger arising therefrom for the public and/or workmen, all in accordance with the requirements of the prevailing legislation and related regulations.

Unless otherwise instructed by the Engineer, no services shall be left exposed after its exact position has been determined and all excavations carried out for the purpose of exposing underground services shall be promptly backfilled and compacted. In roadways, the requirements of sub-clause 5.9 of SABS 1200 DB

should be observed. In other areas, compaction is to be to 90% modified AASHTO density.

PSA 5.4.3 Alterations and repairs to existing services

Unless the contrary is clearly specified or ordered, the Contractor shall not carry out alterations to existing services. When this is necessary, the Contractor shall inform the Engineer, who will either make arrangements for such work to be executed by the owner of the service, or instruct the Contractor to make such arrangements himself.

When the Contractor damages existing services, he shall immediately inform the Engineer or the relevant authority and obtain instructions as to who should carry out repairs. In urgent cases the Contractor shall take the necessary steps to minimize damage to and interruption of the service. No repairs of telecommunication cables or electric power lines and cables shall be attempted.

The Employer will accept no liability for damages due to a delay in having such alterations or repairs affected. The Contractor shall provide all reasonable opportunity, access and assistance to persons carrying out alterations or repairs of existing services.

PSA 5.7 SAFETY

REPLACE THE CONTENTS OF SUBCLAUSE 5.7 WITH THE FOLLOWING:

"Pursuant to the provisions of the Conditions of Contract, and without in any way limiting the Contractor's obligations there under, the Contractor shall at its own expense (except only where specific provision (if any) is made in the Contract for the reimbursement to the Contractor in respect of particular items)":

a) Provide to its Employees on the Site of the Works, all safety materials, clothing and equipment necessary to ensure full compliance with the provisions of the Occupational Health and Safety Act (Act No 85 of 1993) as amended (hereinafter referred to as the Act) at all times, and shall institute appropriate and effective measures to ensure the proper usage of such safety materials, clothing and equipment at all times; and

b) Provide, install and maintain on all barricades, safety signage and other measures to ensure the safety of workmen and all persons in, on and around the Site, as well as the general public; and

c) Implement on the Site of the Works, such procedures and systems and keep all records as may be required to ensure compliance with the requirements of the Act at all times; and

d) Implement all necessary measures as to ensure compliance of the Act by all subcontractors engaged by the Contractor and their employees engaged on the Works; and

e) Comply fully with all other requirements pertaining to safety as may be specified in the Contract.

The Employer and the Engineer shall be entitled, although not obliged, to make such inspections on the Site as they shall deem appropriate, for the purpose of verifying the Contractor's compliance with the requirements of the Act. For this purpose, the Contractor shall grant full access to the Site of all parts of the Site and shall co-operate fully in such inspections and shall make available for inspection, all such documents and records as the Employer's and/or Engineer's representative may reasonably require.

Where any such investigations reveal, or where it comes to the Engineer's attention that the Contractor is in any way in breach of the requirements of the Act or is failing to comply with the provisions of this clause, the Engineer shall, in accordance with the provisions of Clause 42 of the Conditions of Contract, be entitled to suspend progress on the Works or any part thereof until such time as the Contractor has demonstrated to the satisfaction of the Engineer, that such breach has been rectified.

The Contractor shall have no grounds for a claim against the Employer for extension of time and/or additional costs if the progress on the Works or any part thereof is suspended by the Engineer in terms of this clause and the Contractor shall remain fully liable in respect of the payment of penalties for late completion in accordance with the provisions of Clause 46(1) of the Conditions of Contract should the Contractor fail to complete the Works on or before the specified Due Date for Completion in consequence of the suspension.

Persistent and repeated breach by the Contractor of the requirements of the Act and/or this clause shall constitute grounds for the Engineer to act in terms of Clause 9.2.1.3.5 (GCC 2015 3rd Edition) of the Conditions of Contract and for the Employer to cancel the Contract in accordance with the further provisions of the said Clause 9.2 (GCC 2015 3rd Edition)."

ADD THE FOLLOWING NEW SUB-CLAUSE:

All work and particularly work carried out in the proximity of buildings, bridges, tanks or other structures shall be carried out in conformance with the regulations framed under the Occupational Health and Safety Act, 1993 and the Minerals Act, (Act 50 of 1991) (including shoring where necessary) to ensure the safety of structures that are risk.

The Contractor shall make available for the duration of the contract safety helmets, gumboots and any other necessary safety equipment for sole use by the Engineer and his representative(s).

ADD THE FOLLOWING NEW SUB-CLAUSES TO CLAUSE 5:

PSA 5.9 SECURITY

PSA 5.9.1 Security of Contractor's Plant and Personnel

The Contractor shall note that, notwithstanding any insurances which may be by the Employer, the Contractor shall be responsible for the effecting of safety and security of plant and personnel on and around the site of the works, and that no claims in this regard will be entertained by the Employer.

The sum entered by the Contractor in the Schedule of Quantities for effecting of safety and security of plant and personnel on and around the site of the works shall be deemed to include full compensation for all the necessary to affect the safety and security including, where necessary, the employment of the services of a security organization.

PSA 5.10 SITE MEETINGS

The Contractor or its authorized agent will be required to attend regular site meetings, which shall normally be held twice a month on dates and at times determined by the Engineer, but in any case, whenever reasonably required by the Engineer. Unless otherwise indicated in the Contract or instructed by the Engineer, such meetings shall be held at the Contractor's offices on the Site. At such monthly meetings, matters such as general progress on the Works, quality of work, problems, claims, payments, and safety etc., shall be discussed, but not matters concerning the day-to-day running of the Contract.

PSA5.11 WAYLEAVES AND PERMITS

The Employer has obtained wayleaves and access rights for the construction of the works.

The Contractor shall give notice and obtain all permits, licences and approvals as required by the Laws, and shall keep copies of such applications, permits, licences and approvals on site at all times. The Employer shall have access to such documents for its purpose under the Contract.

PSA5.12 CARE OF THE SITE AND PUBLIC

At all times during construction of the Works and upon completion thereof, the Site of the Works shall be kept and left in a clean and orderly condition. The Contractor shall store all materials and equipment for which he is responsible in an orderly manner and shall keep the Site free from debris and obstructions.

The attention of the Contractor is drawn to the fact that parts of the Works will be constructed within or adjacent to built-up areas. Certain work shall be constructed within urban areas and in the presence of passing traffic. The Contractor shall exercise all necessary precautions and take all necessary steps to ensure the safety and convenience of the public, including the prevention of unnecessary noise, dust or other nuisance or environmental impact. Where applicable, the Contractor shall provide access for traffic over and through the Works, and for residents to their places of abode. Safety measures shall also provide for wildlife and livestock.

Any rock or debris falling from trucks on the roads in use by the public shall be removed immediately. Precautions shall be taken to prevent fouling of public roads and other works by vehicles and the roads shall be kept clean by the Contractor.

Allowance should be made by the Contractor in his construction programme for delays that may result from foreseen and unforeseen actions that are required to ensure the safety and convenience of the public.

The Contractor shall give residents a minimum of 48 hours written notice of his intent to close access to residential stands and shall provide temporary access during the period of close. No permanent access to residential stands shall be closed for longer than 48 hours. The access shall be fenced off to ensure the safety of the public.

PSA5.13 CONTRACTOR'S REPRESENTATIVE AND SUPERINTENDENCE

The Contractor shall submit to the Employer and Engineer within 14 days of the Commencement Date a list of addresses and telephone numbers of its Representative and key personnel who may be contacted both during and outside normal working hours in connection with the Works.

It is recommended that the Contractor's key personnel be suitably qualified as per the guidelines in the table below:

Key personnel	**Qualification**
Contracts Manager	B. Tech or B Eng degree Civil Engineering
Construction Manager	National Diploma Civil Engineering
Site foreman	Trade test in plumbing
Safety Officer	Professional registration with SACPCMP

PSA5.14 NOTICES, SIGNS, BARRICADES AND ADVERTISEMENTS

Notices, signs and barricades as well as advertisements may only be erected where approved by the Engineer. The Contractor shall be responsible for their supply, erection, maintenance and ultimate removal and shall make provision for this in his tendered rates.

The Engineer shall have the right to have any sign, notice or advertisement moved to another location, or to have it removed from the Site of the Works, should it in any way prove to be unsatisfactory, inconvenient or a safety hazard.

PSA5.15 ACCOMMODATION OF TRAFFIC

Accommodation of traffic during construction of the Works forms an integral part of the obligations of the Contractor. The Contractor's plan for the accommodation of traffic and directional signs shall be prepared in terms of the latest version of the South African Road Traffic Signs Manual and CSRA Road Note 13, 3rd Edition 1988 (ECSRA Road Sign Note) and must be submitted to the Engineer together with the approval of the applicable authorities prior to the commencement of construction activities.

The travelling public shall have the right of way on public roads (whether closed to through traffic or not), and the Contractor shall apply suitable approved methods for controlling the movement of the contractor's equipment, materials, plant and Temporary Works in such a way that the latter will not constitute a hazard to residents and the travelling public.

The Contractor shall exercise all necessary precautions and take all necessary steps to ensure the safety and convenience of the public. In addition, the Contractor shall provide access for traffic over and through the Works, and for residents to their places of abode. Allowance must be made by the Contractor in his programming for delays resulting from the aforesaid.

Failure to maintain road signs, warning signs or flicker lights, etc., in good condition shall be deemed sufficient cause under the applicable clause of the Conditions of Contract for the Engineer to instruct the Contractor to suspend part or all of the Works at the cost of the Contractor until the default has been rectified.

The Contractor's tendered amounts for the work shall include full compensation for all costs and profit which may arise from the accommodation of traffic and no claims for extra payment in this respect shall be considered.

PSA5.16 GENERAL ENVIRONMENTAL REQUIREMENTS

All chemicals, lubricants and fuels shall be stored in secondary containment units that are capable of storing 110% of the contents stored. These secondary containment units must be impermeable, fire proof and constructed to the approval of the Engineer.

Washing of tools and/or equipment shall take place at dedicated washing facilities within the construction camps. Suitable wash facilities must be provided at all construction camps and all wastewater must be treated before discharge into any natural watercourse.

The Contractor shall prevent the discharge of any pollutants, such as cement, concrete, lime, chemicals and fuels into any water sources. Runoff from fuel storage areas/ workshops/vehicle washing areas and concrete swills shall be directed via an oil separator into a settlement pond and this will be disposed of at a site approved by the Engineer. Appropriate measures to prevent water pollution at/from batching plants must be implemented.

The Contractor shall be responsible to safeguard the plant and areas adjacent to the Contractor's camp against fire caused in any way by the construction activities on Site. The Contractor shall be responsible for any damage or loss suffered in this regard.

PSA5.17 PRE-CONSTRUCTION SURVEY

Landowners

The pre-construction survey must be conducted per affected property. It must be attended by the Landowner (or designated representative), the Engineer and the Contractor. The following must be established, agreed and recorded.

- communication protocol for future communication between the parties (introduce all parties, roles and functions)
- contact details
- activities usually undertaken in the construction servitude area, particularly in agricultural areas
- impacted services e.g. telephone, electricity, water supply lines and others, and the protection of these services
- fire protection and fighting measures
- fencing and gate requirements (any special requirements for special livestock, type of stock proof fencing, no of wire strands, location of gates, opening and closing of gates etc.)
- interim access requirements to rivers and streams
- security issues

Information and agreements are to be captured in a document for each affected land portion (a copy of which to be submitted to the Engineer).

Existing services, buildings and structures

Position, type, condition and other details of existing services (fencing, gates, roads, telephone lines, power lines etc), buildings and structures within the construction site including the pipeline servitudes.

This survey must include photographical records, documented per cadastral portion.

PSA5.18 FENCING

The Contractor shall replace all existing fencing that encroaches within the proposed permanent and temporary servitude and that cannot be re-used, with new stock-proof or game-proof (where applicable) fencing.

New gates shall be installed where required for access to properties or servitudes. The Contractor shall liaise with property owners with regard to the position and width of the gate.

The Contractor shall give all land owners and residents a minimum of 48 hours' notice of its intent to dismantle fences to properties. The Contractor shall note and take photos of all aspects relevant to the condition of existing fencing prior to dismantling, and shall acquire the signature of the owner/occupant agreeing to such conditions.

After reinstatement, the Contractor has to acquire the owner / occupant's written confirmation that the condition of the fence is at least equivalent to its condition before dismantling.

PSA 6 TOLERANCES

ADD THE FOLLOWING SUBCLAUSE TO CLAUSE 6:

PSA 6.4 USE OF TOLERANCES

No guarantee is given that the full specified tolerances will be available independently of each other, and the Contractor is cautioned that the liberal of full use of any one or more of the tolerances may deprive him of the full or any use of tolerances relating to other aspects of work.

Except where the contrary is specified, or when clearly not applicable, all quantities for measurement and payment shall be determined from the 'authorized' dimensions. These are specified dimensions or those shown on the Drawings or, if changed, as finally prescribed by the Engineer, without any allowance for the specified tolerances. Except if otherwise specified, all measurements for determining quantities for payment will be based on the 'authorised' dimensions.

If the work is constructed in accordance with the 'authorised' dimensions plus or minus the tolerances allowed, the calculation of quantities will be based on the 'authorised' dimensions, regardless of the actual dimensions to which the work has been constructed.

When the work is not constructed in accordance with the 'authorised' dimensions plus or minus the tolerances allowed, the Engineer may nevertheless, at his sole discretion, accept the work for payment. In such cases no payment shall be made for quantities of work or material in excess of those calculated for the 'authorised' dimensions, and where the actual dimensions are less than the 'authorised' dimensions minus the tolerance allowed, quantities for payment shall be calculated based on the actual dimensions as constructed."

PSA 7 TESTING

PSA 7.1 PRINCIPLES

PSA 7.1.2 Standard of Finished Work Not to Specification

INSERT THE WORDS "or checks by an approved laboratory ..." AFTER THE WORDS "Where the Engineer's checks ..." IN THE FIRST LINE OF SUBCLAUSE 7.1.2.

PSA 7.2 APPROVED LABORATORIES

REPLACE THE CONTENTS OF SUB-CLAUSE 7.2 WITH THE FOLLOWING:

"Unless otherwise specified in the relevant specification or elsewhere in the Project Specification, the following shall be deemed to be approved laboratories in which design work, or testing required in terms of a specification for the purposes of acceptance by the Engineer of the quality of materials used and/or workmanship achieved, may be carried out:

a) any testing laboratory certified by the South African National Accreditation Systems (SANAS) with respect to the nature and type of testing to be undertaken for the purposes of the Contract;

b) any testing laboratory owned, managed or operated by the Employer or the Engineer;

c) any testing laboratory established and operated on the Site by or on behalf of the Employer or the Engineer.

d) Any other laboratory that the Engineer approves in his absolute discretion."

PSA 8 MEASUREMENT AND PAYMENT

PSA 8.1.1 Method of Measurement, All Sections of the Schedule

DELETE THE WORDS: "and South West Africa".

PSA 8.1.2 Preliminary and General Item or Section

PSA 8.1.2.1 Contents

"Separate items will be scheduled to cover the Fixed, Value-related and Time-related components of the Contractor's Preliminary and General Costs."

AND REPLACE THE WORDS "substantial completion" IN SUBCLAUSE 8.1.2.1(c) WITH "Certificate of Completion".

PSA 8.1.2.2 Tendered sums

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Except only where specific provision is made in the Specifications and/or the Schedule of Quantities for separate compensation for any of these items, the Contractor's tendered sums under items PSA 8.3 and PSA 8.4 shall collectively cover all charges for:

- risks, costs and obligations in terms of the Conditions of Contract and of this standardized specification; and
- head-office and site overheads and supervision; and
- profit and financing costs; and
- expenses of a general nature not specifically related to any item or items of the permanent or temporary work; and
- providing such facilities on Site as may be required by the Contractor for the proper performance of the Contract and for its personnel, including, but without limitation, providing offices, storage facilities, workshops, and ablutions, for providing services such as water, electricity, sewage and rubbish disposal, for access roads and all other facilities required, as well as for the maintenance and removal on completion of the Works of these facilities and for the cleaning-up of the site of the Contractor's establishment and reinstatement to not less than its original condition.
- providing the facilities for the Engineer and his staff as specified in the Contract and their removal from the Site on completion of the Contract."
- providing security for Contractor's Plant and Personnel
- compliance with Occupational Health and Safety

PSA 8.2 PAYMENT

PSA 8.2.1 Fixed-Charge and Value-Related Items

REPLACE THE CONTENTS OF SUBCLAUSE 8.2.1 WITH THE FOLLOWING:

PSA 8.2.1.1 Fixed Charge Items

"Payment of fixed charges in respect of item 8.3.1 will be made as follows:

a) EIGHTY PERCENT (80%) of the sum tendered will be paid when the facilities have been provided and approved; and

b) The remaining TWENTY PERCENT (20%) will be paid when the Works have been completed, the facilities have been removed and the site of the Contractor's establishment has been cleared and cleaned to the satisfaction of the Engineer.

c) No adjustment will be made to the sum tendered in respect of item 8.3.1 should the value of the Works finally executed or the Time for Completion vary in any way from that specified in the Tender.

PSA 8.2.1.2 Value-related items

Payment for the sum tendered under item 8.3.2 will be made in three separate instalments as follows:

a) The first instalment, which is 40% of the sum, will be paid when the Contractor has fulfilled all his obligations to date under this specification, the General Conditions of Contract and the Special Conditions of Contract, and when the value of work certified for payment, excluding materials on site and payments for preliminary and general items, is equal to not less than 5% of the total value of the work listed in the Schedule of Quantities.

b) The second instalment, which is 40% of the sum, will be made when the amount certified for payment, including retention money but excluding this second instalment, exceeds 50% of the tender sum.

c) The final payment, which is 20% of the sum, will be made when the works have been certified as completed and the Contractor has fulfilled all his obligations to date under this Specification, the General Conditions of Contract and the Contract Data (GCC 2015 3rd Edition).

Should the value of the measured work finally completed be more or less than the tender sum, the sum tendered under item 8.3.2 will be adjusted up or down in accordance with the provisions of Clause 6.11 (GCC 2015 3rd Edition) of the Conditions of Contract, and this adjustment will be applied to the third instalment."

PSA 8.2.2 Time-related items

REPLACE THE CONTENTS OF SUBCLAUSE 8.2.2 WITH THE FOLLOWING:

"Subject to the provisions of Subclauses 8.2.3 and 8.2.4, payment under item 8.4.1 (time-related item) will be made monthly in equal amounts, calculated by dividing the sum tendered for the item by the tendered contract period in months;

Provided always that the total of the monthly amounts so paid for the item is not out of proportion with the value of the progress of the Works as a whole.

ADDITIONAL CLAUSES: ADD THE FOLLOWING:

PSA9 HEALTH AND SAFETY

The Works to comply with the Occupational Health and Safety Act (Act 85 of 1993), the Construction Regulations GNR.84 of 7 February 2014 and the Employer's Safety Specifications.

The maintenance of safe work practices at all times and in all sections of the execution of the works shall form part of the day-to-day site activities of all the Contractor's management, staff and workforce on the contract.

The Construction Regulations require the Employer to ensure that the Contractor has made adequate provision for the execution of the works within the Act, Regulations and Specifications. The items listed below have been identified as critical towards ensuring the minimum standards of safe work practice. It must however be noted that the list below is not exhaustive and that it is the Contractor's responsibility to allow for all costs involved to comply with the requirements in terms of the Contract.

Also, refer to health and safety requirements in Section 3.5.B (Management).

Rates given for items under this section should ensure compliance with the relevant requirements in the Occupational Health and Safety Act, 1993 (OHSA), Construction Regulations, 2014 (CR), General Administrative Regulations, 2003 (GAR) and the General Safety Regulations, 2003 (GSR).

PSA9.1 Fixed-charge items

ADD THE FOLLOWING NEW CLAUSE (Clause 8.3.5):

Compliance with the Occupational Health and Safety Act

(Act 85 of 1993) and its Regulations and with the Employer's

Health and Safety Specification……Unit: Sum

The fixed charge item shall include but shall not be limited to the following:

- Preparation and implementation of Health and Safety Plan,
- Establishment of Health and Safety File,
- Health and Safety Training
- Personal Protective Clothing and Equipment
- Fences, Signs and Barricades
- Establishment of Safety Administration
- Compliance with all Health and Safety regulations in terms of COVID-19
- Other Health and Safety Fixed-charge Obligations

PSA9.2 Time-related Items

ADD THE FOLLOWING NEW CLAUSE (Clause 8.4.6):

Compliance with the Occupational Health and Safety Act

(Act 85 of 1993) and its Regulations and with the Employer's

Health and Safety Specification……Unit: month

The time-related item shall include but shall not be limited to the following:

- The employment cost of all health and safety personnel including consultants, health and safety officers, inspectors, supervisors and issuers required in terms of the Contractor's Health and Safety Plan,
- Updating the Health and Safety Plan as needed,
- Carrying out periodic own audits and follow-up audits,

- Compiling ongoing risk assessments and risk assessment reports as required by the Works,
- Convening of regular safety meetings with the Safety Representatives,
- Accompanying and supporting the Employer or his Safety Agent during ad hoc audits,
- Compilation of monthly safety reports and statistics for the Employer or his Safety Agent,
- Implementation and maintenance of Training
- Maintenance of personal protective clothing and equipment
- Maintenance of fences, signs and barricades
- Implementation and maintenance of safety administration
- Maintain compliance with all Health and Safety regulations in terms of COVID-19
- Other Health and Safety Time-related Obligations

PSA10 ENVIRONMENTAL MANAGEMENT PLAN

The Contractor shall comply with all the conditions of the Environmental Authorisation (Record of Decision) and the Environmental Management Plan bound into Section C3.5C.

PSA10.1 Fixed-charge Items

ADD THE FOLLOWING CLAUSE (Clause 8.3.6):

Compliance with the Environmental Management Plan and

Environmental Authorisation (Record of Decision)……Unit: Sum

The sum tendered shall cover all costs, overheads, profits and charges incurred in complying with all the conditions of the Environmental Management Plan and Environmental Authorisation bound into Section C3.5C.

PSA10.2 Time-related Items

ADD THE FOLLOWING CLAUSE (Clause 8.4.7):

Compliance with the Environmental Management Plan

and Environmental Authorisation……..Unit: month

The sum tendered shall cover all costs, overheads, profits and charges incurred in complying with all the conditions of the Environmental Management Plan and Environmental Authorisation.

PSA11 PROVISION OF LEP PLAN

ADD THE FOLLOWING FIXED-CHARGE ITEM (Clause 8.3.7):

Provision of a suitable Local Economic Participation Plan……..Unit: Sum

The sum tendered shall include full compensation for the provision of a suitable Local Economic Participation plan as required in terms of section T2.2.18 [Local Economic Participation Specification]. The tendered sum shall also include the auditing by a recognised external auditing firm of the expenditure on local goods, services and labour as defined in the mentioned specifications. Two audits shall be included – the first interim audit shall be undertaken once 70% of the construction period has lapsed while the second and final audit will be done once the Taking-Over Certificate has been issued. The issue and approval of the final audit results will be a pre-requisite for the issue of the Performance Certificate. The tendered sum shall furthermore include the submission of monthly progress information related to LEP.

PSA12 SUMS STATED PROVISIONALLY (Clause 8.5)

PSA12.1 Contingencies

If applicable, a Provisional Sum has been included in the Summary of Schedules for contingencies. No percentage markup will be applicable to any payments made using contingency money other than the markup included in prices for variations determined in terms of the Conditions of Contract.

PSA12.2 Contract Price Adjustment (CPA)

If applicable, a Provisional Sum has been included for Contract Price Adjustment in the Summary of Schedules to make provision for contract price adjustment in terms of the Conditions of Contract. The value of the Provisional Sum shall be based on the percentage of the subtotal value as specified in the Summary of Schedules. No percentage markup will be applicable to any payments made in this regard.

Else, if CPA is approved by the Employer, each certificate issued shall be adjusted in accordance with the Contract Price Adjustment Schedule (GCC 2015 - page 86) with the following coefficients/ indices/ references obtained from Statistics South Africa and as published by SAFCEC from time to time (As defined in C1.2 – Clause 6.8.2):

8) The proportion not subject to adjustment: x = 0.10.

9) “L” is the “Labour Index” and shall be the “Consumer Price Index” for the province nearest to the Site as stated in the Contract Data and as published in the Statistical News Release P0141.1, Table A of Statistics South Africa. The associated coefficient shall be 0.25.

10) “P” is the “Contractor’s Equipment Index” and shall be the “Producer Price Index” for “Civil Engineering Plant” as published in the Statistical News Release P0151.1, Table 4, Plant and Equipment, of Statistics South Africa. The associated coefficient shall be 0.15.

11) “M” is the “Materials Index” and shall be the “Consumer Price Index” for “Building and Construction / Civil Engineering”, as published in the Statistical News Release P0151.1, Table 6, Civil Engineering Material, of Statistics South Africa. The associated coefficient shall be 0.55.

12) “F” is the “Fuel Index” and shall be the “Producer Price Index” for “Coal and petroleum. Products - Diesel, as published in the Statistical News Release P0141.1, Table 1 of Statistics South Africa. The associated coefficient shall be 0.05.

13) The province nearest to the site is “**Free State**”.

14) The base months will be the month prior to the month in which Contractor’s was appointed,

PSA12.3 Salary for Labour Desk Officer, Community Liaison Officer and Project Steering Committee

If applicable, a Provisional Sum has been included in Section 1 for salaries to be paid to the Labour Desk Officer (LDO), Community Liaison Officer (CLO) and Project Steering Committee (PSC).

In addition to the abovementioned amount, provision is made in Section 1 for a mark-up on the amount to be paid. The markup shall be regarded as full compensation for overheads, charges and profits as provided for in the Conditions of Contract.

PSA12.4 Artisans and skills training

If applicable, a Provisional Sum has been included in Section 1 for payments to be made to specialists for the training of unskilled or semi-skilled persons in industry accredited management and generic skills.

Payment to the Contractor will be based on invoices certified by the Engineer and issued by training specialists to the Contractor for work undertaken in terms of this item.

In addition to the above amount, provision is made in Section 1 for a markup on any payments made by the Contractor in this regard. The markup shall be regarded as full compensation for overheads, charges and profits as provided for in the Conditions of Contract.

PSA12.10 Locating existing services

A Provisional Sum has been included in Section 1 for the location/identification of existing services in terms of the Specifications where required and agreed with the Engineer (e.g. Ground Penetrating Radar (GPR) survey).

In addition to the abovementioned amount, provision is made in Section 1 for a mark-up on the amount to be paid. The mark-up shall be regarded as full compensation for overheads, charges and profits as provided for the Conditions of Contract.

PSA12.11 Relocation of Existing Services

If applicable, a Provisional Sum has been included in Section 1 for the relocation of existing services by specialists where required and agreed with the Engineer.

The markup shall be regarded as full compensation for overheads, charges and profits as provided for in the Conditions of Contract.

PSA12.12 Specialized services

Where applicable, a Provisional Sum has been allocated in Section 1 for the appointment and payment of specialized services, should they be required during the course of the project. These services may include, but are not limited to, the following specialist areas:

- Electrical
- Landscaping and hydro seeding;
- CCTV;
- Geotechnical surveys and inspections;
- Land Surveyor; and
- Acceptance control testing of pipework, coatings and linings.

In addition to the abovementioned amounts, provision is made in Section 1 for a mark-up on the amount to be paid. The markup shall be regarded as full compensation for overheads, charges and profits as provided for in the Conditions of Contract.

PSAB ENGINEER'S OFFICE

PSAB1 NAME BOARDS (Clause 3.1)

Name board(s) conforming to the standard requirements of the South African Association of Consulting Engineers and as shown on the relevant drawing must be provided and erected at points to be designated by the Engineer. A contract name board drawing is included with the tender drawings.

PSAB2 OFFICE BUILDING (Clause 3.2)

Office facilities shall be provided and appropriately furnished for the Engineer's Representative's personnel and maintained for the duration of the contract as per drawing no. 35431-BCN-ZZZ-00-DR-CIV-003-TS-001, included in the tender drawings.

The Contractor shall provide all electrical equipment as required by the office staff as well as all consumables required for facilities and equipment i.e. pens, paper, files, toner, stationery etc.

The Contractor shall also be responsible for providing and maintaining a reliable and high-speed internet connection, such as Wi-Fi or fibre-optic broadband, for the Engineer's offices. The Contractor shall ensure reliable and uninterrupted internet connectivity to support daily operations, communications, and all project-related digital needs throughout the duration of the contract.

All offices, facilities and equipment shall be new and be furnished, serviced, cleaned and maintained by the Contractor. The Contractor shall provide a full-time assistant to clean the offices and car wash. The Contractor shall provide a full-time guard service and ablution facilities for the office complex.

The Contractor shall be responsible for all running costs and costs for other services, including telecommunication, electricity, water, etc. to operate and maintain the offices efficiently.

The Contractor will remain the owner (or renter) of the offices, furniture and equipment and shall be responsible for the maintenance and insurance thereof.

Upon completion of the Works, the Contractor shall remove the offices, furniture, equipment and all related services from the Site.

PSAB3 TELEPHONE (Clause 5.4)

The Contractor shall provide and make available a mobile phone for the exclusive use of Engineer's Representative's staff for the duration of the contract, including all call and service costs associated with the provision of mobile phones. The phone provided must meet or exceed the following minimum specifications:

1. Battery:
   - Li-Po 5000 mAh, non-removable, for extended battery life.
2. Display:
   - 6.5-inch PLS LCD, minimum 720 x 1600 pixels, ensuring clear visibility in outdoor conditions.
3. Performance:
   - Octa-core CPU (e.g., Mediatek MT6765 Helio P35 or equivalent).
   - Minimum 2GB RAM and 32GB internal storage (expandable via microSD) to support essential apps and data storage.
4. Cameras:
   - Rear Camera: 13 MP (wide angle).
   - Front Camera: Minimum 5 MP
5. Connectivity:
   - Support for GSM / HSPA / LTE networks.
   - Wi-Fi 802.11 b/g/n, Bluetooth 5.0, GPS for reliable on-site communication and navigation.
6. Airtime and Data:
   - Minimum 200min. per month for the duration of the contract.
   - Minimum 2.5GB Data per month for the duration of the contract.

The Contractor is responsible for ensuring the mobile phone is operational for the entire duration of the contract, including any necessary call and data services, and insurance (optional). All related costs should be included in the monthly payment claims, based on invoices submitted by the Engineer. The cellular phone will remain the property of the Contractor.

PSAB5 SURVEY ASSISTANTS (Clause 5.5)

One suitably educated Survey Assistant shall be made available for the sole use of the Engineer's Representative personnel for the duration of the Contract. Transport shall be supplied for the Survey Assistant by the Contractor for the duration of the Contract should he be requested to do so. In such event payment will be made at scheduled daywork rates.

PSAB6 SURVEY EQUIPMENT

The survey equipment listed below shall be made available and maintained in good condition for the exclusive use of the Engineer or his Representative for the duration of the Contract.

No.	Item Description	Quantity
1	Automatic surveyor's level complete with tripod and carry case (e.g., DLS1 ROSS, Bosch GOL 32 D)	1 No
2	Nylon-coated steel surveyor's tape, 100m long, 10mm wide	1 No
3	10m long steel tape	1 No
4	5m three-piece telescopic survey staves (metric double-face) with angle bracket level	2 No
5	Survey books: Level	3 No
6	2kg hammer with rubber handle	1 No
7	Steel pegs, 300mm long, 12mm diameter	100 No
8	Measuring wheel	1 No
9	Tripod holders for ranging rods (heavy duty)	2 No
10	Digital Spirit Level	1 No
11	Three metre aluminium straight edge	1 No

PSAB7 CARPORTS

The Contractor shall provide and maintain carports as indicated on the detail drawing mentioned in PSAB2 for the duration of the Contract. The floor shall consist of 19mm crushed aggregate to alleviate dusty and muddy conditions.

PSAB8 INSURANCE, MAINTENANCE ETC.

The Contractor shall be responsible for the insurance of all facilities and equipment, running costs and costs for other services, including telecommunication, electricity, water, sanitation, etc. to operate and maintain the office efficiently.

The Contractor shall provide assistants to clean the offices.

The Contractor shall provide all consumables required for the facilities and equipment.

PSC SITE CLEARANCE

PSC3 MATERIALS

PSC3.1 DISPOSAL OF MATERIAL

ADD THE FOLLOWING:

"Materials arising from clearing and grubbing shall be disposed of at a suitable spoil site. The Contractor shall be responsible for making his own arrangements for a suitable spoil site. Trees and stumps necessarily removed shall not be burnt unless authorised by the Engineer but shall be cut and stacked at areas designated by the Engineer."

PSC5 CONSTRUCTION

PSC5.1 AREAS TO BE CLEARED AND GRUBBED

ADD THE FOLLOWING:

"Pipeline routes shall be cleared to a distance of 1.5m on both sides of the pipeline centre line. Route pegs or makers shall not be destroyed or damaged during clearing operations."

PSC5.2 CUTTING OF TREES

PSC5.2.3 Preservation of trees

PSC5.2.3.2 Individual trees

REPLACE THE LAST SENTENCE WITH THE FOLLOWING:

"An amount of R5000.00 will be deducted from moneys due to the Contractor as a penalty for every tree that is damaged or removed unnecessarily."

PSC5.5 RECLEARING OF VEGETATION

ADD THE FOLLOWING:

"When areas have to be re-cleared on the written instructions of the Engineer, such re-clearing shall be carried out at the Contractor's own cost and the Contractor is therefore advised not to clear the areas too soon"

PSC8 MEASUREMENT AND PAYMENT

PSC8.2 PAYMENT

PSC8.2.1 Clear and grub

REPLACE THE FIRST LINE WITH THE FOLLOWING:

"The area designated by the Engineer to be cleared and grubbed will be measured in square metre to the nearest square metre or,"

The rate for clear and grub shall include the transport of materials for an unlimited free haul distance for disposal.

ADD THE FOLLOWING CLAUSES:

"PSC8.2.11 Take down and re-erect existing fences……..……..Unit: m

The rate shall cover the cost of taking down the fences, coiling wire, sorting, stacking and guarding all materials, the cost of loading, transporting and off-loading such materials, the cost of re-erecting the fence in its original position using the dismantled material, the cost of temporary bracing of the fencing sections not taken down and the cost of appurtenant materials that may be required to restore the fence to its original condition before dismantling."

"PSC8.2.12 Take down existing fences and reinstate using new fencing material…..……..Unit: m

The rate shall cover the cost of taking down the fences, disposing of the material that cannot be reused, the supply of all new fencing materials required, the cost of re-erecting the fence in its original position, the cost of temporary bracing of the fencing sections not taken down and the cost of appurtenant materials that may be required to restore the fence to its original condition before dismantling."

"PSC8.2.13 Hydro jet cleaning of blocked sewer lines (Supply all equipment and operate high-pressure pumps and jets to clear blocked pipe sections):

a) Supply of all equipment complete to hydro jet existing pipelines……..Unit: Sum

The tendered sum shall include all equipment required for hydro-jet cleaning of pipelines and that follow the prescribed guidelines for operating pressures, nozzle specifications, minimum flow rates, and power requirements to ensure effective cleaning without damaging the pipeline infrastructure, as set out below:

<u>Pressure and Flow Requirements for Specific Pipe Diameters:</u>

- For 300mm pipelines, jetting equipment must operate at:
  - Flow rate: 41 L/min
  - Pressure: 150 Bar
  - Power: 15 kW
- For 400mm pipelines, jetting equipment must operate at:
  - Flow rate: 70 L/min
  - Pressure: 130 Bar
  - Power: 20 kW

<u>Pressure Adjustment:</u>

- Allowances should be made for friction losses in the water supply hose, and pump gauge pressure should be adjusted according to hose size, length, and flow rate.
- Contractors must verify that the pump gauge pressure matches the required nozzle pressure to maintain cleaning efficiency without exceeding material limits.

<u>Nozzle Specifications:</u>

- Nozzles should have a smooth external surface and feature jet holes around the circumference for balanced and controlled cleaning.
- Nozzles with forward-facing jets must be fitted with drain bars to prevent the nozzle from rotating inside the pipeline.
- Prohibited Nozzle Types: Avoid using nozzles with flailing chains, wires, or aggressively rotating features, as these can damage pipe interiors.
- The water jet discharge angle must be set between 6° and 15° relative to the axis

of the pipe to ensure effective deposit removal without causing structural damage.

Minimum Flow Rates and Maximum Pipeline Diameters:

- Contractors must adhere to the minimum flow rates and corresponding pipeline diameters outlined below for effective debris removal:

Flow Rate (l/s)	Flow Rate (l/min)	Maximum Pipeline Diameter
0.4	25	225mm
1.5	90	450mm
3.0	180	900mm
4.5	270	1600mm

Flow Rate Consistency:

- Contractors must maintain a steady flow rate to ensure effective removal of deposits without causing over-pressurization. Equipment should be regularly calibrated to verify flow rate accuracy.

Safety Protocols:

- Contractors must implement safety protocols to protect workers and the public from high-pressure jetting operations. Adequate PPE, including eye protection, waterproof clothing, and gloves, is mandatory.
- Establish barriers or signage to restrict unauthorised access to the work area during jetting operations.

Operational Practices:

- Only trained operators shall handle jetting equipment. Regular equipment checks should be conducted to ensure no damage to hoses, nozzles, or pump components.
- All operations should be conducted in compliance with environmental and local wastewater discharge regulations.

Quality Assurance and Reporting

- Inspection and Documentation:
  - Contractors must inspect pipelines post-cleaning to verify deposit removal and ensure no damage to the pipes.
  - Submit daily logs of cleaning operations, including pressure and flow rates used, hose adjustments, and inspection results.
- Final Review and Approval:
  - Upon completion, the employer's agent will review the cleaning results. Payment will only be processed after approval of the completed work and submission of all required documentation.

b) Operate and maintain equipment, including labour, fuel and other consumables, to clear blocked sewer pipes of various sizes up to 400 mm ø, remove debris from manholes and dump at municipal dump sites……..……...Unit: m

The rate shall cover the cost per linear metre for clearing blocked sewer pipes of various sizes up to 400 mm ø using the equipment supplied by item a) above, removing debris from manholes, and dumping at municipal dump sites. of various sizes up to 400 mm ø, remove debris from manholes and including all associated labour, fuel and other consumables."

"PSC8.2.14 Combination vacuum/jetting trucks to pump out blocked manholes. (Supply tanker trucks complete with vacuum pumps to empty blocked manholes and cart sewer to the nearest WWTW):

a) Supply of combination trucks……....Unit: Number

The tendered rate shall cover all the costs to supply a jetting and vacuum combination sewer cleaning truck, with an operator, for the duration of the contract. The combination sewer cleaning truck shall have a recycling system to decrease water usage during sewer cleaning.

b) Operate and maintain the tanker including all running costs per manhole emptied……..……..Unit: Number

The tendered rate shall cover all the costs per manhole for emptying and cleaning of the manhole, transportation and disposal of waste at an approved site, running costs of the vehicle supplied under a) and all labour required.

c) Supply temporary portable diesel trailer pump for over-pumping during conventional construction (up to 10m head and 50l/s)……...Unit: Day

The tendered rate shall cover all the costs per day to supply a temporary trailer with a self-priming sewage pump and a diesel engine to be used for over-pumping. The sewage pump must be able to deliver up to 50l/s at a 10m head.

d) Supply temporary submersible pump with a generator for over pumping during conventional construction (up to 10m head and 50l/s)……...Unit: Day

The tendered rate shall cover all the costs per day to supply a temporary submersible sewage pump and a suitable generator to be used for over pumping. The sewage pump must be able to deliver up to 50l/s at a 10m head.

e) Supply temporary lay flat delivery pipe for over pumping between manholes (max. 100m)…….Unit: Sum

The tendered sum shall cover all the costs to supply temporary lay-flat delivery pipes for the duration of the contract. The lay-flat pipes shall be able to handle over-pumping over distances of up to 100m and the size of the pipes shall be suited to the pumps in c) and d).

f) Supply of temporary sewer pipe plugs to fit a variety of diameters of sewer pipes to prevent sewerage from entering the construction/refurbishment area (to suit pipe sizes in Sections 4, 9 and 10) ……..……..……..Unit: Number

The contractor is required to supply temporary sewer pipe plugs to fit a variety of sewer pipe diameters as specified in Sections 4, 9, and 10, to prevent sewerage from entering the construction or refurbishment area. These plugs must be capable of fully blocking the sewer flow at designated points, typically within a manhole, to allow for work on the downstream pipeline.

The tendered price must include all costs associated with:

- Supply the appropriate size and type of pipe plugs (inflatable or mechanical) to suit the required pipe diameters.
- Installation of the plugs at the specified locations, ensuring a complete seal to prevent any sewerage flow.
- Operation of the plugs during the construction or refurbishment works, ensuring they remain effective throughout the project.
- Maintenance of the plugs, including any adjustments, inspections, or repairs necessary to maintain their integrity.
- Removal of the plugs at the end of the works, ensuring the system is safely restored to normal operation.

The tendered rate must cover all aspects of this service, including labor, equipment, transportation, and any other resources required to ensure the proper functioning of the pipe plugs. This rate should be all-inclusive, meaning no additional costs will be incurred for the installation, maintenance, or removal of the plugs throughout the duration of the project.

g) Diverting sewer flow from an upstream manhole to a manhole further downstream to allow for upgrades, repairs or connections (over-pumping)
……...Unit: Day

The tendered rate shall cover all the costs per day to install temporary pipe plugs, supplied in f), at an upstream manhole from the pipeline on which work is to be done, and then pump the sewage from the upstream manhole to a manhole further downstream of where work is to be done, using the pump supplied in c) or d), and lay flat hoses supplied in e). The rate shall also include the fuel and running costs for all equipment used, all required labour, overnight security/supervision if over-pumping has to be done for an extended time, subsequent removal of the temporary pipe plugs and cleaning of the manhole."

PSD EARTHWORKS

PSD3 MATERIALS

PSD3.1 CLASSIFICATION FOR EXCAVATION PURPOSES

PSD3.1.1 Method of Classifying

REPLACE THE CONTENTS OF SUBCLAUSE 3.1.1 WITH THE FOLLOWING:

"The Contractor may use any method he chooses to excavate any class of material but his chosen method of excavation shall not determine the classification of the excavation. The Engineer will decide on the classification of the materials. Said classification will be based on the criteria as stated in PSD 3.1.2 as described below. All equipment described in PSD 3.1.2 is to be in good mechanical condition and be operated efficiently by an experienced and licenced operator. "**Efficiently**" means "in a manner that can reasonably be expected of a contractor, having regard for the production achieved". In the event of a disagreement between the Engineer and the Contractor, it shall be the responsibility of the Contractor, if so required and subject to the provisions of 4.1, to make available at his own expense such equipment as is specified in PSD 3.1.2 in order to assess the reasonable removability or otherwise of the material. The Engineers decision shall then, subject to the provisions of the contract, be final and binding."

PSD3.1.2 Classes of Excavation

REPLACE THE CONTENTS OF SUBCLAUSE 3.1.2(a), (b) and (c) WITH THE FOLLOWING:

"The excavation of material will be classified as follows for purposes of measurement and payment:

(a) Soft excavation

1. Soft excavation shall be excavation in material that can be efficiently removed or loaded, without prior ripping, by the following plant:
   i. a track-type back-acting excavator unit with a total mass of approximately 30t and flywheel power of approximately 150kW.

(b) Hard rock excavation

1. Material shall be deemed to be hard rock when a track-type back-acting excavator unit with a total mass of approximately 30t and a flywheel power of approximately 150 kW fails to achieve a trenching production rate of 10m³ per hour.
2. Hard rock excavation shall be excavation in material that cannot be efficiently removed without blasting or without wedging and splitting.
3. Small quantities of hard material which can be removed by means of pneumatic equipment such as an excavator-mounted hydraulic hammer or pneumatic hand tools will also be classified as hard rock.

(c) Intermediate excavation

1. There will be no intermediate classification of material for this contract. The material will be either soft excavation or hard excavation and will be classified as described in (a) and (b) above.

(d) Approval for Blasting

1. Permission for the use of explosives will only be given once the engineer has been notified that the hard excavation conditions have been encountered and when he has verified that excavation by conventional means is not possible.
2. All blasting will take place in accordance with the safety and security regulations applicable to such activities.

PSD5 CONSTRUCTION

PSD5.1. PRECAUTIONS

PSD5.1.1. SAFETY

PSD5.1.1.1 Barricading and lighting

REPLACE "Machinery and Occupational Safety Act, 1983 (Act 6 of 1983) WITH "Occupational Health and Safety Act, 1993 (Act 85 of 1993)

PSD5.1.1.2 Safeguarding of excavation

REPLACE "Machinery and Occupational Safety Act" WITH "Occupational Health and Safety Act, 1993 (Act 85 of 1993)

PSD5.1.1.3 Explosives

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

The use of explosives is prohibited on this project.

PSD5.1.2 Existing services

PSD5.1.2.2 Detection, location and exposure

REPLACE THE CONTENTS OF SUBCLAUSE 5.1.2.2 WITH THE FOLLOWING:

The exposure by the Contractor of underground services, as required in terms of sub-clause 5.4 of SABS 1200A (as amended) shall be carried out by careful hand excavation at such positions and to such dimensions as agreed to by the Engineer.

Unless otherwise instructed or agreed by the Engineer, no service shall be left exposed after its exact position has been determined and all excavations carried out for the purposes of exposing underground services shall be promptly backfilled and compacted to the following densities:

(a) In roadways: 93% Mod AASHTO density; and
(b) In all other areas: 90% Mod AASHTO density.

Where hand excavations to expose underground services have to be carried out in roadways, the Contractor shall reinstate the road layer works in accordance with the provisions of sub-clause 5.9 of SABS 1200DB.

Payment in respect of exposing the services by means of hand excavation as described above, will be made in accordance with subclause PSD 8.3.8.1.

Payment in respect of reinstating the layer works in roadways will be made in accordance with sub-clause 8.3.6.1 of SABS1200DB (as amended).

PSD5.1.2.3 Protection of cables

REPLACE SUBCLAUSE 5.1.2.3 WITH THE FOLLOWING:

"5.1.2.3 Protection during construction

Further to the requirements of sub clause 5.4.2 of SABS 1200A (as amended), major excavating equipment and other plant shall not be operated dangerously close to known services. Where necessary, excavation in close proximity to known services shall be carefully carried out with suitable hand tools, excluding picks wherever their use could damage the services. No additional payment will apply to such more difficult work.

Should any service not being a known service be discovered or encountered during the course of the Contract, the Contractor shall, in addition to complying with the requirements of sub clause 5.4.2 of SABS 1200A (as amended), immediately notify the Engineer thereof and implement such measures as will prevent damage of such service or, if it was damaged in the course of discovery, will prevent and minimize the occurrence of any further damage occurring."

PSD5.1.2.4 Negligence

DELETE SUBCLAUSE 5.1.2.4

PSD5.1.3 Stormwater and groundwater

ADD THE FOLLOWING

"The Contractor shall, where applicable and at the earliest practicable opportunity, install the permanent drainage specified or shown on the Drawings and shall at his own cost provide the temporary drainage required to protect the works."

PSD5.1.5 Reinstatement and maintenance of roads

ADD THE FOLLOWING:

Where crossings have been made, roads shall be reinstated in accordance with the details specified in sub-clause 5.9 of SABS 1200 DB.

PSD5.1.6 Road traffic control

DELETE THE SECOND SENTENCE OF SUBCLAUSE 5.1.6

PSD5.2 METHODS AND PROCEDURES

PSD5.2.2 EXCAVATION

PSD5.2.2.3 Disposal

ADD THE FOLLOWING:

"Surplus material will be disposed and finished off on site or at an approved site in compliance with the Engineers requirements"

PSD5.2.5.1 Freehaul

REPLACE THE CONTENTS OF SUBCLAUSE 5.2.5.1(a) and (b) WITH THE FOLLOWING:

"The freehaul distance within which the Contractor will be required to move material without separate compensation shall be 5km."

PSD.7 TESTING

PSD.7.2 TAKING AND TESTING OF SAMPLES

ADD THE FOLLOWING:

"The Contractor shall include in his rate for the cost of density testing. These tests will be carried out on each layer of material utilized for filling."

PSDA EARTHWORKS (SMALL WORKS)

PSDA3 MATERIALS

PSDA3.1 CLASSIFICATION FOR EXCAVATION PURPOSES

PSDA3.1.1 METHOD OF CLASSIFYING

ADD THE FOLLOWING:

In case of excavation by hand, the following method of classification will be used:

3.1.2(a) **Soft excavation** will be classified as material which can be excavated with a pick and shovel. Should this material be measured with a DCP testing apparatus, the density of the material will be such that a penetration of not less than 10mm per blow will occur for every layer of 150mm.

3.1.2(b) **Intermediate excavation** will be classified as material which can be excavated with a pick and shovel and the penetration of a DCP testing apparatus is less than 10mm per blow

3.1.2(c) **Hard Rock excavation** will be classified as material which can only be removed with compressed air equipment, wedging and blasting.

PSDA3.1.2 Classes of Excavation

REPLACE THE CONTENTS OF SUBCLAUSE 3.1.2(a), (b), and (c) WITH THE FOLLOWING:

"The excavation of material will be classified as follows for purposes of measurement and payment:

(e) Soft excavation

1. Soft excavation shall be excavation in material that can be efficiently removed or loaded, without prior ripping, by the following plant:
   ii. a track type back-acting excavator unit of total mass of approximately 30t and flywheel power approximately 150kW.

(f) Hard rock excavation

1. Material shall be deemed to be hard rock when a track type back-acting excavator unit with a total mass of approximately 30t and a flywheel power of approximately 150kW fails to achieve a trenching production rate of 10m per hour.
2. Hard rock excavation shall be excavation in material that cannot be efficiently removed without blasting or without wedging and splitting.
3. Small quantities of hard material which can be removed by means of pneumatic equipment such as an excavator mounted hydraulic hammer or pneumatic hand tools will also be classified as hard rock.

(g) Intermediate excavation

1. There will be no intermediate classification of material for this contract. Material will be either soft excavation or hard excavation and will be classified as described in (a) and (b) above.

(h) Approval for Blasting

1. Permission for the use of explosives will only be given once the engineer has been notified that the hard excavation conditions have been encountered and when he has verified that excavation by conventional means is not possible.

2. All blasting will take place in accordance within the safety and security regulations applicable to such activities.

PSDB EARTHWORKS (PIPE TRENCHES)

PSDB3 MATERIALS

PSDB3.5 BACKFILL MATERIALS

ADD THE FOLLOWING PARAGRAPHS TO SUBCLAUSE 3.5:

(c) Cement-stabilized backfilling

Backfilling shall, where directed by the Engineer, be stabilized with 5% cement. The aggregate shall consist of approved soil or gravel containing stones not bigger than 38mm and with a plasticity index not exceeding 10.

The soil or gravel shall be mixed with 5% cement and shall be compacted in layers of 100mm thick to 90% of modified AASHTO density.

(d) Soilcrete backfilling

The aggregate for soilcrete shall be mixed with 5% cement and shall consist of approved soil or gravel containing stones not bigger than 38mm and with a plasticity index not exceeding 10.

The soil or gravel shall be mixed in a concrete mixer with the cement and enough water to acquire a consistency that allows the mixture to be placed with vibrators to fill voids between the pipe and the sides of the trench. Shuttering shall be used where necessary.

PSDB3.7 SELECTION

ADD THE FOLLOWING:

"Where suitable backfilling material is available in layers of 150mm or more, it will be separated during excavation and utilised for backfilling. Should this material not be utilised, an estimation of the available quantity will be made and deducted from the material which was imported."

PSDB5 CONSTRUCTION

PSDB5.1 PRECAUTIONS

PSDB5.1.3 Accommodation of traffic and access to properties

REPLACE THE SEMICOLON AND THE WORD "and" AT THE END OF SUBCLAUSE 5.1.3(a) WITH A FULL STOP AND REPLACE ITEME (b) WITH THE FOLLOWING:

(b) Where necessary to achieve compliance by the Contractor with his obligations in terms of sub-clause C3.4.2.5 (e) Scope of Works to provide and maintain pedestrian and vehicular access to properties affected by the works, the Contractors shall construct and maintain to the satisfaction of the Engineer, such temporary access roads around and/or steel or timber bridges over excavations in roads, pavements, entrances or accesses to properties.

Temporary pedestrian access bridges shall be at least 1,2m wide and temporary access bridges for vehicles shall be at least 3.6m wide. All temporary access bridges shall be fitted with handrails as well as protective mesh fencing on both sides.

On completion of the work, the Contractor shall dismantle and remove all such temporary constructions and reinstate these areas to their former condition.

Except only where the Engineer has included in the Schedule of Quantities, particular payment items specifically therefore, the Contractor will not be paid

directly for the construction and maintenance of temporary access roads and/or the provision and maintenance of bridges as aforementioned and the costs thereof shall be deemed included in the Contractor's offered rates for excavation.

ADD THE FOLLOWING NEW SUBCLAUSES TO SUBCLAUSE 5.1

PSDB5.1.5 Removal of existing pipelines

Where existing pipes have to be removed, they shall be carefully opened up by machine excavation to 300mm above the pipes after which the whole pipe shall be fully exposed by means of hand excavation. The excavation width shall comply with subclause 8.2.3.

The pipes shall be removed from the trench in a manner approved by the Engineer and brought to the surface for inspection by the Engineer.

Pipes that are declared suitable for reuse and pipes declared unfit for reuse shall be dealt with in an applicable manner described in the specifications, or on the Drawings or on the Engineer's instructions as relevant.

PSDB5.1.6 Removal of Asbestos Pipelines

Where existing asbestos pipes have to be removed, they shall follow the same process as described in sub-clause 5.1.5, and will also have to adhere to the Asbestos Regulations, OHS Act 85/93 and the Asbestos Regulations promulgated by Government Notice No R155 of 10 February 2002, as amended.

PSDB5.4 EXCAVATION

ADD THE FOLLOWING:

Except where otherwise specified, trenches shall be of such a depth that the minimum cover over the pipes shall be 700mm except at road- crossings where the minimum cover shall be 1000mm.

PSDB5.6 BACKFILLING

PSDB5.6.2 Material for Backfilling

ADD THE FOLLOWING:

"Rocks and rubble removed from the trench exceeding 250mm in diameter will be deemed unsuitable for backfilling above the bedding (cradle and blanket) and should be separated and removed to spoil."

PSDB5.6.4 Disposal of Hard Rock and Intermediate Material

ADD THE FOLLOWING:

"It is the contractor's responsibility to level the disposed spoil heaps and tip the following loads on the levelled material. The Contractor will not be permitted to dispose of unsuitable material by just dumping it onto the horizontal surface. Excess material which cannot be flattened sufficiently will be removed from

the site to an approved spoil site. All excavated rock material exceeding 250mm in diameter is to be removed to an approved spoil site."

PSDB7 TESTING

PSDB7.1 Density Test

ADD THE FOLLOWING:

"The frequency of density test shall be 4 tests at every 100m interval on each backfill layer."

PSDB8 MEASUREMENT AND PAYMENT

PSDB8.3 SCHEDULED ITEMS

PSDB8.3.2 Excavation

(a) Excavate in all materials for trenches, backfill compact and dispose of surplus material

REPLACE "of 1,0m" IN THE FIRST SENTENCE OF 8.3.2(a) WITH: 'as specified in the Schedule of Quantities"

(b) Extra over item (a) above for:

ADD THE FOLLOWING AT THE END OF THE EXISTING SUBITEM 2:

"No payments will be made under sub-items (1) and (2) in respect of any material measured and paid for under sub-item 3 below"

AND ADD THE FOLLOWING NEW SUBITEMS IN 8.3.2(b):

"(3) **Hand excavation where ordered by the Engineer in:**

(a) Soft material …….…….... Unit: m^3
(b) Intermediate material ……..…….…….…… Unit: m^3
(c) Hard material ……..…….……Unit: m^3

The unit measurement shall be the cubic metre of material, measured in place according to the authorized dimensions, which was excavated by hand on the specific prior written instructions of the Engineer; provided always that the Engineer said instruction shall have stated that measurement and payment for such hand excavation will be in accordance with this item.

The offered rate shall include full compensation for the additional cost, effort and time resulting from excavating in the respective materials using hand methods only.

The Engineer shall not be obliged to authorize payment under this item in respect of any hand excavation carried out (whether ordered in writing or otherwise), which hand excavation was, in any case, necessary to achieve compliance by the Contractor with his obligations under the Contract to:

(i) utilize construction appropriate to the nature of the specific parts of the works; and/or
(ii) protect existing structures and/or services; and/or
(iii) Comply with all prevailing legislation and regulations

(4) **Backfill stabilized with 5% cement where directed by the Engineer**……..…..Unit: m³

The unit of measurement shall be the cubic metre of backfill material, measured in place after compaction according to the authorized dimensions, which was stabilized on the Engineers instruction in accordance with sub-clause PSDB3.5(c).

The offered rate shall include full compensation for supplying the cement and for selecting, mixing, backfilling and compacting the stabilized material to 90% of modified AASHTO density.

(5) **Soilcrete backfill where directed by the Engineer**……....Unit: m³

The unit of measurement shall be the cubic metre of soilcrete placed on the Engineer's instructions in accordance with sub-clause PSDB 3.5(d), measured in place according to the authorized dimensions.

The offered rate shall include full compensation for supplying the cement and for selecting, mixing and placing the soilcrete as well as for the cost of shuttering if required.

ADD THE FOLLOWING SUBITEMS IN 8.3.2 AFTER SUBITEM 8.3.2(C):

'(d) **Excavate in all materials for stormwater inlet and outlet structures and for manholes, catch pits, valves chambers and the like, irrespective of depth and backfill around structures**……..…….....Unit: m³

The unit of measurement shall be the cubic meter of material excavated, measured in place according to the authorized dimensions, and excluding the volume of material excavated and paid for under sub item (a).

The offered rate shall include for the costs of excavating in all materials, backfilling, compacting, trimming and tidying the final surface around the structure, disposing of surplus and unsuitable materials within the free-haul distance and where applicable, selecting and keeping separate, excavated material suitable for the use of backfill.

'(f) **Extra over sub-items (d) and (e) for excavating in**

(1) Intermediate material……..……Unit: m³
(2) Hard rock material……..……Unit: m³
(3) Hard rock where chemical blasting is required: ……..……Unit: m³

Measurement and payment shall be in accordance with the provisions of 8.3.2(b) of SABS 1200D (as amended).

PSDB8.3.4 Particular Items:

REPLACE THE CONTENTS OF CLAUSE 8.3.4 (a) WITH THE FOLLOWING:

a) Shore trench……..……Unit: m

All trenches deeper than 1,0m shall be shored.

The Contractor shall assume full responsibility for the safety of excavations and shall carry out all measures necessary to make the work secure, by timbering and strutting or sheet piling the excavated face or by side sloping where it is not required to act as a mould to concrete work. All timbering and strutting must be of sufficient strength and be capable of being removed readily as the work proceeds.

All timbering and strutting or sheet piling shall be subject to the Engineer's approval but such approval shall not relieve the Contractor of any responsibility with regard to the safety or suitability of the timbering/sheet piling used.

The Contractor shall further take all precautions to safeguard existing services and structures near or next to excavations carried out by him and shall provide and erect any shoring or underpinning that may be necessary.

All claims for compensation for damage or injury caused or aggravated by the Contractor not taking all precautions to safeguard persons or property shall be met entirely by the Contractor.

The length measured for payment will be that of the centre-line of the trench regardless of whether supports are placed on one or on both sides of the trench. The rate shall cover the cost, for both sides of the trench, if necessary, of the supply, placing, maintenance and removal of timbering and other support measures together with any cost that results from the inconvenience of working in the supported trench and the cost of any risks inherent in the operation. The rate shall also include the temporary works design and inspection by a competent person/structural engineer.

ADD THE FOLLOWING CLAUSE:

PSDB8.3.8 Removal of Existing Pipes

a) Remove pipes from trench and dispose……Unit: m

The unit measurement shall be the linear metre length of pipe removed.

The offered rate shall include full compensation for the additional cost, effort and time resulting from the removal, handling and disposal of the existing pipe only.

b) Remove AC pipes from the trench, handle and dispose at a suitable site……....Unit: m

The unit measurement shall be the linear metre length of pipe removed.

The offered rate shall include full compensation for the additional cost, effort and time resulting from the removal, handling and disposal of the existing pipe, including adherence to the Asbestos Regulations, OHS Act 85/93 and the Asbestos Regulations promulgated by Government Notice No R155 of 10 February 2002, as amended, only.

PSG SANS 1200 G: CONCRETE (STRUCTURAL)

PSG3 MATERIALS

PSG3.8 CURING COMPOUND

Curing compound shall be white pigmented natural resin based liquid curing compound complying with ASTM C 309-74.

PSG4 PLANT

PSG4.4 FORMWORK

PSG4.4.2 Finish

The finish to all exposed concrete shall be smooth and that to buried or backfilled surfaces, rough.

PSG5 CONSTRUCTION

PSG5.1 REINFORCEMENT

PSG5.1.2 Fixing

Delete the words "or, if permitted by the Employer's Agent, by welding" in the second paragraph of this subclause. Welding will not be permitted.

PSG5.4 CONCRETE

PSG5.4.1 Quality

PSG5.4.1.5 Strength Concrete

ADD THE FOLLOWING TO SUBCLAUSE 5.4.1.5:

"The Contractor shall when requesting approval of a mix design, submit the constituent proportions of the proposed mix together with the results of compressive strength tests carried out."

PSG5.4.1.6 Ready-mixed concrete

Notwithstanding the provisions of this subclause, the results of tests carried out by the manufacturer as part of his quality control system will not be used as a basis for evaluating the acceptability of delivered concrete in terms of subclause 7.3.

PSG5.4.2 Batching

Notwithstanding the requirements of this subclause, the method of batching shall be subject to approval. If volume batching is allowed, only full standard 50kg bags of cement may be used to make up a batch.

PSG5.4.6 Compaction

Replace "or (if approved) forking" in the first sentence of subclause 5.4.6.3 with "using approved vibrators".

PSG5.4.7 Curing and Protection

Notwithstanding the provisions of this subclause, all cast in situ concrete shall, except where otherwise authorised, be cured in accordance with the requirements of subclause (c) using curing compound of the type specified in PSGA 3.8.

PSG5.4.8 Concrete surfaces

All unformed concrete surfaces shall be given a wood float finish.

PSG7 TESTS

PSG7.1 FACILITIES AND FREQUENCY OF SAMPLING

PSG7.1.2 Frequency and Sampling

Notwithstanding the requirements of this subclause, the Contractor shall take note that he is responsible for taking an adequate number of tests to ensure that the concrete being used complies with the specification. The Employer's Agent will only carry out such check testing as he requires.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PSG8 MEASUREMENT AND PAYMENT

PSG8.1 MEASUREMENT AND RATES

PSG8.1.3 Concrete

Add after "testing" in the second line of subclause 8.1.3.3(a) "including transport to an approved laboratory".

PSG8.4 SCHEDULED CONCRETE ITEMS

PSG8.4.4 Unformed Surface Finishes

ADD THE FOLLOWING TO SUBCLAUSE 8.4.4:

“The rate shall further include the cost for complying with Clause PSGA 5.4.8”.

PSGA5.4.1.6 Ready-mixed concrete

DELETE THE CONTENTS OF THE SUBCLAUSE AND REPLACE WITH THE FOLLOWING:

"Concrete produced at a central facility, other than at the site of the Works, shall be accepted for use in the Works except. When such approval has been given the Engineer will then decide whether or not to accept the test results obtained by the facility concerned. The use of concrete from a ready-mixed concrete facility shall be permitted subject to the following provisos:

The facility shall be accredited as being compliant with the requirements of the ISO 9001 standard.

The concrete batching plant shall be inspected by the Engineer for compliance with sans specifications and his approval must be obtained in writing before commencement of the concrete works.

Before any ready-mixed concrete is used on the works, the contractor shall furnish the Engineer with a copy of his letter to the supplier in which was specified:

(i) the type of cement(s);

(ii) the nominal maximum sizes of aggregates;

(iii) the cement / water ratios;

(iv) the required compressive strengths;

(v) the required slump at the time and place of delivery; and

(vi) the type of additive - documentary evidence proving the suitability of the additive for use in the concrete, particularly in the grade 35/19 water retaining concrete, shall be given to the Engineer for his prior approval.

The following shall be specified in the contractor's contract/order with the ready mixed concrete supplier and a copy of the relevant documentation shall be given to the Engineer's Representative: a maximum delivery period of 90 minutes from the time water is added to the concrete mix to the actual completion of the discharge of concrete on site shall be permitted. 120 minutes is a max. the discharge period (including placing the concrete) shall not exceed 30 minutes.

The concrete slump of every truckload shall be measured on delivery to site as soon as discharge commences and it shall comply with clause sabs 1200 G 5.4.1.2 prior to any concrete from that truck being placed. no additional water may be added to the mix after it has left the batching plant without the written approval of the Engineer‘s Representative. under no circumstances shall the cement/water ratio for concrete in water retaining structures be less than 2,0.

A detailed computer printout of the constituents of the concrete mix from the batching plant is to be handed over to and retained by the Engineer‘s Representative on site on arrival (i.e. truck registration, mix proportions and the time water was added to the mix). the masses of the concrete constituents of each truck shall be checked against that of those submitted with the trial mix, subject to the batching accuracy as specified in sans 0100-2: 1992. the arrival time of each truck on site and the time that the concrete discharge is completed shall also be recorded by the Engineer‘s Representative. Dedicated truck drivers shall be used, where possible, for the delivery of the concrete to site. When required the contractor shall satisfy the Engineer that acceptable alternative means of supplying concrete have been arranged and can be brought into operation in the event of disruption in the supply of concrete. in this regard, the Engineer may require that the alternative means of supply shall commence if the disruption in the supply of ready-mixed concrete has lasted for a period of 1½ hours. The use of ready-mixed concrete will in no way relieve the contractor of any of his obligations for providing concrete that complies with the specifications.

PSGA5.4.5 Placing ADD TO SUBCLAUSE 5.4.5.4: "

In the case of continuous walls these are to be cast in lifts of such height that each lift can be poured uninterruptedly in one continuous operation over the entire length of the wall. No vertical or inclined construction joints of any kind will be permitted in continuous walls unless they have been specifically ordered or authorised by the Engineer. The placing of concrete shall commence at convenient points on the length of the wall and shall proceed both ways simultaneously so that fresh concrete meets fresh concrete. Any rest pauses, such as for meals, shall be avoided as far as possible, and the Contractor may be required by the Engineer to make the operation continuous by working in shifts. A workable arrangement must be made before each concreting operation commences

PSGA5.4.5.5 Adverse weather conditions (See PSGA 2.3(d))

Under adverse cold weather conditions, effective measures shall be taken to ensure that the temperature of the concrete, from the time of placing until it has hardened (i.e. about 24 h), is maintained at not less than 5 °C. If the atmospheric temperature in the vicinity of the concrete is below 2 °C or is expected to fall below 2 °C during the curing period (see Subclause 5.4.7), water shall not be used for curing. All surfaces shall be protected from ice or frost damage. When the ambient temperature is above 32 °C, the temperature of the concrete when deposited shall not be allowed to exceed 32 °C. Under adverse hot weather conditions, the Contractor shall take all reasonable steps to reduce to a minimum the placing temperature of the concrete. Stockpiles of aggregates and all metal surfaces in contact with aggregates and concrete shall be shielded from the direct rays of the sun or cooled by being sprayed with water, and windbreaks shall be erected, if necessary, to prevent the initial rapid drying-out of concrete which would otherwise occur before normal curing procedures can be undertaken. Concrete shall not be placed during periods of heavy or prolonged rainfall.

PSGA5.4.9 Watertight Concrete

ADD TO THE END OF THE FIRST SENTENCE:

"and shutter-tie positions."

ADD TO THE SUBCLAUSE:

The following structures shall be subject to water-tightness tests: All concrete chambers/structures below ground shall exclude water and shall be subject to a visual test for watertightness. No horizontal or inclined construction joints of any kind will be permitted in the external walls of the inlet control chamber unless these have been specially ordered or authorised by the Engineer

PSGA6 TOLERANCES

PSGA6.1 BASIS OF MEASUREMENT

PSGA6.1.1 General

REPLACE "Degree of Accuracy III" *IN THE THIRD LINE WITH* "Degree of Accuracy II".

ADD TO THE SUBCLAUSE:

"The Permissible Deviations for the following elements of the Works shall be to Degree of Accuracy III:

PSGA8.4 SCHEDULED CONCRETE ITEMS

PSGA8.4.1 Prescribed Mix Concrete

DELETE FROM THE SUBCLAUSE ALL BUT THE FIRST SENTENCE.

ADD THE FOLLOWING NEW ITEMS:

"**PSGA8.7 GROUTING**

This clause is amended to delete the last sentence and to include the following: "Grouting under structural steel column bases or members or under pumps, motors or other machinery will be measured on site as executed provided the concrete is within the specified tolerances. Should the concrete not be within the specified minus tolerance, site measurements will be adjusted accordingly.

Rates for grouting are to allow for all necessary preparatory work (hacking, slurry etc.) and for all necessary formwork.

PSGA8.9 MISCELLANEOUS

PSGA8.9.1 Concrete coring……..Unit: No

The rate shall cover the products, tools and equipment for the coring of openings, in existing concrete structures, complete, as described on drawings or in the Bill of quantities. Any exposed existing reinforcement after coring and the prevention of concrete over-break are to be treated with approved products."

PSH STRUCTURAL STEELWORK

PSH3 MATERIALS

PSH3.1 STRUCTURAL STEEL

All steel used in the construction of these works shall comply with SABS 1431 Grade 300WA.

PSH3.6 BOLTS, NUTS AND WASHERS

All bolts, nuts and washers shall be Precision Bolts Grade 8.8, unless otherwise specified on the drawings.

PSH5 CONSTRUCTION

PSH5.1 DRAWINGS AND SHOP DETAILS

It shall be the structural steel fabricator's responsibility to prepare full shop details for approval by the Engineer.

The structural steel fabrication will be executed as a Subcontract to the Civil Works contract. The Main Contractor will be responsible for providing the Subcontractor with copies of all the relevant drawings and specification clauses to enable him to prepare the required shop details.

PSH5.1.2 Contractor Provides Shop Details

The shop drawings shall be submitted to the Engineer at least three (3) weeks before fabrication is due to commence. The Engineer will provide his approval and/or comments within two (2) weeks of receipt of ALL the shop details.

PSH5.2 FABRICATION

PSH5.2.2 Identification

The Contractor shall maintain adequate records to ensure that all steel can be positively identified in respect of its grade.

PSH5.2.3 Cutting

If flame cutting is utilised all edges of plates shall be dressed by grinding to remove all burrs and notches.

PSH5.2.4 Holes for Fasteners

No holes may be formed by flame cutting and punching.

PSH5.6 GROUTING OF SUPPORTS

PSH5.6.1 Responsibility

Grouting of base plates may be carried out either by the Civil Contractor or the Structural Steelwork Subcontractor as agreed between them. In either event the following shall apply.

It is important that the base plates of the portal columns in particular are grouted to ensure full and intimate contact between the underside of the base plate and the foundation.

No grouting shall commence until the Engineer's approval is given for grouting to commence.

All base plates shall be grouted using Durabed NF grout as supplied by Messrs ABE Industrial Products or equal approved.

All grout shall be mixed and used in strict compliance with the manufacturer's instructions. The grout shall be placed in a "Flowable" state and shall be poured into a mould formed around the base plate. The mould shall be constructed in such a manner that an effective head of grout equal to 50mm

above the bottom of the base plate can be achieved and maintained until after the final setting time of the material.

The grout shall be poured in a manner agreed with the Engineer in advance of the commencement of grouting operations to ensure that no air is trapped beneath the base plate.

PSH7 TESTING

PSH7.1 TEST CERTIFICATES

The structural steel fabricator shall obtain and submit to the Engineer certificates from all suppliers from whom steel is purchased stating that the material supplied conforms in all respects with SABS 1431 Grade 300WA.

PSH8 MEASUREMENT AND PAYMENT

PSH8.3 SCHEDULED ITEMS (Subclauses 8.3.1 to 8.3.5)

The unit of measurement shall be the metric tonne with weights being calculated as defined in Clause 8.2, or for single items combining the requirements of Subclauses 8.3.1 to 8.3.5, as scheduled.

The rates tendered shall include for all aspects contemplated in these subclauses including but not confined to the preparation of shop drawings, supply, fabrication, delivery to site and erection complete of the structure including the provision of all bolts, nuts and washers required for the full and proper erection of the structure as detailed.

The rate tendered shall include for provision of formwork as required and specified above, the supply and deliver to site of the proprietary grout, mixing of grout and placing the grout in position as specified. It shall include all labour, materials and plant of whatever nature required for the operation.

PSL MEDIUM PRESSURE PIPES

PSL3 MATERIAL

PSL3.1 GENERAL

ADD THE FOLLOWING PARAGRAPHS:

Each type of pipe delivered to the Site shall be of a standard length corresponding to the standard lengths offered by the pipe manufacturer in his catalogue, with a maximum permissible variation in length of ±2%.

A pipe that is shorter or longer than the defined standard will be rejected by the Engineer, except when

such non-standard lengths are required in terms of the Contract and have been specifically manufactured or cut as such by the pipe manufacturer or supplier.

Valves

Valves shall be stored under cover and shall be stacked off the ground in a manner which will prevent the ingress of dirt and ensure that the valve faces, spindles and coatings are not damaged.

PSL3.3 C.I. PIPES, FITTINGS AND SPECIALS (SUB-CLAUSE 3.3)

ADD THE FOLLOWING TO SUBCLAUSE 3.3:

Cast iron fittings shall comply with SANS 546 class D.

PSL3.4 STEEL PIPES, FITTINGS, AND SPECIALS

PSL3.4.1 General

The Contractor shall submit to the Engineer or his representative, the certificates covering the chemical analysis and physical properties of the iron used in the manufacture of pipes and specials.

Written confirmation that welding has been carried out by coded welders shall also be provided if required.

Each pipe or fitting shall have its relevant item number painted onto the exterior surface prior to despatch from the factory.

PSL3.4.3 Pipes of Nominal Bore over 150mm

ADD TO THE SUBCLAUSE 3.4.3:

All steel pipes, fittings and specials shall be manufactured from 4,5mm thick Grade B steel plate and shall comply with the requirements of SABS 719.

PSL3.4.4 Fittings and Specials

ADD TO THE SUBCLAUSE 3.4.4:

All fittings and specials shall be manufactured from straight pipe materials specified under the previous Clauses; the pipe so used shall have satisfactorily passed the stipulated hydraulic pressure test.

PSL3.4.5 Welds

Pipes shall be manufactured from steel strips or plates continuously welded along the seams and the height of the inner weld reinforcement shall not exceed 1mm. In the case of pipes to be used with couplings, the external weld reinforcement shall be ground flush with the outer wall of the pipe over a suitable distance from the end. Pipes shall preferably have a continuous helical seam but nevertheless, longitudinal and circumferential seams would be acceptable for this Contract.

PSL3.4.6 Puddle Pipes

Puddle pipes shall be manufactured from 4,0mm grade B carbon steel pipes and shall comply with the requirements of SABS 719 for electric welded low carbon steel pipes for aqueous fluids.

PSL3.7 OTHER TYPES OF PIPES

PSL3.7.1 uPVC pipes

ADD THE FOLLOWING:

"uPVC pipes and specials for sewer mains and house connections shall be PVC-U Class 34 pipes."

PSL3.7.2 Polyethylene pipes

ADD THE FOLLOWING:

"Polyethylene pipes and specials for sewer mains and house connections shall be HDPE PE100 PN10 SDR 17 pipes.

All HDPE pipes shall be joined by welding."

PSL3.8 JOINTING MATERIALS

PSL3.8.2 Flexible Couplings

Flexible couplings for steel pipes shall be of the "Viking Johnson" type. All nuts and bolts shall be Stainless steel (heavy duty).

The plain end of the steel pipe shall be properly prepared, before corrosion protection, so as to accept the flexible coupling

PSL3.8.3 Flanges and Accessories

Where new pipework is to be joined onto existing pipework, the Contractor shall measure the existing flanges and report the dimensions to the Engineer. The drilling of new flanges shall match the existing flanges.

In new installations, where pipes are not coupled onto existing pipework, the flanges shall be in accordance with SANS 1123. The dimension and drilling of flanges shall be in accordance with the requirements of SABS 1123, table 1600, unless scheduled otherwise. All flanges shall be truly at right angles to the axis of the pipe or fitting.

Puddle flanges used as pipe anchorage shall be of the same dimensions as corresponding flanges but are to be undrilled. The flange shall be welded to the pipe with sufficient strength to be capable of transmitting a longitudinal force 50% greater than the force to be applied under test conditions.

Flanges shall be machined flat and without a raised joint face.

Flanges for low-pressure applications (less than 10 bar) shall be of the slip-on type. Flanges for high-pressure applications (greater than 10 bar) shall be of the socket weld type, unless otherwise agreed with the Engineer.

Flanges shall be manufactured from materials equal to or better than the pipes to which they are connected.

PSL3.8.6 Spigot and socket Pipes

ADD THE FOLLOWING:

The shortest length of pipe which may be used in the pipeline is 0,5m, thus the shortening of an adjacent pipe may be necessary so as to ensure compliance with the position of specials. When pipes of 1m or less in length are used or where specials are laid within 1m of each other, they shall be jointed by means of C.I. repair couplings.

PSL3.8.8 Jointing Gaskets

Jointing gaskets for flanged joints shall comply with the requirements of BS 4865 and be cut to the full width of the flange. The materials shall be suitable for and compatible with the required pressure and temperature duties, and characteristics of the material conveyed.

PSL3.8.9 Fasteners

Bolts and nuts shall be hexagon head type complying with SANS 1700 with threads of the coarse pitch series.

Washers of similar material to the bolts shall be provided under each nut and bolt head. Multiple washers or shims shall not be used. Spring washers or other approved locking arrangement shall be used, together with flat washers on all fasteners subject to vibration.

All fasteners shall be manufactured of grade 316 stainless steel.

PSL3.8.10 Anti-seize Compound

Before assembly, threads shall be treated with a nickel based, anti-seize/corrosion protection compound such as Chesterton 725: Nickel Anti Seize Compound, or equivalent and approved.

Copper based compounds are not acceptable and, if used, shall be cleaned off before the correct compound is applied.

If it is found during inspection that compound has not been applied, the Contractor shall disassemble all fasteners and comply with this requirement.

A small amount of compound shall be applied along the full length of the thread before the nut is applied. Excessive compound visible on the thread after the nut has been applied shall be cleaned off.

PSL3.9 CORROSION PROTECTION

PSL3.9.2 Steel pipes

ADD THE FOLLOWING TO SUBCLAUSE 3.9.2:

Steel Pipes except Puddle Pipes

Before leaving the factory all mild steel pipes, fittings and other steelwork shall be abrasive blast- cleaned internally and externally to Grade Sa2½ of the Swedish Standard SIS 05-5900 to an angular surface profile within the limits of 30 - 50 microns and immediately thereafter all mild steel pipes and fittings shall be galvanised.

After galvanising, the pipework shall be degreased and cleaned using an approved degreasing agent. The surface shall be self-etch primed with a primer which is suitable for a galvanised surface and which is compatible with the specified paint system.

Steel pipes shall receive the following paint system:

Internally (including end of plain ended pipes and fittings): A polyamide-cured epoxy system consisting of three coats of Copon EP 2300 or other approved (by the Engineer) non-toxic epoxy resin paint to give a total minimum dry film thickness of 250 micrometres without holidays, both coats being supplied within the time limits specified for the paints.

Externally: As above (the same system specified for "Internally").

Plain ends of pipes and fittings shall be covered and protected against damage whilst being transported from the factory to the Site.

Puddle Pipes

Carbon steel puddle pipes shall be protected against corrosion in terms of System C described in Particular Specification PA for immersed conditions.

PSL3.9.5 Joints, Bolts, Nuts and Washers

ADD THE FOLLOWING TO SUB-CLAUSE 3.9.5:

Bolts, nuts and washers shall conform to SANS 135. All bolts, nuts and washers shall be hot dipped galvanised (heavy duty) Gr8.8.

PSL3.9.6 Corrosive soil

ADD THE FOLLOWING:

Where shown on the Drawings, steel pipes in contact with corrosive soil shall be wrapped with Densopol 80HT or an equivalent approved product, strictly in accordance with the manufacturer’s instructions.

Saddles, cast iron detachable and flanged joints together with their bolts, and a minimum of 100mm of pipe on each side of the joint shall be protected by means of either an approved protective petrolatum paste, then wrapped with three layers of an approved petrolatum impregnated tape, or other means of inhibiting corrosion approved by the Engineer. All overlaps shall be 30mm minimum. This protection shall also be applied to the bolts and flanges used by the manufacturer in the construction of valves and hydrants.

The rates shall cover the cost of corrosion protection for the complete joint.

PSL3.10 Valves

Valves shall comply with the requirements of SANS 1200 LK, and the following requirements:

PSL3.10.1 Gate Valves

All valves shall be AVK or similar approved by the Engineer. Resilient seal valves shall be used for general applications and shall:

(a) bear the SABS mark of approval, shall comply with SABS 664;

(b) be double socketed for PVC pipes or flanged for steel pipes, or as scheduled by the manufacturer;

(c) The direction of rotation shall be anti-clockwise for closing when viewed from above. The direction of opening or closing of each valve, and the appropriate words and have the direction of opening clearly embossed on the valve body and spindle cap;

(d) be heavy duty Class 16, unless a different class is specified;

(e) have non-rising spindles along pipelines, but have rising spindles within the Pump Stations;

(f) Bodies, gates and glands shall be cast iron or cast steel, spindles bronze, and sealing rings on gate and body gunmetal or stainless steel;

(g) be fitted with cast iron square cap tops or handwheels (as specified) secured with retaining bolts, top permanently marked with the direction of closing;

(h) Dimensions and drilling of flanges shall be in accordance with the requirements of SANS 1123 Table 1600/3 unless scheduled otherwise;

(i) Before or after completion of the factory tests, whichever is applicable, all valves shall be thoroughly cleaned and painted at the factory prior to despatch to Site;

(j) be protected against corrosion by:

1) Electrostatically applied epoxy resin to DIN 30677 with a minimum coating thickness of 250 micron; or

2) coating with a minimum thickness of 250micron copon KSIR 88 epoxy paint applied to all internal and external surfaces after it has been thoroughly cleaned by grit blasting to SA 2 ½ finish in compliance with the requirements of SIS 05 09 00, or similar approved coatings.

Rates shall include for testing and providing the test certificates and the specifications from the manufacturer before installation of the valves commence. The batch serial numbers for cross reference shall be clearly marked on the body. No payment will be made unless the test certificates and specifications have been submitted.

PSL3.10.2 Sluice Valves

Sluice valves shall be double flanged and shall comply with the requirements of SABS 664, Class PN16.

Valves shall be drop tight under test and working conditions and shall have non-rising spindle, wedge closure, and flanged suitable for repacking under pressure. Bodies, gates and glands shall be cast iron

or cast steel, spindles bronze, and sealing rings on gate and body gunmetal or stainless steel. Dimensions and drilling of flanges shall be in accordance with the requirements of SABS 1123 Table 1600 unless scheduled otherwise.

All sluice valves shall be fitted with square caps. The direction of rotation shall be anti-clockwise for closing when viewed from above. The direction of opening or closing of each valve, and the appropriate words shall be embossed on the cap and gland.

Before or after completion of the factory tests, whichever is applicable, all valves shall be thoroughly cleaned and painted at the factory prior to despatch to Site.

All cast iron surfaces of every valve shall be prepared for painting to a thoroughly clean condition free of all grease and deleterious matter.

Valves shall be protected against corrosion by:

1) Electrostatically applied epoxy resin to DIN 30677 with a minimum coating thickness of 250 micron; or

2) coating with a minimum thickness of 250micron copon KSIR 88 epoxy paint applied to all internal and external surfaces after it has been thoroughly cleaned by grit blasting to SA 2 ½ finish in compliance with the requirements of SIS 05 09 00, or similar approved coatings.

Rates shall include for testing and providing the test certificates and the specifications from the manufacturer before installation of the valves commence. The batch serial numbers for cross reference shall be clearly marked on the body. No payment will be made unless the test certificates and specifications have been submitted.

PSL5 CONSTRUCTION

PSL5.1 LAYING

PSL5.1.3 Keeping Pipelines Clean

All pipes and specials strung out above ground along the line of the trench shall have both ends closed by means of an adequately fixed plastic cap or other approved material, supplied by the Contractor, in order to prevent the ingress of foreign material.

PSL5.1.4 Depths and Cover

PSL5.1.4.1 *ADD THE FOLLOWING TO SUB-CLAUSE 5.1.4.1:*

Watermains and rising mains shall be laid so that the cover to the top of the pipe barrel from finished surface level is generally, but not less than, 800 mm in the case of watermains less than 250 mm diameter, and 1.0 m in the case of the 300 mm and larger diameter pipelines.

The value of 800 mm above shall be increase to 1 m within road reserves.

During construction there shall be not less than 0,5 metre of cover over the pipes, where construction traffic is liable to cross them, hence road crossings, shall be constructed after the construction of the road layers has reached the stage where 0,5 metre cover is available.

PSL5.1.4.3 *ADD THE FOLLOWING TO SUB-CLAUSE 5.1.4.3:*

Where the minimum clearance between pipe crossings would be less than that specified in Sub- Clause 5.1.4.3, the watermain shall be laid beneath the service crossed at an invert level which allows for the clear space as specified. The watermain shall be laid horizontally at this level for a distance of at least 1,0 m on either side of the centreline of the service crossed and then revert to the specified cover.

No decrease in cover or clear space between the pipe barrels as specified will be permitted unless otherwise instructed by the Engineer in writing.

PSL5.1.6 Changes in Direction

Vertical and horizontal direction changes less than 11¼º shall be achieved by deflecting the pipes at the joints. The deflection at each joint shall not exceed the value recommended by the pipe manufacturer and if necessary, the specified change in direction shall be achieved over a number of pipe lengths.

PSL5.2 JOINTING METHODS

PSL5.2.1 Detachable Couplings (AC and uPVC Pipelines)

ADD THE FOLLOWING TO SUB-CLAUSE 5.2.1:

Unless otherwise specifically detailed on the drawings, uPVC water pipes, specials and fittings shall be coupled with spigot and socket joints fitted with rubber sealing rings. In the following cases, ductile iron repair couplings shall be used:

(a) on one end of each valve and hydrant;

(b) where pipes have to be cut to fit specials in designated positions, refer to PSL 3.8.6.

ADD THE FOLLOWING NEW SUBCLAUSE TO SUBCLAUSE 5.2:

"PSL5.2.5 Welding of polyethylene pipes

All Contractors shall comply with all product and welding standards as set out in the IFPA Code of Conduct and minimum audit requirements. Copies of such documents can be obtained from IFPA and all current IFPA members.

The welding equipment and processes shall comply with the applicable SANS (South African National Standard) for the welding operation as follows:

- The SANS 1671 "series" of standards specifies the requirements for conformance of machines and equipment.
- The SANS 10268 "series" of standards specifies the requirements for conformance of welding processes.
- SANS 10270 Welding of thermoplastics – Approval of welding procedures and welds.

Before work commences the contractor shall be required to obtain approval by conforming to the following:

- SANS 10269 Welding of thermoplastics – Testing and approval of welders
- SANS 10269 Plastics welder Test Piece Certificate
- SANS 10270 Welding of thermoplastics – Approval of welding procedures and welds.

The process of each approval is witnessed by an independent qualified welding inspector (Plastics SA Certificate of Competence "Thermoplastic Welding Inspection" or similar certificate from an accredited institution) who documents conformance on completion, records the approval and certificates it.

Non-destructive visual assessment of the weld shall be conducted in accordance with the following:

- SANS 10268-10 Welding of thermoplastics – Welding processes Part 10: Weld defects.

Destructive testing of the weld shall be conducted in accordance with the following:

- Weld qualification (competence):
- SANS 6269 Welding of thermoplastics – Test methods for welded joints.
- System weld (performance):
- Pipe system standard
- System designed weld factor.

No welding inline of unmarked non-traceable non-conforming product (Components) shall be done.

During the construction of the works, the "last weld" shall be "cut-out", on a random basis, from the pipeline for visual inspection and destructive testing at a sampling rate as follows:

- 0 – 250 welds 5%
- 250 – 500 welds 3%
- 500 – 1200 welds 2%
- 1200 – 3200 welds 1%
- 3200 – 10000 welds 0,5%

The contractor shall allow for this sampling rate in their tender and in the construction program for the works.

Non-conforming workmanship will be reported and corrected in line with the standards and specific requirement and will be signed off for inclusion in the Welding and Qualification file."

PSL5.3 SETTING OF VALVES, SPECIALS AND FITTINGS

ADD THE FOLLOWING:

Valves and hydrants shall be so sited that the valve spindle or hydrant outlet is directly opposite an erf side boundary or splay corner peg, to within 150 mm, or as otherwise dimensioned on the drawing.

Where specials are required in close proximity of one another the minimum pipe length between specials shall not be less than one metre unless adequate precautions are taken to prevent excessive movement of the numerous flexible couplings.

The shortening of the adjacent pipes may be necessary to achieve the above and ensure compliance with the position of specials" (see sub-clause PSL 3.8.6).

PSL5.5 THRUST BLOCKS

All thrust blocks shall be cast against undisturbed material. In the event of the Contractor over-excavating, he shall carry the cost of any additional concrete required to comply with this provision.

Prior to casting any thrust blocks, the Contractor shall notify the Engineer who shall inspect the nature of the ground against which the thrust block is to be cast and either confirm that the specific conditions do not differ from those on the basis of which the thrust blocks shown on the drawings were designed, or instruct the Contractor to alter the dimensions of the thrust block to suit the actual ground conditions.

Any pipe laid on a gradient exceeding 25% shall be anchored as directed by the Engineer.

PSL5.12 CONNECT TO EXISTING MAINS

Where connections have to be made to the existing water mains, the following procedure has to be followed:

(a) Liaise with the Local Authority to arrange a suitable time period for the proposed connection.

(b) Ensure all tools and fittings of the correct size and type are on site prior to requesting the shutdown of the mains.

(c) Advise the Local Authority at least 3 days in advance of the intention to commence work, in order for them to shut down the mains.

(d) Arrange with the Local Authority to have an official present on site when the work commences.

(e) Advise the Local Authority when work is complete and thrust block in place and sufficiently cured, for the system to be recharged. Work to be completed to minimise the disruption to the supply to a maximum of 12 hours.

All arrangements and planning must be made in close collaboration and with the approval of the Engineer's Representative on site. Names and contact personnel at the Local Authority will be advised at the required time.

PSL5.13 AS BUILT SURVEYS

The Contractor shall survey the final position of all buried pipework installed, prior to backfilling.

The pipework shall be surveyed and the information submitted to the Engineer as the work progresses. No joint shall be backfilled before the survey information has been approved by the Engineer.

The pipelines shall be coordinated at centrelines of all bends, specials and fittings and intermediate points at intervals of not more than 50 m.

The survey data shall be presented in tabular format giving Y-Coordinate, X-Coordinate, chainage and level. All coordinates and levels shall be referenced to the WGS 84 system and Mean Sea Level (MSL).

for the temporary termination of supply, as specified in Clause PSL 5.1. Fittings required for the connections shall be measured elsewhere.

PSL7 TEST

PSL7.3 STANDARD HYDRAULIC PIPE TEST

PSL7.3.1 Test Pressure and Time of Test

PSL7.3.1.2 Test Pressure

ADD THE FOLLOWING:

"Before any connections are made, pipes are to be tested to 1.5 times the working pressure of the specific class of pipe. After connections have been done, the complete network is to be tested at the maximum static pressure as specified by the Engineer."

PSL 8 MEASUREMENT AND PAYMENT

PSL8.2 SCHEDULED ITEMS

PSL8.2.6 Specials

ADD THE FOLLOWING:

"Where the new works are to be connected to existing pipelines or fittings, all costs associated with the excavation, removal of fittings, cutting in, joining, labour and complete finishing are deemed to be included in the tendered price."

PSL8.2.11 Anchor blocks/ Thrust blocks and pedestals

INSERT "concrete" BEFORE "and" IN THE LAST LINE OF THE LAST PARAGRAPH ADD THE FOLLOWING:

The offered rates shall also include the wrapping of uPVC pipes and fittings with Densopol 80 or similar approved material where the pipes and fittings come into contact with concrete.

ADD THE FOLLOWING CLAUSE:

"PSL8.2.16 Connection to existing services.....Unit: sum

The offered sum shall include full compensation for exposing the existing pump station pipework, cleaning up the connection point, dealing with water, supplying and installing a suitable coupling between the new pipe and existing pipes of varying materials, ensuring the water tightness of the new connection, backfilling of the excavations, all labour and equipment required to make the connection, and liaison with the local authorities."

PSLB BEDDING (PIPES)

PSLB2.2 RIGID PIPES

All steel, clay and concrete pipes shall be laid on a class C bedding as shown on Drawing LB-1 of SABS 1200LB.

PSLB2.3 FLEXIBLE PIPES

uPVC, mPVC and polyethylene pipes will be regarded as being flexible and shall be bedded as per Drawing LB-2 of SABS 1200 LB.

PSLB3 MATERIAL

PSLB3.1 SELECTED GRANULAR MATERIAL

REPLACE THE CONTENT OF THIS SUBCLAUSE WITH THE FOLLOWING:

Selected granular material shall have a PI not exceeding 6 and shall be free from sharp-edged particles exceeding 19mm.

PSLB3.2 SELECTED FILL MATERIAL

ADD THE FOLLOWING:

Selected fill material used for bedding shall, where indicated on the Drawings be stabilized with 5% cement as specified under subclause PSDB 3.5(c).

PSLB3.3 BEDDING

ADD THE FOLLOWING:

"Class C bedding as applicable to rigid pipes is required. Material for the Class C bedding will only be imported where insufficient suitable material is obtainable from the excavated material. The selected blanket material must cover the pipe by at least 200mm and not 300mm as specified in the applicable General Specification.

Where large diameter uPVC pipes (> 300mm diameter) are utilized, compaction on either side of the pipe should be carefully done in layers not exceeding 100mm in thickness to ensure that the bedding and pipe act as a "pipe-soil system" to prevent ovality of the pipes occurring during backfilling"

PSLB3.4 SELECTION

PSLB3.4.2 Suitable Material not available from the trench excavation

ADD THE FOLLOWING:

"Should there during selective excavation methods (including screening) with the correct tools still be insufficient suitable material available for the bedding, the material must be imported. The Contractor will find a suitable source of bedding material and submit it to the Engineer for approval.

The finding of a suitable source/quarry/borrow pit, loading, transport, placement and compaction of the imported material is deemed to be included in the rate tendered by the Contractor."

PSLB5 CONSTRUCTION

PSLB5.1.4 Compaction

ADD THE FOLLOWING:

"After excavation of the trench, the trench bottom will be levelled by means of a rake and compacted. Compaction may be conducted by hand tools. The required compaction to be achieved must exceed or equal 90% Mod ASHTO density.

After installation of the pipes, similar compaction must be applied to the blanket material. Now the final backfilling to 50mm above the adjacent soil levels may be carried out. The total working area shall then be finished off. Only when specified by the Engineer will sidewalks be finished to specific standards and levels.

Where streets and roads are crossed, compaction of the bedding and backfill must be conducted by mechanical means to achieve a density of 98% Mod AASHTO."

PSLB6 TOLERANCE ON COMPACTION OF BEDDING MATERIAL

Degree of accuracy II shall prevail.

PSLB7 TESTING

PSLB7.1 DENSITY

ADD THE FOLLOWING:

"After compaction of the bedding layers inside the trench, each layer shall be tested at 100m intervals. A minimum of 3 test per layer within the 100m interval shall be taken. The Engineer may order additional testing.

Density tests shall not be taken on the bedding - blanket layer material directly above the pipe to mitigate damages imposed by the Troxler or DCP.

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

The Contractor shall supply, insure and maintain the following equipment for use by the Engineer's Representative's personnel for the duration of the Contract:

(a) Dynamic Cone Penetrometer (DCP) Equipment

The Contractor shall supply two (2) Dynamic Cone Penetrometers (DCP) and an assistant to support testing activities as directed by the Engineer's Representative. The equipment shall include the following components:

i. Two (2) DCP units, complete with:
- 1-meter Extension Rod
- DCP Top Rod, including weight
- 1-meter Bottom Rod
- 1-meter, 1.5-meter, and 2-meter Rulers
- Carrying Bag for DCP
- Hardened DCP Cone
- Disposable DCP Cone
- DCP Cone Adapter (for disposable cones)
- 8 kg DCP Weight

All equipment shall be in good working condition and meet the specifications required for accurate and reliable testing"

PSLB8 MEASUREMENT AND PAYMENT

PSLB8.1 PRINCIPLES

PSLB8.1.5 Disposal of displaced material

REPLACE THE CONTENT OF THIS SUBCLAUSE WITH THE FOLLOWING:

Material displaced by the pipeline and by imported material from sources other than trench excavation, shall be disposed of at an approved site furnished by the Contractor. No haulage is payable for such

material.

PSLB8.1.6 FREE-HAUL

DELETE THE WORDS "of 0,5km" IN THE FIRST LINE OF THIS SUBCLAUSE

PSLB8.2 SCHEDULED ITEMS

PSLB8.2.6 Extra over items 8.2.1 and 8.2.2 for bedding stabilized with 5%cement……..Unit: m^3

The extent rate shall include full compensation for selecting, mixing, backfilling and compacting the stabilized material to 90% of modified AASHTO density.

ADD THE FOLLOWING ITEM:

"PSLB8.2.7 Geotextile wrapping around the bedding (Bidim A4 (U24) or approved equivalent; where instructed by the Engineer) ……..……...Unit: m^2

The extent rate shall include full compensation for placing the geotextile sheet on the floor of the trench with a sufficient amount of the sheet left along the sides of the excavation to allow for wrapping over the bedding material, and wrapping the material over the finished bedding material after it has been sufficiently compacted.

ADD THE FOLLOWING ITEM:

"PSLB8.2.8 450mm hard fill pioneer layer (dump rock) at the bottom of trenches (where instructed by the Engineer) with 100mm max. aggregate size. To be compacted with a vibrating roller until settlement of <10mm is achieved ……...Unit: m^2

The offered rate shall include full compensation for excavation, placing and supplying all the necessary materials, compaction, removing surplus material, and all labour and equipment required and providing all as specified. Suitable compaction will be obtained when the surveyed level of a steel plate placed at a point on the dump rock layer, lowers by less than 10mm after being passed over by a vibrating roller.

PSLD SEWERS

PSLD3 MATERIALS

PSLD3.1 PIPES, FITTINGS AND PIPE JOINTS

ADD THE FOLLOWING TO SUBCLAUSE 3.1.5:

"Pipes and specials for sewer mains and house connections shall be PVC-U Class 34 pipes, HDPE PE100 PN10 SDR 17 Pipes, Steel-reinforced, spirally wound polyethylene (PE) Pipes or as scheduled.

All HDPE pipes shall be joined by welding.

"Steel-reinforced, spirally wound polyethylene (PE) drainage and sewer pipes shall be manufactured in accordance with the South African National Standard SANS 674:2008.

Steel-reinforced polyethylene pipes shall consist of HDPE PE100 material with integrated steel strips.

The pipes shall have a spiral structure with concentric steel-reinforced HDPE ribs around the

circumference. They shall be joined by HDPE fusion-welding along the spirally wound profile edges using an electrofusion belt system or by means of using a stainless-steel clamp with a rubber sleeve system consisting of three layers."

PSLD3.5 MANHOLES, CHAMBERS, ETC

PSLD3.5.2 Precast concrete sections

ADD THE FOLLOWING:

"Sectional spun-concrete cylinders, mortar, benching and plastering shall be manufactured from dolomitic aggregate."

PSLD3.5.7 Step Irons

Plastic encapsulated step irons or similar approved by the Employers Agent in manholes will be required.

PSLD3.5.8 Manhole Covers and Frames

Notwithstanding the requirements of Sub-Clause 3.4.3 all covers and frames shall be constructed of ductile iron, and shall conform to the requirements of EN 124, Class C250, or D400, as indicated on the Drawings. Concrete cover manholes both medium to heavy duty as maybe deemed appropriate.

Where grid inlets are required these shall be manufactured from ductile iron conforming to the requirements of EN 124, Class C250 or shall be constructed in concrete. A sample of the grid shall be provided to the Engineer for approval.

Once constructed, all covers must be securely seated in the frame and may not wobble, rock or exhibit any instability. Unstable covers will not be accepted and shall be replaced at the Contractor's own cost. Any associated costs, such as the removal, replacement and making good of frames, layer works, kerbing and surfacing, shall also be borne by the Contractor.

PSLD3.6 MARKER POSTS

REPLACE THE WORDS "Project Specification" *WITH* "Drawings"

ADD THE FOLLOWING:

"Marker posts shall be manufactured from 1.5 m long R25 bars hooked at one end and cast into Grade 15 MPa/19 mm concrete blocks not less than 300 x 300 x 300 mm in size. Each post shall have a 150 mm wide band painted at the top using an approved exterior enamel paint to indicate the service."

PSLD5 CONSTRUCTION

PSLD5.6 MANHOLES, INSPECTION CHAMBERS ETC

DELETE AND INSERT THE FOLLOWING:

"Manholes shall generally be precast concrete rings with sealed joints as detailed on Drawings SANS 1200 LD–5, and shall be installed according to the manufacturer's specifications. After the joints have been sealed with an approved sealant in accordance with Sub clause 3.5.2 the joints shall be covered on the outside by a double wrapping of polyethylene adhesive tape.

The flexible connections to the manholes shall be as shown on Drawings SANS 1200 LD-2.

Benching shall be constructed at a slope of 1 (vertical): and 4 (horizontal).

The frames for manhole covers must be fixed to the top of the cover slab with 1:3 cement sand mortar.

Brickwork 220 mm thick with 1:4 cement sand mortar must be used for the correction of cover slab heights.

The depth of the shaft (min 300 mm) may not exceed 600 mm.

The top of manholes situated in the veld shall be 300mm above existing ground level."

PSLD5.9 CONNECTING SEWERS

PSLD5.9.1 Location and details

DELETE THE FOLLOWING FROM THE FIRST PARAGRAPH:

"or required in terms of the Project Specifications."

DELETE THE SECOND PARAGRAPH.

PSLD5.11 PIPE LAYING WITH HIGH WATER TABLE (NEW CLAUSE)

Where a high- water table is encountered and a probability exists of water entering the trench after the pipeline has been laid, the Contractor will be permitted to bed and lay the pipes and backfill sufficiently to prevent flotation, prior to testing.

PSLD6 TOLERANCES

PSLD6.6 AS-BUILT INFORMATION

The Contractor shall submit "As-Built" levels, distances between manholes and the grades of pipelines for which he requires payment at the time he submits his monthly payment claim. A sample form is obtainable from the Employer's Agent.

PSLD7 TESTING

PSLD7.2.7 Acceptance Criteria

The acceptance of the pipe length or manhole shall depend upon whether it satisfies the criteria set out in SABS 1200 LD clauses 6, 7 and the PS clauses above.

Where pipes other than vitro clay pipes are laid, only tests carried out on the pipelines after completion of the backfilling to ground level (excluding surface restoration) and completion of the construction of manholes to roof height, including benching, will be considered for acceptance purposes.

In the case where vitro clay pipes are being laid, no pipelines are to be covered prior to inspection and approval by the Employer's Agent. Once the pipeline has been laid and bedded in the compacted bedding cradle (to half pipe) between control points, the Employer's Agent must be called out to inspect the installation. The Contractor is to provide the necessary equipment in order for the Employer's Agent to adequately assess that the pipeline has been laid to the specified tolerances. Further, an air test, in accordance with the specifications, is to be conducted and witnessed by the Employer's Agent prior to the placing of the Fill Blanket.

PSLD8 MEASUREMENT AND PAYMENT

PSLD8.2 SCHEDULED ITEMS

PSL8.2.1 Payment Method

Payment for pipes shall be per meter length calculated based on the number of lengths supplied in each sized length category. The bends, tees, valves and meters are measured as separate payment items.

The following shall apply:

80% of the total tendered rate payable upon completion of laying and jointing;

20% of the total tendered rate payable upon completion and approval of testing.

PSLD8.2.11 Connection to existing sewer at

REPLACE THIS ITEM WITH THE FOLLOWING:

"PSLD8.2.11 Connection to existing sewer manhole.....Unit: Number

The offered rate shall include full compensation for excavation, making an opening in the existing manhole, installing new pipes in the new opening, breaking out and modifying the channelization inside the manhole to suit the new pipe layout, ensuring the water tightness of the new connection, supplying all the necessary materials, removing surplus material and debris, all labour and equipment required to make the connection, and liaison with the local authorities."

ADD THE FOLLOWING ITEM:

"PSLD8.2.13 Breaking into existing sewer and building a new manhole……Unit: Number

The offered rate shall include full compensation for excavation, building a new manhole over the sewer, breaking into the existing sewer, building the channelization under wet conditions, ensuring the water tightness of the new connection, supplying all the necessary materials, removing surplus material, all labour and equipment required to make the connection, and liaison with the local authorities." the draw wire, jointing, bedding and providing all as specified.

ADD THE FOLLOWING ITEM:

"PSLD8.2.14 Construction of extended manhole structures (where instructed by the engineer), including formwork and allowance for reinforcement of 125kg/m³ …….....Unit: Number

The offered rate shall include full compensation for excavation, 50mm blinding layer, formwork, providing reinforcement of approximately 125 kg/m³, building the reinforced concrete structure of approximately 2 m³, supplying all the necessary materials, removing surplus material, all labour and equipment required and providing all as specified.

ADD THE FOLLOWING ITEM:

"PSLD8.2.15 450mm hard fill layer (dump rock) under manhole foundations, with 100mm max. aggregate size and extending 500mm beyond the manhole foundation footprint. To be compacted with a vibrating roller until settlement of <10mm is achieved .....Unit: m³

The offered rate shall include full compensation for excavation, placing and supplying all the necessary materials, compaction, removing surplus material, and all labour and equipment required and providing all as specified. Suitable compaction will be obtained when the surveyed level of a steel plate placed at a point on the dump rock layer, lowers by less than 10mm after being passed over by a vibrating roller.

NALA LOCAL MUNICIPALITY

CONTRACT NO.

NLM/TS/004/2025-26

THE REFURBISHMENT OF SEWER PUMP STATION AND ERADICATION OF 250 BUCKETS IN EXT. 12 & 13 IN WESSELSBRON

SECTION C3.3

PROJECT SPECIFICATIONS

NALA LOCAL MUNICIPALITY

CONTRACT NO.

NLM/TS/004/2025-26

THE REFURBISHMENT OF SEWER PUMP STATION AND ERADICATION OF 250 BUCKETS IN EXT. 12 & 13 IN WESSELSBRON

PORTION 2: CONTRACT

PART C3.3.1

General Project Specifications

The Project Specifications (PS) form an integral part of the contract and supplement the Standard Specifications. They contain a general description of the works, the site and the requirements to be met.

In the event of any discrepancy between a part or parts of the Standard or Particular Specifications and the Project Specification, the Project Specification shall take precedence. In the event of a discrepancy between the Specifications, (including the Project Specifications) and the drawings and/or the Bill of Quantities, the discrepancy shall be resolved by the Employer's Representative before the execution of the work under the relevant clause or item.

Any reference to "the Engineer" in this document is to be read as "the Employer's Agent" in terms of the definition 1.1.1.16 of the General Conditions of Contract for Construction Works as issued by SAICE - Third edition (2015).

PS 15 MATERIALS AND PLANT
PS 16 NOTICES, SIGNS, BARRICADES AND ADVERTISEMENTS
PS 17 SETTING OUT OF WORK
PS 18 WORKMANSHIP AND QUALITY CONTROL
PS 19 TRANSPORT OF MATERIAL
PS 20 LIAISON WITH LOCAL AUTHORITIES
PS 21 LOCAL LABOUR AND LOCAL SUBCONTRACTORS
PS 22 TRAINING SCHEMES
PS 23 PRESCRIPTIONS IN RESPECT OF EXISTING SERVICES
PS 24 ENGINEERING
PS 25 PROCUREMENT

PS 1: CONSTRUCTION PROGRAMME

It is a prerequisite of this contract that minimal disruption of the public is ensured during construction. Construction methods must be of such a nature that no property or life is endangered. The Employer accepts no responsibility for any work done outside the site boundaries without the Engineer's approval. The Contractor himself is responsible for liaison and arrangements with the Engineer in connection with the finalization and approval of the construction programme.

The Contractor is responsible for liaison with residents and house owners via the Project Steering Committee in respect of the programming of construction through private erven and the crossing of driveways to erven. No additional payment will be made in this regard and it shall be deemed to be covered by the relevant items.

Sufficient digital photographs of all existing structures and obstructions in the pipeline routes must be taken by the Contractor, compiled electronically, indexed and handed over to the Engineer before construction commences. A special payment item is included for a digital photo record in the Schedule of Quantities under other fixed-charge obligations.

The Contractor shall submit a programme of work to the Engineer not later than 14 (fourteen) days after the Contractor has been notified of the acceptance of his tender. This programme must take into account, and allow for phased completion of the work. The Engineer may instruct the Contractor to stop construction work at any stage and time, as may be dictated by financial constraints highlighted by the Employers Cost Control Programme.

If necessary, the Engineer may instruct the Contractor to adjust his programme to suit other activities.

The programme shall not be in the form of a bar chart only, but shall clearly show the anticipated quantities, the production rates and the value of work to be performed each month.

A network-based programme according to the precedence method shall also be provided showing the various activities and critical path in such detail as may be required by the Engineer. The programme shall be updated monthly in accordance with the progress made by the Contractor.

Failure to comply with these requirements will entitle the Engineer to use a programme based on his own assumptions for the purpose of evaluating claims for extension of time or additional payments.

If the programme submitted by the Contractor in terms of Clause 5.6.1 of the General Conditions of Contract, 2015, has to be revised because the Contractor is falling behind in his programme, he shall submit a revised programme of how he intends to regain lost time to ensure completion of the Works within the period defined in Clause 5.3.3 of the General Conditions of Contract or within a granted extension of time. A proposal to increase the tempo of work must incorporate positive steps to increase production either by more labour and plant on the site, or by using the available labour and plant in a more efficient manner.

Failure on the part of the Contractor to submit or to work according to the programme or revised programmes shall be sufficient reason for the Engineer to take steps as set out in Clause 9.2 of the General Conditions of Contract.

The approval by the Engineer of a programme shall have no contractual significance other than the Engineer will be satisfied if the work is carried out according to the programme. The said approval shall not limit the right of the Engineer to instruct the Contractor to vary the programme if necessary. The Contractor shall allow for the effect of normal rainfall and special non-working days in his programme.

(CRITICAL PATH MUST BE INDICATED ON PROGRAMME)

PS 2: SITE FACILITIES AVAILABLE

PS 2.1: Campsite

The Contractor shall negotiate with property owners and make his own arrangements to obtain sites for the erection of offices, laboratories, yards, etc. Written approval must be obtained from the owners on whose property the camp is to be situated. The choice of all sites for the establishment of camps is subject to the approval of the Engineer. Campsites within the road reserve will not be permitted.

PS 2.2: Water, electricity and sewage

The Contractor shall make his own arrangements concerning the supply of electrical power, water, telephone and all other services, both for use at the site establishment area as well as for the use in the construction of the Works. No direct payment shall be made for the provision of any service and the cost thereof shall be deemed to be included in the rates tendered for the various items of work for which these services are required.

PS 2.3: Rain gauge

The contractor must set up his own rainfall gauge. This item is included in the Schedule of Quantities under other fixed-charge obligations.

PS 3: SITE FACILITIES REQUIRED

PS 3.1: Facilities for the Engineer

An office is required for the use of the Employer's Agent representative on site. (See SABS 1200 AB and as amended in the project specifications).

It will be a requirement of this contract that all work pertaining to the provision of the office of the Employer's Agent shall be completed in full prior to the Contractor being permitted to commence work on site.

The Contractor shall provide one dedicated parking area for the Employers agent representative for exclusive use. The Parking area should be covered with suitable covering to provide 100% shade.

A male and female ablution facility with a hand wash basis shall be made available for exclusive use for the Engineer and Employer.

PS 3.2: Equipment for Engineering staff

The Contractor shall allow for providing the following protective clothing for the engineering staff:

2 high visibility vests
2 hard hats (white)
2 sets of safety boots

The contractor shall supply the Engineer with a Business cell phone and be responsible for the monthly running cost, and other costs relating to the use of the cell phone.

PS 3.3: Water, electricity and sewage

The Contractor shall, at his own expense, be responsible for obtaining and distributing the water and electricity required for construction and domestic use. The distribution of water and electricity shall be carried out in accordance with the applicable laws and regulations.

No separate payment will be made for obtaining and distributing water and electricity, the cost of which will be deemed to be included in the tendered rates.

PS 3.4: Site instruction book

A triplicate book shall be provided by the Engineer to be used for site instructions. It shall at all times be kept on the site.

PS 4: FEATURES REQUIRING SPECIAL ATTENTION

PS 4.1: Access to properties

The Contractor shall organize the work in such a manner as to cause the least possible inconvenience to the public and to the property owners adjacent to or affected by the work included in this contract.

If, as a result of restricted road reserve widths and the nature of the works, the construction of bypasses is not feasible, construction shall be carried out under traffic conditions in order to provide access to the erven and properties.

The Contractor may, with the approval of the Engineer, make arrangements with the occupiers of the affected erven and properties to close off a portion of a street, road, footpath or entrance temporarily, provided the Contractor duly notifies the occupiers of the intended closure and its probable duration and shall, as punctually as possible, re-open the route at the prescribed time. Where possible, the road shall be made safe and re-opened to traffic overnight. Any such closure shall be made by arrangement between the Contractor and the occupiers and shall not absolve the Contractor from his obligations under the contract to provide access at all times. Barricades, traffic signs and drums shall be provided by the Contractor to suit the specific conditions. The Contractor shall also comply with all the requirements of the Local Authority with regard to safety, signage and notices to the public.

PS 4.2: Existing residential areas

Access to the adjacent residential areas shall be maintained at all times, as shall access to individual houses.

Electricity and water supply interruptions to existing residential areas shall be kept to a minimum. Whenever it is necessary to interrupt these supplies, the Engineer's approval shall first be obtained. The affected residents shall then be notified in writing at least 3 days, but not more than 5 days in advance. Supplies shall be normalized by 16:00 on the same day.

Cognisance shall be taken by the Contractor of the possibility of residents from the adjacent residential areas having access, whether authorized or not, to the works. It is strongly emphasized that under no circumstances shall any claims be considered for delays or disruptions as a result of the presence of residents from the adjacent occupied areas.

PS 4.3: Facilities to other Contractors

In addition to the requirements of clause 5.4.2 of the General Conditions of Contract, the Contractor must make allowance for the presence of other Contractors engaged on other contracts on the site, which may involve, inter alia, the adoption of his programme to fit in with work to be done by the other Contractors, as well as assuring other Contractors' access to their sites along prescribed routes which may fall within the site of this contract.

PS 4.4: Contractor's vehicles

All equipment and vehicles used by the Contractor shall be roadworthy at all times and all drivers and operators shall be in possession of valid drivers' licenses.

PS 4.5: Site maintenance

During the progress of the work and upon its completion, the site of the works shall be kept and left in a clean and orderly condition. The Contractor shall at all times store materials and equipment for which he is responsible in an orderly manner, and shall keep the site free from debris and obstruction. Workers shall lunch or have tea breaks only in a designated area with approved refuse and toilet facilities.

No open fires shall be permitted on the site.

Vehicles and workers must adhere to property-demarcated access routes and not take or make shortcuts.

PS 4.6: Testing and quality control

The Contractor shall engage the services of an approved independent testing laboratory for the testing of materials and the quality testing of layer works, to ensure that his work conforms to the specifications.

No separate payment will be made for such testing by an approved independent laboratory, the costs of which will be deemed to be included in the Contractor's tendered rates for the various items of work requiring testing in accordance with the specifications.

Certificates shall be submitted to the Engineer for all materials and equipment included in the works, where applicable.

PS 4.7: Subcontractors

The Contractor is responsible for work carried out on his behalf by subcontractors. The Engineer will not liaise directly with such subcontractors, and all problems relating to payments, programming, workmanship, etc, shall be the concern of the Contractor and the subcontractor, and the Engineer will not be involved.

Selected sub-contractors pertaining to the procurement, supply and installation of HDPE using trenchless methods are to be managed by the main Contractor.

Attendance to sub-contractors is to comply with the Conditions of Contract.

PS 4.8: Existing Services

Before the Contractor commences operations, he must discuss with and have the approval of the Employer, authority or owner concerned regarding the method he proposes to use for relocating or safeguarding any services and existing works he may encounter during construction.

The positions of existing services shown on the Drawings are given in good faith and no guarantee can be given that:

(a) these services actually are in the approximate positions indicated.
(b) that these are the only services in the vicinity, and
(c) that the nature and description of these services are correct.

Attention is drawn to the fact that whilst the position of the existing pipelines in servitudes, as well as other services in the vicinity of servitudes, and all other services are indicated on the drawings have been provided as accurately as possible, this information may not be completely accurate and it will be necessary for the Contractor to communicate with the service providers and to prove, trace and expose services which the Contractor has been made aware of as a result of his interaction with service providers. The Contractor shall coordinate meetings with all relevant service providers before construction commences and take all the necessary steps to ascertain the location of existing services before commencing work on any section of the Works. The rates tendered for the location of services and proving of same as well as the updating of existing records of services, shall be deemed to include for these meetings.

The Contractor shall establish at the meetings with service providers, the lead times required to update records and he shall include for this activity in his Construction Programme.

The Contractor shall take all the necessary steps to ascertain the location of existing services before commencing any section of the Works and shall exercise the greatest care when working in the vicinity of such services. Before commencing his operations in any particular area, the Contractor shall request the latest available drawings from the relevant local Service Authorities, showing the location of their services already installed. The Contractor shall ensure that adequate time is allowed for making contact with the relevant Service Authorities in order for them to respond meaningfully. The Contractor shall compare the latest service locations obtained from the Service Authorities with the drawings provided for construction and where required, such construction drawings shall be updated. The Engineer shall be notified of any changes in service locations found on the construction drawings.

The Contractor shall take all necessary steps to protect any existing works or service whatsoever, against damage which may arise as a result of his operations on Site. The Contractor shall bear the cost of the repair of damage to any known service, the possible existence of which could reasonably have been ascertained by him beforehand.

The Contractor shall make allowance for wayleave applications under “other fixed charge obligations” in Section 1 of the BOQ.

The Contractor shall procure the required equipment which will enable him to prove services.

The Contractor shall locate existing pipes, optic fibres cables, electric cables and/or any other services by hand excavation without the use of picks, to minimise the risk of damaging existing services. The Contractor shall be held responsible for any damage caused to existing services that can reasonably be traced and located.

Whilst the location of power, telephone and optic fibre cables, as well as pipelines and other services are indicated on the plan and longitudinal section drawings, this may not be comprehensive. It is the Contractor's responsibility to obtain the latest known information on services, at all times.

It is a requirement of this contract that the Contractor exposes and proves every known service within the advance work front ahead of any work being performed, in order to determine whether its level or location clashes with the designed grading of the pipeline or with the coordinates of the proposed road alignment. All services are to be proved in conjunction with each service provider prior to excavation. Such proving shall be timed to coincide with the requirements of the programme and the limitations on the length of work fronts as specified.

The cost of this work is to be included in the tendered rates for trench excavation or any other excavation and all tendered rates shall be deemed to include for the exposing of known services and the proving of its location No additional payment will be considered for the exposing and proving of services as payment for this shall be deemed to be included in existing payment items as specified in the Bill of Quantities for all types of excavation and the Lump Sum provided for this purpose under Preliminary and General. The item for excavation by hand to expose unknown and known services where instructed by the Engineer is for use by the Engineer only on an as-and-when-required basis.

The Contractor shall be required to prove each and every service, indicating X, Y and Z coordinates. Claims for delays etc. arising from non-compliance with this requirement will not be entertained.

In addition to the marking/pinpointing of known services, the Contractor is to screen the line of the proposed excavations by means of appropriate electronic tracing apparatus for other buried services, such as pipes or cables that may not be shown in services records. All services found in this manner shall be classified as known services and shall be proved as set out above.

Service connections to individual erven are to be located and handled in a manner acceptable to the Engineer. Located and proved services are deemed to be known services.

Should any services which are not on the existing services layout drawings be located, the Contractor shall add the new information to the services layout drawings in order for the employer to update his information. All tendered rates for trench excavations and road works shall include the location of services and the updating of services drawings for the Employer.

The Contractor shall be responsible for immediately notifying the Engineer and the authorities concerned regarding any damage caused to public services and existing works.

Any alteration to public services shall be carried out by the Authority concerned unless the Contractor is instructed otherwise.

The Contractor shall provide the necessary assistance during any operations necessary in connection with the removal, alteration or safe-guarding of any public service.

PS 4.9 Safety

The Contractor shall apply suitable proven methods for construction so that his activities will not constitute a hazard to the public or any adjacent property. All excavations shall be suitably safeguarded and barricaded especially during night time, weekends or holidays and any other day of inactivity by the Contractor.

PS 5: INFORMATION SUPPLIED BY EMPLOYER

Certain information contained in these contract documents, or provided separately, is being offered in good faith. However, in the circumstances pertaining to the type of information supplied, no guarantee can be given that all the information is necessarily correct or representative. More specifically this applies to all material surveys and reports and similar information, the accuracy of which is necessarily subject to the limitation of testing, sampling, the natural variation of material or formations being investigated and the measure of confidence with which conclusions can be drawn from any investigations carried out. It also applies to the positions of existing services as indicated on the drawings.

The Employer accepts no liability for the correctness or otherwise of the information supplied or for any resulting damages, whether direct or consequential, should it prove during the course of the contract that the information supplied is either incorrect or not representative. Any reliance placed by the tenderer on this information shall be at his own risk.

PS 6: EXTENSION OF TIME ARISING FROM ABNORMAL RAINFALL

If abnormal rainfall or wet conditions occur during the course of the Contract, the Employer may grant an extension of time in accordance with Clause 5.12 of the General Conditions of Contract, calculated in accordance with the formula given below for each calendar month or part thereof:

$$V = (Nw - Nn) + (Rw - Rn)/X$$

If V is negative and its absolute value exceeds Nn, then V shall be taken as equal to minus Nn.

The symbols shall have the following meanings:

V = Extension of time in calendar days for the calendar month under consideration. When the value of V for any month exceeds the number of days in the particular month, V will be the number of days in the month.

Nw = The number of days in the calendar month on which a rainfall of Y mm or more was recorded.

Nn = Average number of days, derived from existing rainfall records, on which a rainfall of Y mm or more was recorded for the calendar month.

Rw = Actual rainfall in mm recorded on the Site in an approved rain gauge for the calendar month under consideration.

Rn = Average rainfall in mm for the calendar month, derived from existing rainfall records.

The total extension of time is the algebraic sum of all the monthly totals for the period under consideration, but if the total is negative, the time for completion will not be reduced on account of subnormal rainfall. Extensions of time for part of a month will be calculated by using pro rata values for Nn and Rn.

The factor (Nw - Nn) is considered a fair allowance for variations from the average number of days during which the rainfall exceeds Y mm.

The factor (Rw - Rn)/X is considered a fair allowance for variations from the average number of days during which the rainfall did not exceed Y mm but wet conditions prevented or disrupted work.

The average rainfall record for the past 10 years at the nearest rainfall station shall be for the purposes of this Contract are taken as normal rainfall refer to the table below. Rn and Nn for this period shall be used and the values of X and Y are 20 and 10 respectively.

The average number of days on which Y mm of rain or more has been measured was used to determine the monthly averages (Rn and Na) for this period and shall for the purposes of this Contract be taken as normal:

Month	**N_n (Days)**	**R_n (mm)**
January	11	80
February	10	51
March	8	51
April	5	43
May	1	5
June	1	10
July	1	2
August	1	2
September	2	10
October	3	21
November	7	62
December	11	71
Total	**61**	**408**

PS 7: CERTIFICATES OF PAYMENT

It was agreed that the master copy of the payment certificates would be drawn up and processed by the Contractor. All costs to this effect, as well as reproduction costs shall be to the account of the Contractor. It was agreed that the first month's certificate will be evaluated and if in order, the same format will be used throughout the contract.

Measurement for payment purposes will take place between the 18th and 20th of each month. The Contractor needs to submit his monthly payment claim to the Engineer by the 26th of each month.

Should any of these noted dates fall on a non-working day or a special non-working day, the following working day shall be applicable.

PS 8: CONSTRUCTION IN LIMITED AREAS

In certain cases, working space may be limited. The method of construction in these restricted areas will depend largely on the Contractor's plant. However, the Contractor must note that measurement and payment will be according to the specified cross-sections and dimensions irrespective of the method used to achieve these cross-sections and dimensions, and that the rates and prices tendered shall be deemed to include full compensation for any difficulty encountered while working in limited areas and narrow widths, and that no extra payment will be made, nor will any claim for payment due to these difficulties be considered.

PS 9: NON-WORKING DAYS

The Contractor shall not work on Sundays or on the following statutory Public Holidays: New Years Day, Human Rights Day, Good Friday, Family Day, Freedom Day, Workers Day, Youth Day, National Women's Day, Heritage Day, Day of Reconciliation, Christmas Day and Day of Goodwill. Whenever any of the above statutory Public Holidays fall on a Sunday, the following Monday shall be a Public Holiday.

PS 10: SPOIL MATERIAL

Disposal of spoil and surplus material needs to conform with the requirements of the Environmental Specification.

Spoil may only be dumped at registered spoil disposal sites and the Contractor is responsible for determining which registered sites he/she would like to utilise.

All costs pertaining to removal and dumping of spoil are to be included in the Contractors rates for the construction of the Works.

The Employer will not accept spoiling on a third-party property, regardless of arrangements concluded upon between the Contractor and such third-party property owner, as spoiling needs to conform with legislative environmental requirements and short-term arrangements normally do not see such requirements being met.

PS 11: DRAWINGS

The drawings issued to Tenderers as part of the tender documents must be regarded as provisional and preliminary for the Tender's benefit to generally assess the scope of work and to develop his pricing strategy. These drawings are marked as "Tender Drawings".

The construction of the Works shall be carried out against drawing revisions marked as "for construction purposes".

The Contractor has to ensure that he always refers to the latest construction drawing revision issued by the Engineer.

The Engineer shall, at commencement of the Contract, deliver to the Contractor, copies of the construction drawings and any associated instructions required for the commencement of the Works.

The Engineer may issue, from time to time, during the construction of the Works, revisions to previously issued drawings as may be required for adequate construction and completion of the Works. The Contractor shall ensure he has a drawing register listing the revisions of each drawing issued.

The drawings for the construction of the Works have been prepared by the Employers Agent

The contractor shall be supplied with two sets of A1 hard copies of the construction drawings. The Contractor shall at his own costs produce additional copies required for the construction of the work.

All "as built" information, as listed below, must be submitted to the Engineer’s Representative before a certificate of completion will be issued. No separate payment will be made for the "as_built" drawings

List of "as built" information required

(a) Exact coordinates or chainage on the centre line of the pipeline including the information regarding parallel or crossing of electrical, Telkom, Sewer and irrigation services.
(b) Exact coordinates, cover levels and invert levels of all construction work

A Registered Land Surveyor must provide the above information.

In addition to the above, the Contractor must submit the As-Built drawings in both PDF and DWG formats. The manhole survey information must be provided in CSV format.

Only figured dimensions shall be used on the drawings; scaling from the drawings is not permitted unless explicitly instructed by the Engineer.

If any figured dimensions are omitted from the drawings, the Engineer will supply the necessary details.

PS 12: LENGTH OF TRENCHES

Where no limitations are imposed by construction stages and unless otherwise permitted in writing by the Engineer, not more than 200 m of trench in any one place shall be opened in advance of pipe laying operations.

No trench may be left open over the builders' holidays.

PS 13: SAMPLES

The Contractor shall at his own cost, supply all samples or tests that may be required. Material or work not conforming to the approved tests shall be rejected. The Engineer reserves the right to submit samples to any tests to ensure that the material represented by the sample conforms to the requirements of the specifications. The cost of all tests failed shall be for the Contractor’s account.

PS 14: MANUFACTURER'S INSTRUCTIONS

The recommendations of the manufacturers of patented materials must be strictly adhered to regarding the use, mixing, application, fastening, etc. thereof except when otherwise instructed in writing by the Engineer.

PS 15: MATERIALS AND PLANT

The contractor, when using materials that are required to comply with any standard specification, shall, if so ordered, furnish the engineer with certificates of compliance.

Where so specified, materials shall bear the official mark of the appropriate authority. Samples ordered or specified shall be delivered to the engineer's office on the site free of charge.

Where proprietary products have been specified, similar products may be used subject to the prior written approval of the engineer.

Unless otherwise specified, all proprietary materials shall be used and placed in strict accordance with the relevant manufacturer's current published instructions.

Unless anything to the contrary is specified, all manufactured articles or materials supplied by the contractor for the permanent works shall be unused.

Existing structures on the site shall remain the property of the employer and except as and to the extent required elsewhere in the contract, shall not be interfered with by the contractor in any way.
Materials to be included in the works shall not be damaged in any way and, should they be damaged on delivery or by the contractor during handling, transportation, storage, installation or testing they shall be replaced by the contractor at his own expense.
All places where materials are being manufactured or obtained for use in the works, and all the processes in

their entirety connected therewith shall be open to inspection by the engineer (or other persons authorised by the engineer) at all reasonable times, and the engineer shall be at liberty to suspend any portion of work which is not being executed in conformity with these specifications.

The contractor shall satisfy himself that any quarry selected for use provides the necessary mined material in accordance with the specification.

PS 16: NOTICES, SIGNS, BARRICADES AND ADVERTISEMENTS

The Contractor shall erect the necessary signs, notices and barricades for the duration of the contract in order to safeguard both the works and the public.

Notices, signs and barricades as well as advertisements may be used only upon approval by the Engineer, and the Contractor shall be responsible for their supply, erection, maintenance and ultimate removal and shall make provision for this in his tendered rates.

The Engineer shall have the right to have any sign, notice or advertisement moved to another position or to have it removed from the site of the works, should it in any way prove to be unsatisfactory, inconvenient or dangerous to the general public.

Such notices, signs and barricades shall be provided and erected at the Contractor's own expense.

The standard name board of the South African Association of Consulting Engineers is specified. The cost of which shall be included in the rates tendered for items 1300 (COLTO) of the Schedule of Quantities.

PS 17: SETTING OUT OF WORK

Reference and level beacons will be shown to the Contractor by the Engineer at the commencement of the Contract and the Contractor will be responsible for transferring the data to the Site of Works.

The Contractor shall check the condition and accuracy of all reference and level beacons and satisfy himself that they have not been disturbed and are true with regard to position and level. A beacon that has been disturbed shall not be used until its true position and level have been re-established and the new values have been certified by the Engineer. The Contractor shall thereafter be held entirely responsible for the protection of all reference and level beacons.

The Contractor shall employ a capable surveyor to set out the Works to the required lines and levels. The Engineer shall be informed immediately should any discrepancy be discovered between the levels or dimensions obtained by the Contractor and those shown on the drawings.

Where a beacon is likely to be disturbed during construction operations, the Contractor shall establish suitable reference beacons at locations where they will not be disturbed during construction. No beacons shall be covered over, disturbed or destroyed before accurate reference beacons have been established and details of the positions and levels of such beacons have been submitted to the Engineer. The Contractor's reference beacons shall be of at least the same accuracy and sturdiness of construction as the existing beacons.

The Contractor shall submit the method of setting out he proposes to employ to the Engineer. Accurate control of line and level shall be provided by the Contractor at all stages of construction.

Work set out by the Contractor may be checked by the Engineer and any errors found shall be rectified by the Contractor at his own expense. The Contractor shall supply any instrument, equipment, material and labour required by the Engineer for this survey work. Any assistance, including checking given to the Contractor by the Engineer or any setting out done by the Engineer for Contractor shall not be held as relieving the Contractor of his responsibility for the accurate construction of the Works.

The Contractor's survey instruments and survey equipment shall be suitable for the accurate setting out of the Works and shall be subject to the approval of the Engineer. They shall furthermore be checked and correctly adjusted by the authorized agents before the commencement of the contract and subsequently

when required by the Engineer and when otherwise necessary.
When required the Contractor shall, at his own expense, provide two labourers to assist the Engineer. The Engineer shall have the sole right to approve of such a labourer.

Survey work shall not be measured and paid for directly and compensation for the work involved in setting out shall be deemed to be covered by the rates tendered and paid for the various items of work included under the contract.

PS 18: WORKMANSHIP AND QUALITY CONTROL

The onus to produce work which conforms in quality and accuracy of detail to the requirements of the Specifications and Drawings rests with the Contractor, and the Contractor shall, at his own expense, institute a quality-control system and provide experienced Engineers, foremen, surveyors, materials technicians, other technicians and technical staff, together with all transport, instruments and equipment, to ensure adequate supervision and positive control of the works at all times.

The costs of all supervision and process control, including testing thus carried out by the Contractor shall be deemed to be included in the rates tendered for the related items of work.

The Contractor's attention is drawn to the provisions of the various standardized specifications regarding the minimum frequency of testing that will be required for process control. The Contractor shall, at his own discretion, increase this frequency where necessary to ensure adequate control.

On completion of every part of the work and submission thereof to the Engineer for examination, the Contractor shall furnish the Engineer with the results of all relevant tests, measurements and levels to indicate compliance with the specifications.

PS 19: TRANSPORT OF MATERIAL

All costs of transporting material shall be included in the applicable tendered rates.

PS 20: LIAISON WITH LOCAL AUTHORITIES

The Contractor will have to liaise with local authorities regarding the following matters:

(a) Dealing with traffic.
(b) Locating of existing underground services.
(c) Protection of existing services during construction.

All the relevant authorities were notified of the above operations. It is then the Contractor's onus to immediately contact all these authorities and to accommodate their involvement in his programme of work. The Contractor should also warn the authorities at least 48 hours before the actual work commences. Compensation for delays, losses or accidents will not be considered should the Contractor at any time have failed to keep the local authorities informed.

The Engineer or Employer must immediately be notified, should the Contractor experience any problem regarding work which involves a local authority.

The Contractor will be required to take cognisance of and comply with the general wayleave and 'permission to occupy' requirements of the authorities and land owners during the construction of the Works.

The Contractor will be required to confirm that he has notified property owners and authorities of his intentions to exercise his right in terms of the relevant wayleave or "permissions to occupy" in good time before commencement of the required work on the said properties.

PS 21 LOCAL LABOUR AND LOCAL SUBCONTRACTORS

PS 21.1 Introduction

It is envisaged that the works will be constructed by one Contractor employing local labour to construct the work by applying the principles of the Expanded Public Works Programme (EPWP).

PS 21.2 Workload

The Contractor is required to execute certain components of this contract with labour-based construction methods as described in paragraph PS 21.5.

PS 21.3 Local Labour

It is the intention that this Contract should make maximum use of the local labour force that is presently under-employed. To this end, the Contractor is expected to limit non-local employees to key personnel only and to employ and train local labour on this Contract.
The Contractor shall complete Form T2.2.5 and state how many non-local key personnel he intends to employ in the various categories. The numbers stated on the above-mentioned form will be strictly controlled during the Contract period and any increase in numbers is subject to the approval of the Employer.

A Project Steering Committee (PSC) has been formed and consists of representatives of the affected community, Nala Local Municipality and the Engineer. The PSC is up to date with the details of the project and appointment of all local labour must be through the PSC.

The Contractor will be required to arrange his own documentation regarding a contract for locally employed labour and must include provisions for the Occupational Health and Safety Act (1993) and the Compensation for Occupational Injuries and Diseases Act. The minimum daily wage to be paid in accordance with the Wage Bill for the geographical area shall be as stated in the Government Gazette in terms of Wage Determination for the Civil Engineering Industry.

PS 21.4 Contractors Obligations

The Contractor is to supply the Engineer with copies of the agreements between himself/herself and his/her subcontractors within twenty-one (21) days of the contract being awarded.

Should the Contractor be unable to or unwilling to:

i) Subcontract the required Works as detailed in his/her tender document;
ii) Submit the necessary documentation to prove that he/she is subcontracting the work as specified in paragraph PS 25.1.
iii) Implement his/her proposed training scheme or any other scheme agreed to by the relevant parties;

The Employer reserves the right to:

a) nullify the said contract and re-issue it to tender;
b) nominate available local subcontractors for the required Works;
c) deduct payment from the monthly certificates, the value of which will be calculated as follows:

$X = Y - Z$

X = Amount of deduction from the monthly certificate
Y = Value of the work that should have been undertaken by the subcontractor during the month
Z = Value of the work actually undertaken by the Subcontractor during the month;
(d) = Nominate agents to undertake the proposed training at the expense of the Contractor.

PS 21.5 Work Considered to be Labour Based

It is a condition of this contract that the following components of work must be executed using labour-based construction methods.

1) Excavation of soft/ intermediate / hard material in trenches not deeper than 1,5 m.
2) Shaping of open drains.
3) Preparation of pipe bedding.
4) Laying and jointing of all pipes.
5) Backfilling of all trenches with compaction excluded.
6) Location of existing services.

Note:

The abovementioned work must either be done by local labourers employed by the Contractor or by local subcontractors. In the Schedule of Quantities, as an alternative to machine excavation, the cost of a compulsory labour-based construction activity is covered by using the standard SABS payment item (where applicable). Site conditions and material present will dictate the application of labour-based trench excavation or machine excavation. A prerequisite for payment of these labour-based excavation items is that the Contractor keeps daily written records with names of labourers, tasks completed, man-hours spent and payments made.

Items excluded from labour-based items:

1) Excavation in Boulders and rock material - Mechanical excavators and blasting allowed.
2) Compaction of bedding and backfilling - Rollers and plate compactors allowed.
3) Transport of materials LDV, dumpers and other transport equipment allowed.
4) Mixing of concrete - Mechanical mixers allowed.
5) Vibration of concrete - Vibrators compulsory.
6) Precast concrete manholes.

PS 22 TRAINING SCHEMES

Certain members of the contractor staff will be selected from the locally recruited employees, to be subjected to training in tasks related to the execution of the contract. An item with a provisional sum to cover the cost of training is included in the Schedule of Quantities.

The PSC will select the trainees and decide upon the specific training for each of them. The Contractor must guide PSC in this regard and make all the necessary arrangements with the training institution and the trainees, to ensure that the process runs smoothly. This training must be completed before the Contractor will receive any payments. The provisional sum in the Schedule of Quantities is to cover the fees of the training institution and an R30 per day allowance for each trainee during training. All other costs, including transport of trainees, will be borne by the Contractor and should be included in the percentage handling fee of the Contractor.

PS 23 PRESCRIPTIONS IN RESPECT OF EXISTING SERVICES

The scope of work for this contract could be affected by existing services. Where necessary the contractor must familiarize himself with the position and extent of existing services and to carry out the works in such a manner as not to cause damage to existing services.

PS 23.1 Water and Storm Water Services

Any cost of repairs, replacement and/or installation of services and equipment resulting from the contractor's negligence or unauthorized action shall be to the contractor's account.

PS 23.2 Electrical Services

The following procedures will apply:

1. The Contractor will in all instances submit construction drawings to the Electricity Supply Authority (ESA) for comments and for ESA to indicate known electrical services. These drawings will in all instances be available on site during the construction period or in the possession of the supervisor of the construction workers.

2. The cable's precise position on the terrain, with reference to the approximate position as indicated on the drawing, must be confirmed on the terrain by means of cable tracing equipment to be supplied or arranged by the Contractor for this purpose. In the case of primary cables (11 kV and 33 kV), as indicated on the drawings, it is essential that cable tracing be conducted by ESA. The Contractor will provide sufficient white lime to mark the cable on the ground. The contact persons and telephone numbers for cable tracing personnel shall be obtained from ESA by the Contractor.

3. The Contractor must thereafter, very carefully, open up the cable by hand in at least two places, of which the in-between distances will not exceed 50 meters.

4. At any position, between any two points of the exposed cable, as described in 1.3 above, that cable shall be identified as a known service if it lies within 0,5 meters of a straight line drawn between these two points

5. If the cable lies further than 0,5 meters away from a straight line drawn between the two exposed points, it shall be identified as an unknown service.

6. With reference to the approximate position of cables on the drawing, the Contractor will be responsible for confirming the location of such cables on the terrain by means of the equipment referred to in 1.2 above, and by careful digging by hand. If the exact position of the cables cannot be determined without a doubt, ESA can be approached for help.

7. When existing electrical cables fall within the excavation area of the new service, the Contractor will be responsible for protecting and supporting such cable. During the backfilling of the trench, the Contractor will ensure that the cable is not damaged and repositioned at the original position and depth with the necessary bedding and marker tape.

8. Before any exposed cables are backfilled, such cables shall be inspected for possible damage by the terrain agent, in the presence of the Engineer or his/her representative. A complete record of all positions where cables were exposed must be indicated on the drawing.

9. The Contractor is responsible for keeping a complete record of incidents where electrical cables

   (known or unknown) were damaged that includes the following:

   - Date when damaged and the reason
   - Date when repaired
   - The extent of repairs, for instance, cable size, number of joints necessary, the length of cable replaced etc
   - The exact cable position and depth indicated on the plan

10. The Engineer's representative must check these records. The above-mentioned record will be an annexure to the minutes of the monthly site meetings. All repairs of damaged cables (known or unknown) will be conducted by ESA. The account for repairs done on known services (cables) will be delivered to the Contractor via the Engineer. On the basis of accounts delivered monthly by ESA, the repair cost of a known service (electrical cable) that was damaged, will be recovered from the Contractor's certificate.

11. 33 kV Cables

In no instances will any Contractor be allowed to expose cover 33kV cables or excavate closer to 500mm (by hand) and 2000 mm (mechanical excavation) from the centre of a 33 kV cable. ESA will do the required excavation for the Contractor's account.

12. Overhead Services

Excavation and backfill shall be such that no foundation of overhead structures (power lines, streetlights, high mast lights, stays etc.,) will be disturbed. If disturbed, the Contractor will inform ESA in writing and will reinstate the foundation to its original state.

13. Maintenance Period

During the defects liability period, the Contractor's responsibility shall include:

- All electrical cables that were exposed or handled by him
- Excavations in the vicinity of poles and stays, at the time of the construction activities

This makes provision for instances where damaged cables were covered up without informing ESA which may cause many problems later on. The Contractor is responsible for repairing all disturbed poles and stay foundations and reinstating them to their original condition (electrical and structural), as they are disturbed.

PS 24 ENGINEERING

PS 24.1 Employers Design

The Employer is responsible for the design of the permanent works.

PS 24.2 Contractors Design

The Contractor is responsible for the design of all temporary works and all construction methods. This includes all tie-ins and interconnecting works, all shoring and lateral support systems required for trenching and protection of the works, as well as protection of existing anchor block systems. It is the Contractor's responsibility to prepare method statements and to prepare designs for the removal, relocation and /or reconstruction of infrastructure and facilities on private properties or properties of parastatals that will be affected by the construction of the Works.

The Contractor is responsible for the development of HDPE welding procedures and certification of welders against such procedures.

PS 24.3 Drawings

The drawings issued to Tenderers as part of the tender documents must be regarded as provisional and preliminary for the Tender's benefit to generally assess the scope of work and to develop his pricing strategy. These drawings are marked as "Tender Drawings".

The construction of the Works shall be carried out against drawing revisions marked as "for construction purposes". The Contractor has to ensure that he always refers to the latest construction drawing revision issued by the Engineer.

The Engineer shall, at the commencement of the Contract, deliver to the Contractor, copies of the construction drawings and any associated instructions required for the commencement of the Works.

The Engineer may issue, from time to time, during the construction of the Works, revisions to previously issued drawings as may be required for adequate construction and completion of the Works. The Contractor shall ensure he has a drawing register listing the revisions of each drawing issued.

The drawings for the construction of the Works have been prepared by the Employers Agent.

PS 25 PROCUREMENT

PS 25.1 Scope of Mandatory Sub-Contracting

It's Mandatory that the Contractor select local sub-contractors from the affected wards under this Contract. The sub-contractors known as SMME'S shall be mentored by the main contractor.

PS 25.2 Sub-Contractors

Selected sub-contractors pertaining to the procurement, supply and installation of HDPE pipes using trenchless method of construction are to be managed by the main Contractor.

PS 25.3 Attendance to Sub-Contractors

Attendance to sub-contractors is to comply with the Conditions of Contract.

NALA LOCAL MUNICIPALITY

CONTRACT NO.

NLM/TS/004/2025-26

THE REFURBISHMENT OF SEWER PUMP STATION AND ERADICATION OF 250 BUCKETS IN EXT. 12 & 13 IN WESSELSBRON

SECTION C3.4

PARTICULAR SPECIFICATIONS

NALA LOCAL MUNICIPALITY

CONTRACT NO.

NLM/TS/004/2025-26

THE REFURBISHMENT OF SEWER PUMP STATION AND ERADICATION OF 250 BUCKETS IN EXT. 12 & 13 IN WESSELSBRON

SECTION C3.4

PARTICULAR SPECIFICATIONS

C3.4 PARTICULAR SPECIFICATIONS

The following additional specifications for work not covered by the Standardised Specifications are required for the contract and are bound into the document in this section:

SPECIFICATIONS FOR CIVIL WORKS:

PA:	Fencing
PB:	Building Work

SPECIFICATIONS FOR MECHANICAL WORKS:

PSM:	Project Specifications - Mechanical Equipment

SPECIFICATIONS FOR ELECTRICAL WORKS:

ELSPEC-01-LVCAB:	Low-Voltage Cables and Trenching Specifications
ELSPEC-02-LVDBMCC:	Low-Voltage Distribution Boards and Motor Control Centres
ELSPEC-03-LVCMS:	Low-Voltage Cable Management
ELSPEC-04-LVLUM:	Low-Voltage Luminaire and Lighting Specifications
ELSPEC-05-LVSPP:	Small Power Points and Wiring
ELSPEC-06-LVMOT:	Electrical Motor Specifications
ELSPEC-07-LVCI:	Control Instrumentation

ELECTRICAL INSTALLATION DETAILS

PA: FENCING

PA 1 SCOPE

This section covers the moving of existing fences where necessary and the erection of new fences. This section also covers the dismantling of existing fences and the stacking of the fencing material.

PA 2 INTERPRETATIONS

PA 2.1 SUPPORTING SPECIFICATIONS

a) Project Specifications;
b) SANS 1200 A or SANS 1200 AA as applicable;
c) SANS 1200 C.

PA 2.2 APPLICATION

This specification contains clauses which apply to fencing in general. The interpretation of and variations from this specification are explained in Part 2 of the project specifications preceding this specification in the contract document.

PA 3 MATERIALS

PA 3.1 MATERIALS FOR SECURITY FENCE

PA 3.1.1 Posts, Stays, Standards and Droppers

Posts, stays, standards, and droppers shall be of the type and size indicated on the drawings. Steel sections shall comply with the requirements of CKS 82, and wooden posts shall comply with the requirements of SANS 457. Timber posts shall be treated at the Engineer's option with either creosote or copper chrome arsenate, the latter preservative not to be used in the case of hardwoods.

Unless otherwise specified or shown on the drawings, rolled steel posts shall be 15 or 22 kg/m rails as shown on the drawings. Standards shall be 2,50 kg/m Y-sections.
Droppers shall be 0,56 kg/m ridge-back pattern droppers.

Where tubular posts are specified, they shall be galvanised in accordance with SANS 763 for class B1 articles and have a wall thickness of 2,95 mm minimum. The length, diameter and hole spacing shall be as shown on the drawings. Unless otherwise shown on the drawings, all tubular sections shall be provided with a 230 x 230 mm footplate and a pressed-steel or cast-iron cap.

Rolled steel sections shall be provided with a protective coating of tar or other approved material. Tubular stays shall have a nominal bore of at least 60 mm and a wall thickness of at least 2,95 mm. They shall be first class galvanised as specified in SANS 763.

PA 3.1.2 Bolts for Stays

Bolts shall be galvanised steel bolts of the required length and diameter which shall not be less than 12 mm. All the necessary bolts together with nuts and washers, shall be supplied with each post.

PA 3.1.3 Wire

a) Barbed wire

Barbed wire shall comply with the requirements of SANS 675 and shall be one or more of the following types:

i. High-tensile-grade:
single-strand 3,15 mm x 2,50 mm oval-shaped (2,81 mm equivalent diameter) either lightly or fully galvanised as specified in the schedule of quantities.

ii. High-tensile-grade:
single-strand fully galvanised (first-class coating wire) 2,80 mm x 1,90 mm diameter oval-shaped (2,31 mm equivalent diameter). This wire shall not be used less than 500 mm above ground where there is danger of veld fires.

iii. Mild-steel-grade:
double-strand unidirectional twist wire, each strand 2,50 mm diameter, for use at any height above ground. The wire shall be either lightly galvanised or fully galvanised as specified in the schedule of quantities.

Barbs shall be manufactured from 2,0 mm galvanised wire and shall be spaced at not more than 152 mm.

b) Smooth wire

Smooth wire shall comply with the requirements of SANS 675 and shall be of the types specified below:

i. Straining wire
shall be 4,0 mm diameter lightly galvanised wire.

ii. Fencing wire
shall be high-tensile-grade 2,24 mm diameter wire either lightly or fully galvanised as specified in the schedule of quantities.

iii. Tying wire
shall be 2,50 mm diameter mild-steel lightly galvanised wire for tying fencing wire to standards and droppers and 1,6 mm mild-steel lightly galvanised wire for tying netting and mesh wire to fencing wire.

PA 3.1.4 Diamond Mesh

Diamond mesh (chain-link fencing) shall comply with the requirements of SANS 1373. The width shall be as shown on the drawings and the edge finish shall be both sides clinched or barbed.

The nominal diameter of the wire shall be 2,5 mm and the mesh size shall be 64 mm x 64 mm.

The wire shall be lightly galvanised.

PA 3.1.5 Wire Netting

Wire netting shall be galvanised mild-steel wire with a minimum diameter of 1,8 mm with 75 mm hexagonal mesh.

The width shall be as shown on the drawings.

PA 3.1.6 Gates

Gates shall be manufactured to the dimensions shown on the drawings. Farm gates shall be standard government-type farm gates.

Gates shall be complete in every respect, including hinges, washers, bolts and a locking chain attached to the gate.

PA 3.1.7 Timber Posts

Timber posts for holding down mats where the fence crosses streams shall comply with the requirements of SANS 457 and shall be creosote impregnated in accordance with SANS 05, with creosote complying with SANS 538 or 539.

PA 3.1.8 Manufacturing Tolerances for Wire

The actual diameter of wire supplied shall nowhere be less than the specified diameters by more than the following tolerances:

Specified Diameter	Tolerance
1,0 - 1,8 mm	0,05 mm
2,0 - 2,8 mm	0,08 mm
3,15 - 4,0 mm	0,10 mm

PA 3.2 MATERIALS FOR PALISADE FENCES

a) Posts
Posts shall be 2.5m in overall length, and shall be 80mm thick in the front, tapering to the back to a thickness of 140 mm, the width of the post shall be 140 mm. Posts to be slotted into positions to take the horizontal load bearing rails. The top edge of the post shall be at an angle of 38□ from back to front. The front and sides shall be of shutter finish and the back to be floated smooth. Reinforcing to the posts shall be 3 N□ 8 mm diameter steel bars.

b) Rails
Rails shall be 2,0 m long x 70 mm thick x 170 mm deep. The rails shall have 9mm diameter holes drilled at 200mm centres for 125 x 8mm diameter galvanised carriage bolts. The rails shall be reinforced with one 10 mm diameter deformed bar and one 8 mm diameter bar. The back, top and bottom edges shall be of shutter finish and the front to be floated smooth.

c) Pales
The pales shall be 1.8 m long, and shall be 80mm thick in the front tapering to 100 mm at the back with a width of 75 mm minimum over the total length of the pale excepting the section where the fixing rail passes through the pale, each pale shall have two holes drilled for fixing

the horizontal rails, each pale shall be reinforced with two 5,6 mm diameter steel mild bars. The top edge of the pale shall be tapered at an angle of 38° from back to front. The front and sides shall be of shutter finish and the back shall be floated smooth. 10 Pales per section of 2,0 m.

PA 3.3 CONCRETE

Concrete used for fencing shall comply with the requirements of SABS 1200G.

PA 3.4 MATERIALS FOR PREFABRICATED CONCRETE FENCES

The concrete for prefabricated concrete fences shall have a 28-day compressive strength of at least 25 MPa.

Reinforcement shall have a diameter not exceeding 0.5 times the thickness of the cover, which shall be a minimum of 12 mm.

Posts shall be one of the following types:

- line posts
- end posts
- corner posts
- junction posts

The length of the posts shall be the height of the wall plus a minimum of 600 mm. The cross-sectional dimensions of the posts shall be a minimum of 140 x 100 mm, with slots of 45 mm wide x 25 mm deep. The minimum concrete dimension between two opposite slots, shall be 50 mm.

Panels shall be of the plain type or of the decorative type, as specified. The panels shall be rectangular, except that panels intended for the finishing off of the top of the fence may have a shaped upper edge, when so required. The lower or upper (or both) edges of a panel shall be so shaped that when panels are in position in a fence, the contiguous surfaces of consecutive panels form a keyed or overlapping joint. The ends of a panel shall provide an acceptable fit with slots in the posts.

The nominal length of all panels shall be 1 450 mm and the nominal width of rectangular panels shall be 300 mm. The actual length and width of a panel shall not differ from the stated values by more than 5 mm. Any departure of an edge of the panel from the straight line joining the ends of that edge, shall not exceed 2 mm. Any out-of-squareness of a panel, shall not exceed 6 mm.

Resistance of posts to concentrated force and resistance of panels to transverse load, shall be in accordance with the specifications of SABS 1372-1983.

PA 4 IMPLEMENTS

No special implements are specified.

PA 5 CONSTRUCTION

PA 5.1 TYPES OF FENCING

The following types of fences shall be erected in accordance with the dimensions shown on the drawings:

a) Stock-proof fences (of various heights with horizontal barbed and smooth fencing wire).

b) Vermin-proof fences (horizontal barbed wire fence above a mesh wire fence).

c) Pedestrian fences (full height diamond mesh fence).

d) Security fences (veranda type with diamond mesh on the vertical portion and barbed wire on the overhang).

e) Concrete Palisade fence (full height fence with concrete posts, rails and pales fastened to rails with carriage bolts).

f) Where existing fences have to be dismantled and re-erected, they shall be re-erected either to the same design as originally constructed with such modifications as the Engineer may require or they shall be erected to one of the standards specified above, all as ordered by the Engineer.

PA 5.2 PROTECTION OF LIVESTOCK

From the time of the occupancy of the site until the date of the final maintenances certificate the Contractor shall take all measures necessary for the prevention of the ingress of vermin, and for the protection and control of livestock, etc., on the sections of the properties affected by his operations. He shall provide gates in existing fences cut by him for the purpose of access and shall ensure that all gates are kept closed during such time as they are not actually in use by his traffic.

Where alternative arrangements cannot be made, the Engineer may direct the Contractor to erect temporary fencing where necessary to protect livestock exposed to straying or vermin through his operations. Such fencing shall be of adequate standard and shall be erected ahead of construction operations. The fencing shall be maintained in good order during construction operations and, on completion of the work, it shall be removed from the site and all surfaces restored. The Engineer may order that any permanent fencing which is required be erected ahead of construction operations, where this is practicable, in lieu of the erection of temporary fencing.

Payment for the protection of livestock, excluding the erection of temporary fences, shall be included in the amount tendered for the Contractors Establishment on site as specified in SANS 1200 A or 1200 AA as applicable.

PA 5.3 CLEARING OF FENCE LINE

The fence line shall be cleared over a width of at least 1 m on each side to the centre-line of the fence and surface irregularities shall be graded so that the fence will follow the general contour of the ground. Clearing shall include the removal of all trees, scrub, stumps, isolated loose boulders or stones and other obstructions which will interfere with proper construction of the fence. Stumps within the cleared space shall be grubbed as described in SANS 1200 C. The bottom of the fence shall be located a uniform distance above the ground line in accordance with the requirements shown on the drawings. All material removed shall be burnt or disposed of in disused borrow pits.

PA 5.4 INSTALLING POSTS AND STANDARDS

Straining posts shall be erected at all ends, corners and bends in the line of fences and at all junctions with other fences. Straining posts shall not be spaced further apart than shown on the drawings. The length of posts above ground shall be such that the correct clearance between the lowest wire and the ground can be obtained.

Posts shall be accurately set in holes, and where shown on the drawings, provided with concrete bases to the dimensions shown on the drawings.

Holes shall be dug to the full specified depth of the posts. Where, due to the presence of rock, the holes cannot be excavated by means of hand or pneumatic tools and the Contractor has to resort to the use of explosives, he will be paid separately for the drilling and blasting operations required.

Corner, gate end and straining posts shall be braced by means of stays or anchors as shown on the drawings or as directed by the Engineer. Pipe stays shall be bolted to the posts. Gate posts shall not be used as straining posts, but at each gate post a straining post shall be placed as shown on the drawings and stayed by means of an anchor consisting of six strands of wire.

Standards shall be firmly planted into the ground at the spacing shown on the drawings or as directed by the Engineer. The spacing of standards between any two straining posts shall be uniform and not greater than shown on the drawings. In rock or hard material standards shall be either driven or set in holes drilled into the rock. The size of drilled holes shall be such that a tight fit is obtained. Care shall be exercised when driving standards to prevent buckling or damaging them.

All posts and standards shall be accurately aligned and set plumb. Where veranda-type security fencing is used, the posts shall be planted with the overhang on the road side and perpendicular to the direction of the fence. After posts and standards have been firmly set in accordance with the foregoing requirements, the fence wire shall be attached thereto at the spacings shown on the drawings.

PA 5.5 INSTALLING WIRE

All fencing wire shall be wired to the sides of standards or posts to prevent the wires from being displaced or becoming loose. The wire shall be carefully tensioned without sagging and with true alignment, care being exercised not to stretch the wire to such an extent that it will break, that end, corner, straining or gate posts will be pulled out, or that it will be easily damaged during veld fires.

Each strand of fencing wire shall be securely fastened in the correct position to each standard with soft galvanised binding wire. The binding wire for each horizontal fence wire shall pass through a hole or notch in the standard to prevent slipping of the fence wire in a vertical direction, while the ends of the wire shall be wound at least four times around the fencing wire to prevent it from moving in a vertical direction.

At the end, corner, straining and gate posts, the fencing wire shall be securely wrapped twice around the post and secured against slipping by tying the end tightly around the wire by means of at least six snug tight twists.

In the case of high-tensile wire, two long windings may first be made before the six tight twists, to prevent the wire from breaking at the first twist. When using smooth wire, the loose end shall preferably be bent over and hooked into the notch between the fencing wire and the first twist.

Splices in the fencing wire shall be permitted if made in the following manner using a splice tool. The end of each wire at the splice shall be carried at least 75 mm past the splice tool and wrapped snugly

around the other wire for not less than six complete turns, the two separate wire ends being turned in opposite directions. After the splice tool is removed the space left by it in the splice wire shall be closed by pulling the wire ends together. The unused ends of wire shall be cut close so as to leave a neat splice.

The gaps between posts and the adjacent straining posts shall be fenced off with short fencing wires.

Droppers shall be tied to each fence wire with soft binding wire in the required position as specified for standards to prevent slipping in a vertical direction. The spacing of droppers between any two straining posts shall be uniform. Anchoring to structures shall be done as shown on the drawings.

PA 5.6 INSTALLING DIAMOND MESH OR WIRE NETTING

In the case of vermin-proof, pedestrian and security fences, or where instructed by the Engineer, wire netting or diamond mesh shall be stretched against the fence and properly tied to the fencing wire as shown on the drawings. The diamond mesh or wire netting shall be secured by means of soft binding wire at 1,2 m centres along the top and bottom wires and at 3 m centres along each of the other fencing wires unless otherwise shown on the drawings.

In the case of vermin-proof fencing, vermin shall be prevented from creeping under the fence by either one of the two methods described below as ordered by the Engineer:

a) By folding back the bottom 130 mm of the wire netting so that it lies flat on the ground and packing stones (minimum dimension 200 mm) end to end on this flap to secure it in position.

b) By embedding the lower 130 mm of the wire netting into to the ground and compacting the earth around it thoroughly on both sides to secure the netting.

PA 5.7 INSTALLING PALISADE FENCES

Foundations to be 400 mm x 400 mm x 600 mm deep, posts shall be set at 2,0 m centres, rails shall be slotted into holes provided in the posts. The pales are then fastened onto the rail with 175 x 8 mm diameter galvanised carriage bolts and the bolts grouted with epoxy cement. 1700 x 250 x 300mm deep beam shall be cast between the post's foundations to form 100 mm gab between the bottom of the pales and the top of the beam.

Class 30/10 concrete shall be used for all precast components. Foundations shall be in class 15/20 concrete.

PA 5.8 INSTALLING PREFABRICATED CONCRETE FENCES

Posts shall be planted in 300 x 300 x 650 deep holes in firm soil, and 400 x 400 x 650 deep holes in soft soil. Each post shall be supported in the centre of its hole on 150 mm of 15 MPa concrete, and, taking care to ensure that the post remains truly plumb, the hole should be filled to within 50 mm of the surface of the ground with similar concrete. The concrete should be compacted properly around each post. A Half brick should be fixed in the surface of the concrete on each slotted side and adjacent to each post, protruding approximately 50 mm above the concrete and forming a support for the bottom panels.

The distance between adjacent posts should be such that the panels will fit with approximately 5 mm play. All posts should be secured before any panels are fitted.

All bottom panels of the fence should be fitted first, keeping each panel level and avoiding excessive pressure that may damage the panel. Each successive row of panels should be placed similarly, ensuring that the panels fit properly onto one another and leaving no unsightly gaps. If a panel exhibits

excessive play in the slots, it should be moved tightly into one slot while the other slot is filled with approved mortar.

After the top panels have been placed, the slots in the posts adjacent to the top panels should be grouted with an approved mortar, to prevent the panels from being lifted out.

PA 5.9 CLOSING OPENINGS UNDER FENCES

At ditches, streams, drainage channels or other hollows where it is not possible to erect the fence so that it follows the general contour of the ground, the Contractor shall close the opening under the fence by means of horizontal barbed wires at distances of 150 mm from each other, stretched between additional posts or straining posts as shown on the drawings or directed by the Engineer. In the case of pedestrian, vermin-proof and security fences the opening shall be covered with strips of wire netting of diamond mesh 1 000 mm wide fixed to the barbed wires.

In the case of larger streams where damming of debris against the fence would constitute a danger, the opening below the lower fencing wire shall be closed by means of loose-hanging wire nets. For this purpose, additional straining posts shall be planted on either side of the stream with a cable consisting of at least five strands of smooth fencing wire stretched between them. Onto this cable vertical strips of diamond mesh, hanging down to ground level, shall be fixed. The sides of the different strips of diamond mesh shall be fixed to each other so that the whole mat may be raised by water flowing underneath and so leave a free stream area. These mats at streams shall only be erected on instructions from the Engineer. If it should be necessary to keep the bottom of the mats on the ground, the Engineer may order that timber posts or pipes be fixed horizontally to the lower ends of the diamond mesh strips.

PA 5.10 EXISTING FENCES

Where a new fence joins an existing fence whether in line or at an angle, the new fence shall be erected with a new straining post positioned at the terminal of the existing fence.

Existing fences that require be taking down or moving to a new location shall be dismantled. Material not required for re-erection or declared unsuitable for re-use shall be neatly stacked at approved locations in accordance with the Engineer's instructions. Fencing wire or netting shall be stacked clear of the ground.

In the case of fences that require moving the Contractor shall re-use all materials, declared suitable for this purpose by the Engineer, plus such new material as may be required to re-erect the fence to the standard specified for new fences. The Engineer shall not be responsible for any delays or costs arising from breakage of re-used wire during straining.

PA 5.11 INSTALLING GATES

Gates shall be installed at the positions indicated by the Engineer. The gates shall be hung on gate fittings in accordance with the requirements shown on the drawings. Gates shall be so erected as to swing in a horizontal plane at right angles to the gate posts, clear of the ground in all positions. At pedestrian and security fences the double swing gates shall leave a gap not exceeding 25 mm between them when closed and other gates shall not be further that 25 mm from the gate post when closed.

PA 5.12 GENERAL REQUIREMENTS

The completed fence shall be plumb, taut, true to line and ground contour, with all posts, standards and stays firmly set. The height of the lower fencing wire above the ground at posts and standards shall not deviate from that shown on the drawings by more than 25 mm. Other fencing wires shall not vary by more than 10 mm from their prescribed relative vertical positions.

Where temporary fences are erected, they shall be firm and of sufficient height with a sufficient number of wires to prevent the passage of stock.

The Contractor shall, on completion of each section of fence, remove all cut-offs and other loose wire or netting so as not to create a hazard to grazing animals or a nuisance to the owners of the ground.

PA 6 TOLERANCES

The maximum deviations are mentioned under the relevant items of PA 5.

PA 7 TESTS

Not applicable to this specification.

PA 8 MEASUREMENT AND PAYMENT

PA 8.1 LISTED ITEMS

PA 8.1.1 Clearing Fence Line…… Unit: Kilometre(km)

The tendered rate shall be in full compensation for the clearing of the fence line as specified, including the removal of trees, stones and other obstructions and the disposal as directed of all material resulting from clearing operations.

The removal of trees and stumps with a girth exceeding 1 m shall be paid for as specified in SANS 1200 C.

PA 8.2 SUPPLY AND ERECTION OF NEW FENCING MATERIAL

The quantity of material used shall be determined by measuring the quantities of individual items of material installed in the complete fence. No linear measure of completed fence shall be applicable.

The applicable units of measurement are as follows:

a) Posts……Unit: Number (No)

All straining posts erected in accordance with the maximum specified spacing or such lesser spacing as authorised by the Engineer, all corner posts authorised by the Engineer and all end posts. Gate posts for new gates shall not be measured for payment.

b) Standards and droppers……..Unit: Number (No)

The unit of measurement shall be the number of standards and droppers erected to be maximum specified spacing or such lesser spacing as authorised by the Engineer.

c) Fencing wire……Unit: Kilometre (km)

The unit of measurement shall be the kilometre of each type of fencing wire measured between end posts. Binding wire and wire used for bracing and anchoring of posts, shall not be measured for payment.

d) Diamond mesh and wire netting……..Unit: Square metre (m²)

The quantity shall be calculated using the prescribed width and the length between straining posts or gate posts, or the length of strips for covering openings under fences, or the length used for the covering of gates.

e) Palisade fences……Unit: Metre (m)

The unit of measurement shall be the metre of palisade fences erected as specified. The tendered rates shall include full compensation for all excavations, concrete, formwork and the completed fence as specified (any barbed wire and concertinas shall be measured in pay item PA 8.2(c)).

f) Supply and erection of prefabricated concrete fences……..Unit: Metre (m)

The unit of measurement shall be the linear meter of prefabricated concrete fence erected as specified. The tendered rates shall include full compensation for the supply and installation of all materials, excavations, concreting of posts, cutting of panels if required etc., to complete the fence as specified.

The tendered rate for each post, standard, dropper, for each kilometre of fencing wire and each square metre of diamond mesh or wire netting shall include full compensation for the provision of all materials including all concrete, binding wire, straining wire, bolts, washers and nuts, for excavation, drilling of holes for standards; for installation of posts, standards and droppers and the complete erection of the fence as specified and as shown on the drawings. No separate payment will be made in respect of stone packing and/or trenching in the case of wire netting. The tendered rate for posts shall include for the construction of the stays of the types shown on the drawings.

PA 8.3 NEW GATES……Unit: Number (No)

At pedestrian- and security fences the pair of gates or sliding gates shall be measured as one.

The tendered rate shall include full compensation for the procuring and furnishing of all material, including gates, gate posts, hinges, bolts, concrete and straining wire, and the erection of the gates as specified and as shown on the drawings. It shall not include for any fencing wire or mesh erected on the gate.

PA 8.4 MOVING OF EXISTING FENCES AND GATES

Each type of fence shall be measured separately and the quantity shall be taken as the length of fence which is permanently erected using material arising from fences which have been dismantled elsewhere. Additional new material used during the re-erection of existing fences shall be measured under item 8.2.

a) Fences
1) Fencing wire……..……Unit: Kilometre (km)
2) Fencing wire……..……Unit: Kilometre (km)
3) Fencing wire……..……Unit: Kilometre (km)
b) Gates……..……Unit: Number (No)

The tendered rate for each kilometre of existing fence moved, or for each existing gate moved shall include full compensation for dismantling old fences, coiling and stacking of material not suitable for re-use, moving all material, including posts and wire and the re-erection of the fence or gate in the new position and the provision of binding, typing and straining wire. Additional new material used during the re-erection of the old fence shall be paid for under item 8.2.

The tendered rate for each gate moved shall include full compensation for taking down the gate and re-erecting it where required including all new bolts, nuts and other accessories required, but excluding new gate posts.

PA 8.5 DISMANTLING OF EXISTING FENCES……..Unit: Kilometre (km)

The unit of measurement shall be the kilometre of existing fencing and gates taken down and dismantled on instructions of the Engineer.

Payment at tendered rates shall include full compensation for taking down existing fences and gates, coiling wires, rolling netting into rolls, transporting the material to designated sites and stacking the material.

PA 8.6 DRILLING AND BLASTING OF HOLES FOR POSTS AND ANCHORS……Unit: Number

The unit of measurement shall be the number of holes for posts and anchors made by drilling and/or blasting where excavation by hand tools or pneumatic tools cannot be done economically.

Payment at tendered rates shall include for drilling and for blasting the holes and for all other expenses in connection with the provision, storage, transport and use of the explosives.

PA 8.7 PROVISION OF TEMPORARY FENCING

a) Stock-proof fences……Unit: Kilometre (km)
b) Vermin-proof fences……Unit: Kilometre (km)
c) Pedestrian fences……..Unit: Kilometre (km)

The tendered rate shall include full compensation for the provision of all labour, new or suitable second-hand material including gates, the erection of the temporary fence and when no longer required, the dismantling and removal from site or to new position where required.

PA 8.8 RINGBOLTS FOR ANCHORING FENCING TO STRUCTURES……Unit : Number

The unit of measurement shall be the number of ringbolts supplied and fixed to the structure.
The tendered rate shall include full compensation for supplying and fixing ringbolts of the type shown on the drawings to the structure, including, where necessary, drilling holes, grouting ringbolts in with epoxy resin and for all incidentals.

PB: BUILDING WORK

PB 1 SCOPE

This section specifies the general requirements for the construction of buildings.

PB 2 INTERPRETATIONS

PB 2.1 SUPPORTING SPECIFICATIONS

a) Project Specification;
b) SANS 1200 A or SANS 1200 AA as applicable;
c) SANS 1200 C;
d) SANS 1200 D or SANS 1200 DA as applicable;
e) SANS 1200 G or SANS 1200 GA or SANS 1200 GB as applicable.

PB 2.2 GENERAL

Building work shall be carried out in accordance with the National Building Regulations and Building Standards Act, 1977, and these specifications.

References to specifications and codes of practice of the South African Bureau of Standards shall be taken to be references to the latest edition of such specifications and codes of practice as amended. Where possible the SANS mark shall appear on all articles, materials or items where it is required to comply with such SANS specification.

PB 2.3 COMMERCIAL PRODUCTS

In all instances where the Contractor handles, stores, uses, applies or fixes commercial products, the work shall be strictly carried out according to the instructions of the manufacturer of such products.

PB 2.4 SAMPLES

The Contractor shall furnish without delay, such samples as called for or may be called for by the Engineer. Materials or workmanship not corresponding with approved samples, may be rejected by the Engineer and shall be removed from the works at the cost of the Contractor.

PB 3 MATERIALS

PB 3.1 CEMENT

Cement for masonry work comply with the requirements of SANS EN 431 1 and cement for concrete work shall be CEM I Portland cement or CEM III blast-furnace cement complying with the requirements of SANS EN 197 1.

Separate storage facilities shall be provided fort the various types of cement.

PB 3.2 WATER

Water shall be clean and free from clay, silt, oil, acid, alkali, organic or other matter which would impair the required strength and durability of mortar, plaster or floor screed.

PB 3.3 LIME

Lime shall be hydrated bedding mortar lime complying with the requirements of SANS 523.

PB 3.4 AGGREGATE

Sand for plaster and mortar shall comply with the requirements of SANS 1090, whereas the aggregates for normal and granolithic floor creeds shall comply with the requirements of BS1199 and BS1201 respectively.

PB 3.5 BURNT CLAY BRICKS

Burnt clay bricks shall comply with the requirements of SANS 227 and shall also be equal in all respects to the three samples of each type of brick furnished by the Contractor prior to commencement of the works and as approved by the Engineer.

General purpose (special) bricks shall be used in foundation walls and lintels.

The colour and texture of face bricks shall be as specified in the project specifications. Care shall be taken to avoid damage to arises and faces during transport and handling.

Fire bricks shall be of well burnt refractory fire clay, resistant to spalling and cracking and of same size as the ordinary bricks.

PB 3.6 CONCRETE MASONRY UNITS

Pre-cast concrete masonry units shall comply with the requirements of SANS 1215 and shall be solid unless specified otherwise in the project specifications.

PB 3.7 CALCIUM SILICATE MASONRY UNITS

Calcium silicate masonry units shall comply with the requirements of SANS 285.

PB 3.8 WALL TIES

Wall ties shall comply with the requirements of SANS 28.

PB 3.9 AIR BRICKS

Air bricks shall be well-burnt terra-cotta air bricks in external faces of walls and 250 mm x 150 mm rectangular gypsum air bricks covered with copper mosquito gauze in internal faces.

PB 3.10 BRICK REINFORCEMENT

Brick reinforcement shall be hard drawn mild steel comprising two 3,15 mm diameter wires spaced 75 mm apart and 2,8 mm diameter cross wires spaced at not exceeding 300 mm apart welded to main wires.

PB 3.11 QUARRY TILES

Quarry tiles shall be of approved quality, even in thickness, truly square, free from cracks, twists and blemishes and uniform in colour and unless otherwise specified, shall be of approved red colour.

PB 3.12 CERAMIC TILES

Glazed ceramic tiles for walls shall comply with the requirements of SANS 22 and, unless otherwise specified, shall be white, size 150 mm x 150 mm x 6,5 mm thick.

Ceramic tiles for floors shall comply with the requirements of SANS 1449 and, unless otherwise specified, shall be unglazed, size 240 mm x 115 mm x 20 mm thick and of approved colour.

PB 3.13 CONCRETE PAVING SLABS

Concrete paving slabs shall be precast units of grade 25 MPa/13 mm concrete and shall be of approved manufacture, at least 50 mm thick and sizes 250 mm x 250 mm minimum and 600 mm x 600 mm maximum.

Concrete slabs shall be even in thickness, truly square, free from cracks, twists and blemishes, with a uniform natural cement colour and surface finished smoothly in the mould and shall also be equal in all respects to the samples furnished by the Contractor prior to commencement of the works and as approved by the Engineer.

PB 3.14 DAMP-PROOF MEMBRANE

Damp-proof membrane under floors, unless otherwise specified, shall be of polyethylene sheeting complying with the requirements of SANS 952 as Type C plain surfaces specified therein, 250 microns in dry areas and 375 microns in wet areas.

PB 3.15 DAMP-PROOF COURSE IN WALLS

Horizontal and vertical damp-proof course, unless otherwise specified, shall be of bituminous sheeting complying with the requirements of SANS 248 and as Type FV (Fibre Base) sheeting or as Type GH (Hessian Base) sheeting specified therein, or of polyethylene sheeting complying with the requirements of SANS 952 and as Type A plain surfaces 450 microns or as Type B embossed surfaces 375 microns as described therein.

PB 3.16 TREATMENT OF TIMBER

All timber shall be given a preservative treatment suitable for the duty for which the timber is intended in accordance with SANS code of practice 05, and no untreated timber shall be used.

The preservative treatment shall not impair the final finish. The timber shall be impregnated throughout. When surface coating is specified, the compounds applied on the surfaces of the timber shall form an unbroken film.

PB 3.17 STRUCTURAL TIMBER

Structural timber, unless otherwise specified, shall be of South African softwood (pine) complying with the requirements of SANS 563 or SANS 1245 and, unless otherwise specified or shown on the drawings, shall be of Grade 4 and shall be marked as laid down in the specification.

Roof battens and other structural timbers not less than 50 mm or more than 65 mm in width and not less than 38 mm or more than 50 mm thickness, shall be of South African softwood (pine) complying with the requirements of SANS 653.

All structural timber shall bear the full standardisation mark of the South African Bureau of Standards.

The tolerance by which "actual" dimensions may vary from the "nominal" dimensions specified or stated on drawings of South African sawn structural softwood, shall be as laid down in SANS 563, SANS 653 and SANS 1245 where relevant.

PB 3.18 STRUCTURAL LAMINATED TIMBER

a) Stock glued laminated timber of S.A. pine:

Stock glued laminated timber of S.A. pine shall comply with the requirements of SANS 1089 and shall be marked as laid down in the specification and shall also bear the standardisation mark of the SANS.

b) Designed glued laminated timber:

Structural glued laminated timber shall comply with the requirements of SANS 876 and shall be marked as laid down in the specification and shall also bear the standardisation mark of the SANS.

The timber shall be of -

i. softwood or hardwood;
ii. the density group and grade;
iii. the exposure category;
iv. moisture content; and
v. of Class A or Class B appearance;

as specified and, in services having timbers treated against infestation by insect pests, shall be treated against pests as laid down in the specification for laminated timber.

PB 3.19 GALVANISED STEEL ROOFING SHEETS

Galvanised steel roofing sheets shall be of the profile as scheduled or shown on the drawings, of 0,60 mm thick mild steel (before galvanising) and shall be galvanised on both sides to the requirements of SANS 934 for a Class Z250 coating, unless a Class Z600 coating is specified, and shall be passivated.

PB 3.20 METAL RIDGING FOR STEEL COVERED ROOFS

Galvanised iron ridging for ridges and hips of steel covered roofs shall be of 0,60 mm thick flat mild steel (before galvanising), galvanised as specified for roofing sheets in clause 3.19.

PB 3.21 FIBRE CEMENT ROOFING SHEETS

Fibre cement roofing sheets shall be of the profile scheduled or shown on the drawings and shall comply with the requirements of SANS 685. The sheets shall be not less than 6 mm thick.

PB 3.22 ADJUSTABLE FIBRE CEMENT RIDGING

Adjustable fibre cement ridging for ridges of fibre cement covered roofs, shall be of same manufacture as the roofing sheets, of not less than 6 mm thick material, with overlapping end joints and shall suit the profile of the roofing sheets. Width of wing shall be not less than 300 mm measured from the centre of roll.

PB 3.23 FASCIAS AND BARGE BOARDS

Fascias and barge boards shall be, unless otherwise specified, of pressed fibre cement boards of section described in long lengths.

PB 3.24 FIBRE CEMENT FLASHINGS

Fibre cement flashing for horizontal top edges of roofs butting against vertical wall or other surfaces, shall be of same manufacture as the roofing sheets of not less than 6 mm thick material and with overlapping end joints. The flashings shall suit the profile of the roofing sheets and shall extend not less than 300 mm onto the roof sheeting, shall have plain upstands against the vertical surfaces and shall be flashed over with metal as described.

PB 3.25 FIBRE CEMENT GUTTERS

Fibre cement gutters shall be of approved manufacture, of not less than 6 mm thick material and with spigot and socket ends.

Gutter brackets shall be heavy quality galvanised steel or non-ferrous metal brackets as supplied by the manufacturers of the gutters.

PB 3.26 FIBRE CEMENT RAINWATER DOWN PIPES

Fibre cement rainwater downpipes shall be of approved manufacture, with spigot and socket ends. The material in circular rainwater downpipes 75 mm diameter shall be not less than 6 mm thick, and in circular pipes over 75 mm diameter and in all sizes of square and rectangular pipes, shall be not less than 8 mm thick.

Holderbats for rainwater downpipes shall be heavy quality galvanised steel or non-ferrous metal holderbats.

PB 3.27 CONCRETE ROOFING TILES

Concrete roofing tiles shall comply with the requirements of SANS 542, except that the concrete in the body of the tile need not be coloured where tiles have natural stone granular finish, and shall be of pattern and colour specified.

Unless otherwise specified, the tiles shall have natural stone granular finish.

PB 3.28 COVERING TO CEILINGS

a) Gypsum plasterboard ceilings with plaster finish

Gypsum plasterboard for ceilings shall be 6,4 mm thick gypsum ceiling board, complying with the requirements of SANS 266.

The cover strips shall be galvanised or lacquered wire gauze not less than 60 mm wide. The plaster shall be a retarded semi-hydrate wood-fibre plasterboard bonding gypsum plaster.

b) Fibre cellulose board ceilings

Fibre cellulose board for ceilings shall comply with the requirements of SANS 803 and, unless otherwise specified, shall be 6 mm thick and of flat (unpressed) type.

PB 3.29 COVE CORNICES TO CEILINGS

a) Gypsum plasterboard cornices

Cove gypsum plasterboard cornices to ceilings shall comply with the requirements of SANS 622 and shall be of 82 mm or 120 mm girth as specified.

b) Timber cornices

Timber cornices to ceilings shall be 32 mm hardwood Scotia's.

PB 3.30 FLAT FIBRE CEMENT SHEETS

Flat fibre cement sheets other than fibre cellulose boards described in subclause 3.28(b), shall comply with the requirements of SANS 685.

PB 3.31 TIMBER FOR JOINERY

Softwood for joinery shall comply with the requirements of SANS 1359 and hardwood with the requirements of SANS 1099.

Timber for joinery shall be of clear grade, unless otherwise specified. Counter tops and other tops, where only one face side is visible, shall be of semi-clear grade timber.

PB 3.32 FRAMED AND LEDGED BATTEN DOORS

a) Softwood doors

To be 44 mm thick framed and ledged batten doors complying with the requirements of SANS 545, but the timber shall comply with the requirements of SANS 1359 and shall be of clear grade.

b) Hardwood doors

To be 44 mm thick framed and ledged batten doors complying with the requirements of SANS 545, but the timber shall comply with the requirements of SANS 1099 and shall be of clear grade. The hardwood shall be solid without any laminations.

PB 3.33 FLUSH DOORS

Flush doors shall be solid, laminated, chip core or hollow-core as specified and shall comply with the requirements of SANS 545. All glue used in the manufacture of the doors shall comply with the requirements of the above specification.

Unless otherwise specified, face veneers shall be rotary cut, and shall be of timber specified or where doors are to be painted shall be of timber suitable for painting.

Edge-strips to conceal the vertical edges of doors shall be not less than 10 mm thick and of the same timber as face veneers; edge strips to meeting edges of doors in two leaves where edges are to be rebated, shall be not less than 20 mm thick.

Faces of doors shall be machine-sanded to a smooth and even surface.

All glueing together of core strips and glueing on of veneers, edge-strips, etc. shall be done under hydraulic pressure.

The top and bottom edges of doors showing end grain, shall be sealed with lacquer, or other suitable material, before leaving the manufacturer's works, and similarly sealed after doors are fitted into frames if the edges of doors are disturbed during fitting.

PB 3.34 IRONMONGERY

All ironmongery shall be of best quality and shall be approved by the Engineer, before fixing. Screws for fixing of articles shall be of similar metal than the articles.

Locks shall comply with the requirements of SANS 4 and shall be supplied with two keys each.

Unless otherwise specified, interior and exterior doors shall be fitted with two and four lever heavy-duty mortice locks respectively, which shall be master-keyed.

No key shall pass a second lock. On no account shall the keys be delivered with the doors or locks to the building site. Failure to observe these instructions may entail the provision of new locks and keys.

PB 3.35 HOT-DIP GALVANISING TO STEELWORK

Where prescribed, all steelwork built in as the work proceeds, shall be hot-dip galvanised after fabrication and before leaving the manufacturer's works, in accordance with SANS 763.

Where they occur, site welds shall be zinc sprayed in order that the zinc coating be even and continuous over all surfaces.

PB 3.36 PRESSED STEEL DOOR FRAMES

Pressed steel door frames shall comply with the requirements of SANS 1129 and shall be constructed of 1,6 mm thick mild steel sheeting, pressed or rolled to the required shapes, properly mitred, welded and reinforced.

Frames shall be of widths required to suit the thickness of walls into which they are built and shall be fitted with suitable tie-bars and braces at bottom, and lugs for building in, three to each jamb of frames without fanlights and four to each jamb of frames with fanlights.

Where fanlights are shown over doors, the frames shall be fitted with transoms of pressed or rolled steel sheet as above and rebate for fanlights and for doors if required.

The rebates in frames and transoms for doors and fanlights shall be of width required to suit the thickness of doors and fanlights.

Frames shall each be fitted in the rebate of one jamb with a pair of approved 100 mm steel butt hinges, and transom to opening fanlights hung at bottom shall each be fitted with a pair of approved 75 mm steel butt hinges, all set flush into recesses in frames and either fixed with countersunk screws or securely welded on.

Frames shall be holed as and where required for screws fixing fanlight openers, keeps of spring catches, etc. Where fanlights are shown to be fixed into frames, the frames shall be holed in the rebates, for screws, securing the fanlights, four to each frame.

Frames shall each be fitted in one jamb, with approved chromium plated or stainless steel (unless otherwise specified) adjustable striking plate keep, boxed in at back of frame with sheet metal box welded on, and not less than two rubber buffers.

All welding shall be cleaned off smooth and flush on exposed faces and frames shall be cleaned and primed as described for steel windows before leaving the manufacturer's works.

PB 3.37 STEEL DOORS, SIDELIGHTS AND FANLIGHTS

Steel doors, sidelights and fanlights shall, in the case of stock types, comply with the requirements of SANS 727, and in the case of purpose made types with the constructional and other requirements of the above specification wherever applicable, and shall in addition be equipped with the following:

a) Suitable weather bars where required to render doors, etc., perfectly watertight;

b) Suitable lugs, or holes at the same spacing as the standard fixing lugs, for screwing frames to plugs in the concrete, where frames of doors, etc. are to be fixed to concrete columns, beams, etc.

c) A primer as described for steel windows, except where hot-dip galvanising is prescribed.

Doors, sidelights and fanlights, unless otherwise shown shall be of "one piece" construction, but where shown to be in two or more "one piece" units, the units shall be coupled together with standard coupling-mullions and/or transoms.

Bottom openings in doors and sidelights shall be fitted with kicking plates of one thickness of 1,6 mm thick mild steel sheet fixed with metal beads.

Frames of outward opening doors shall be fitted at bottom with sills of door framing section (stepped sills) and of inward opening doors with metal ties, welded to frames, for embedding in thresholds (flush sills).

Stock doors, sidelights and fanlights shall be of the types shown on drawings and purpose made doors, sidelights and fanlights shall be constructed to the forms and sizes shown on drawings.

Unless otherwise specified, the doors shall be of not less than 33 mm universal sections and the sidelights and fanlights of standard 25 mm sections.

Fanlights shall be hung and fitted as described for steel windows in clause 3.39.

PB 3.38 BALANCE TYPE STEEL DOOR

The balance type steel door shall be of the "back track" type tip-up door, constructed of not less than 0,8 mm thick mild steel sheeting, pressed to form troughed or fluted pattern horizontal panels, each approximately 200 mm wide, all strongly reinforced at back with 1,2 mm thick top hat section mild steel braces and/or stiffeners and provided all round exposed edges with 1,2 mm thick mild steel channels, all properly welded together and with all welding cleaned off smooth and flush.
The door is to be hung on two galvanised flexible steel cables of not less than 5 mm diameter, connected at lower ends to 125 mm diameter steel encased counterweights of such length and mass as will balance the door in the full open position and connected at upper ends to door unit by passing

cables over 140 mm diameter bushed cast aluminium pulleys, securely fixed to 2,50 mm thick mild steel top plates.

The movement of door is to be controlled by means of sintered metal rollers, (nylon rollers are not acceptable) securely fixed at top and centre of outer edges to door unit to operate in horizontal and vertical runner guides respectively. The guides are to be formed of 37 mm x 32 mm x 25 mm mild steel channels and with vertical channels fitted at upper ends with horizontal channels, welded on to form back track for top rollers. Each vertical channel is to be four times bolted to jamb of door opening and each horizontal channel is to be secured in position to internal wall with mild steel angle bracket, twice bolted to wall to form rigid construction.

The counterweights to door to be encased with 2,50 mm thick mild steel cover plates, each the full height of door and securely fixed to wall and channel guide.

Door to be fitted near bottom with cast aluminium lifting handle for operating the door and with chromium plated locking handle, complete with control rods and with striking plate bolted to lintel, over door opening. The locking handle is to be operated from outside and is to be provided with two keys.

Before leaving the manufacturer's works, all metal is to be given a protective priming coat of paint in accordance with the requirements of SANS 909.

PB 3.39 STEEL WINDOWS

Stock residential and industrial type steel windows shall comply with the requirements of SANS 727 and all other types both stock and purpose made shall comply with the constructional and other requirements of the above specification wherever applicable, and shall in addition be equipped with the following:

a) Suitable weather bars where required to render the windows perfectly watertight;

b) Suitable lugs, or holes at the same spacing as the standard fixing lugs, for screwing frames to plugs in the concrete where frames of windows are to be fixed to concrete columns, beams, etc.;

c) Windows and components, except where specified to be hot-dip galvanised, shall before leaving the manufacturer's works, be cleaned by acid pickling rinsing and drying, as laid down in SANS code of practice 064, or by other approved means, to remove all scale, rust, grease, oil and foreign matter and then primed with red oxide zinc chromate primer complying with the requirements of SANS 909, applied by dipping or by means of spray gun.

Ventilators hung at side to open out in windows above ground floors and not accessible for cleaning from an adjoining opening ventilator in the same window or from verandas, balconies and the like, shall be hung on projecting hinges.

Windows, unless otherwise specified, shall be of "one piece" construction, but where shown to be in two or more "one piece" units, shall be coupled together with standard coupling mullions and/or transoms.
Windows shall be fitted with solid brass handles, stays, catches and other fittings, those to windows constructed of universal sections having polished finish and to all other windows rumbled finish. The fittings shall be fixed in such a way as to be removable after windows are glazed.

PB 3.40 RESILIENT FLOOR FINISHINGS

Semi-flexible vinyl (vinyl-fibre) floor tiles shall comply with the requirements of SANS 581; flexible vinyl (PVC) floor tiles and sheeting shall comply with the requirements of SANS 786 and thermoplastic (asphaltic) floor tiles shall comply with the requirements of SANS 586. Unless otherwise described, the flooring shall be of marbled pattern and of approved light colour and tiles shall be 230 mm x 230 mm or 250 mm x 250 mm in size.

Vinyl cove skirtings shall be of approved manufacture and colour and unless otherwise stated, 70 mm in height.

PB 3.41 GLASS FOR GLAZING

Glass for glazing shall comply with the requirements of CKS 55.

Glass not exceeding 0,75 square metre surface area of glass pane, shall be flat drawn clear sheet glass of "QQ" quality (ordinary glazing quality) and of 3 mm thickness.

Glass exceeding 0,75 square metre and up to 1,5 square metres surface area of glass pane, shall be clear float glass of "GG" quality (glazing quality) and of 4 mm thickness.

Laminated safety glass for glazing shall be of "SQ" quality (selected glazing quality) and of 6 mm thickness unless otherwise specified. If high impact strength glass is used, whether cut to size or not, the stencil mark is to appear in a prominent place on the glass.

Toughened safety glass for glazing up to 3 square metres shall be, unless otherwise specified, of 4 mm thickness and must be ordered to the correct size as toughened glass cannot be cut, and each piece of glass to be marked in a clear and permanent fashion. (For bigger sizes, manufacturer's instructions are to be followed).

Any pane of glass installed in any door shall, where not made of safety glass, be not more than 1 m2 in area and shall have a nominal thickness of not less than 6 mm.

Obscure glass for glazing, unless otherwise specified, shall be Arctic or other similar approved figured rolled glass, of a nominal thickness of not less than 3 mm for glass panes up to a surface area of 0,75 square metre and not less than 5 mm over 0,75 square metre.

Putty for glazing shall comply with the requirements of SANS 680, of Type I for glazing in wood and of Type II for glazing in steel windows, doors, etc. Putty used for glazing in unpainted hardwoods, shall be tinted to match the colour of the wood.

PB 3.42 PAINTS

All materials for paint work for which South African Bureau of Standards specifications have been published, shall comply with the requirements of such specifications and shall bear the standardisation mark of the South African Bureau of Standards on the container or packing. Materials for paint work for which no SANS specifications have been published shall be of brand and manufacture approved by the Engineer.

All materials for paint work must be brought on to the site in unopened containers and no adulteration will be allowed.

Undercoats for paint work shall be as supplied by the manufacturer of the paint being used for the finishing coat.

Paints shall be suitable for application on the surfaces on which they are to be applied, and those used externally shall be of exterior quality or suitable for exterior use.

If necessary, paints shall be strained free from skins and similar impurities immediately before application.

The various primers, undercoats, paints and distempers shall comply with the requirements of the specifications quoted hereunder and shall be of the type of grade stated, viz:

a) Primers

i) For wood:
SANS 678. Type I shall be used on exterior woodwork and Type III on interior woodwork.

ii) For metal:
Dip or spray application (red oxide zinc chromate). For steel windows, doors, door jambs, and other articles normally dip or spray primed in the manufacturer's works: SANS 909.
Brush application (zinc chromate). For all metal surfaces primed on site and then painted: SANS 679, Type I.

iii) For structural steel (red lead)
SANS 312, Type II, Grade I.

iv) For galvanised iron
SANS 912.

v) For galvanised metal surfaces and surfaces of non-ferrous metals
Wash primer (metal etch primer): SANS 723.

b) Undercoats
For all surfaces under HIGH GLOSS, OIL GLOSS, FLAT and EGGSHELL finishing paints:
SANS 681, Type II.

c) Paints

i) High gloss:
SANS 630

ii) Oil gloss:
SANS 631

iii) Flat and eggshell:
SANS 515

iv) Emulsion paint (interior):
SANS 633, Grade I

v) Emulsion paint (exterior):
SANS 634, Synthetic Polymer Base Type, but pure acrylic resin base for fibre cement surfaces

vi) Aluminium paint:
SANS 682, Grade II

vii) Roof paint:
SANS 683, Type B

viii) Structural steel paint:
SANS 684, Type B

ix) Epoxy tar:
SANS 801 (types as specified)

d) Distemper
SANS 322

e) Varnish for interior use
SANS 887, Type I with eggshell finish.

PB 4 PLANT

PB 4.1 GENERAL

The Contractor shall have at his disposal the normal plant necessary for the proper and neat completion and rounding off of all facets of the building work.

PB 5 CONSTRUCTION

PB 5.1 BRICKLAYER

PB 5.1.1 Cement Mortar

Cement mortar shall, unless otherwise specified, be composed of four parts by volume of sand and one part by volume of cement for normal brickwork, and three parts by volume of sand and one part by volume of cement for reinforced brickwork.

The ingredients for cement mortar shall be measured in proper gauge boxes on a boarded platform and thoroughly mixed. Alternatively mixing may be by means of an approved mechanical batch mixer. Only when the dry ingredients have been thoroughly mixed and a mixture of uniform colour has been obtained may the water be added in sufficient quantity to obtain mortar with the required consistency.

Care shall be taken in mixing cement mortar to remove from the mixing machine or platform any old mortar that has already set, as such mortar must not be incorporated in any new batch.

Cement mortar shall be produced in such quantities as can be used before commencing to set, as no cement mortar that has once commenced to set shall be used in any way.

PB 5.1.2 Brickwork

Brickwork, wherever practicable and not otherwise specified, shall be built in English bond. No false headers shall be used, and none but whole bricks employed, except where legitimately required to form bond.

The brickwork, unless otherwise specified, shall be built in 4:1 cement mortar. Brick arches and brick lintels shall be built in 3:1 cement mortar.

The bricks shall be laid on a solid bed of mortar and all joints thoroughly grouted up solid throughout the whole width of each course.

The brickwork shall be carried up in a uniform manner, no portion being raised more than 1,2 m above an adjacent portion.

The bricks shall be well saturated with water, in the stack or dump, approximately two hours before being used. The tops of walls left off, shall be well wetted before work is recommenced.

All rough and fair cutting and cutting of splays, skew backs, chamfers, etc., shall be properly performed.

All necessary openings for pipes, etc., shall be formed or left and made good after pipes, etc., are fixed in position.

Walls generally shall be taken up two courses above panelled ceilings in the same mortar as the wall below and cut between ties, etc.

Where hollow concrete masonry units are used brick-force shall be built into the walls every third course. Mortar for hollow concrete masonry units shall consist of one part cement, two parts lime and nine parts sand by volume. All cavities below floor level shall be filled with Grade 15 MPa/19 mm concrete.

PB 5.1.3 Mortar Joints

Mortar joints to brickwork generally shall be 10 mm in thickness.

The joints in brickwork receiving plaster, tiling or similar finishings, shall be raked out whilst the mortar is soft to form key for the plaster or mortar backing. The depth of the raking out will depend on the condition of the bricks; the rougher the bricks on face the shallower the raking out and the smoother the bricks the deeper the raking out.

The joints in brickwork shall be flushed off where walls are to be bagged, in readiness for the bagging.

PB 5.1.4 Brickwork in Thicknesses

Walls built in two or three thicknesses shall be tied together with and including metal ties of sufficient length to allow not less than 75 mm of each end to be built into brickwork and shall be spaced not more than 1 m apart to every third course and staggered.

PB 5.1.5 Brickwork in Linings

Linings to concrete shall be tied with and including 4 mm diameter galvanised crimped wire ties of necessary length to allow 75 mm to be bedded into concrete and 75 mm of the other end to be built into brickwork and evenly spaced 1 m apart to every third course and staggered.

PB 5.1.6 Half Brick Thick Walls

Half brick thick walls shall be built in 4:1 cement mortar and reinforced with 75 mm wide brick reinforcement, one row to every eighth course in height, and built 100 mm into main connecting walls. The reinforcement shall be lapped 150 mm at end joints, where these are necessary, and 75 mm at angles.

PB 5.1.7 Cavity Walls

Cavity walls, unless otherwise specified, shall be built with two half brick thicknesses of brickwork in stretcher bond with 50 mm cavity between, and the two thicknesses tied together with 200 mm long metal wall ties of the butterfly type, spaced at not more than 1 m centres alternately to every third course of brickwork.

Unless otherwise specified, the brickwork shall be built in 4:1 cement mortar.

The cavities shall be carried up from one course of brickwork below damp course level up to two courses below wall plate level, unless otherwise shown or specified. The brickwork above cavities shall be built solid, and where 270 mm thick shall be cut and well bonded where possible. Cavities in foundation walls of cavity walls shall be filled with Grade 15 MPa/19 mm up to 150 mm below the damp-proof course level.

The cavities shall be kept free of all rubbish, mortar droppings and projecting mortar.

The tops of walls shall be covered with planks or sacking during wet weather to prevent rain from entering the cavities.

The cavities shall not be ventilated.

At door, windows and other openings, the cavities shall be stopped 110 mm back from jambs of openings with the inner thickness of brickwork returned and stopped against the outer thickness and not bonded to same. A 110 mm wide strip of damp-proof sheeting as described for damp- proof course in clause 3.15 shall be built in between the two thicknesses in the joint formed by the return and the outer thickness. The damp-proof strip shall be lapped at least 50 mm on to the sheeting between the two thicknesses of sills and between the two thicknesses of lintels. Sills to windows shall be divided into external and internal thicknesses with strips of damp-proof sheeting as above, built in line with the damp-proof sheeting in jambs and extending 100 mm beyond the jambs of openings.

The lintels shall be provided with damp-proof sheeting as described under lintels.

Unless otherwise specified, cavities shall be stopped one course below and one course above and 110 mm from sides of openings for air bricks and the like.

PB 5.1.8 Reinforced Brick Lintels

Reinforced brick lintels shall be built with sound machine made bricks, in 3:1 cement mortar, with all vertical and horizontal joints filled solid with mortar throughout the required number of courses and to a distance of at least 330 mm on either side of the clear opening.

The number of courses in lintels over the various size openings shall be as specified in table hereunder, and reinforcing steel wires or rods shall be built into the first horizontal joint over the bottom course as laid down therein, viz.:

LINTEL SPAN	NUMBER OF COURSES	REINFORCEMENT
Not exceeding 1m	4	One row of 75 mm wide brick reinforcement for each half brick width soffit.
Over 1m tot 1,5m	6	One row of 75 mm wide brick reinforcement for each half brick width soffit.
Over 1,5m tot 2,1m	7	Three 6,3 mm diameter mild steel rods for each half brick width of soffit.

The reinforcing wires and rods shall be of length at least equal to the width of the clear opening plus 330 mm at each end. The reinforcement shall be evenly spaced in the brick joints, with the outer wires or rods having at least 20 mm cover from face of brickwork.

Brick lintels in 270 mm thick cavity walls shall be built in two half brick thicknesses in stretcher bond, with inner face of outer thickness for a depth of three courses above soffit, covered with sheeting as for damp-proof course, the full length of lintels, and space between the two thicknesses for the depth of the sheeting filled in solid with Grade 15 MPa/19 mm concrete. Where cavities continue above lintels, the sheeting shall be taken up and turned on to top of first course of brickwork to inner thickness of wall, above the concrete filling in lintels.

The lintels, except where built over pressed steel door frames and the like, shall be supported on temporary formwork left in position for at least fourteen (14) days.

PB 5.1.9 Beam Filling

Beam filling, unless otherwise specified, shall be half brick thick, built in similar mortar as used in the walls below, cut in between roof timbers and carried hard up to underside of roof covering, and flushed up in mortar.

PB 5.1.10 Bagged Finish to Brickwork

Bagged finish to brickwork, if done whilst the mortar in joints is still soft, shall be formed by rubbing over the wall surfaces with wet rough sacking, until all joints and crevices are filled up and an even surface is obtained. Mortar, as used for building the brickwork, shall be added as may be necessary. If bagging to walls is done after the mortar in joints has set the wall surfaces shall be rubbed over with wet rough sacking as above, but cement grout shall be added as necessary to fill up the joints and crevices and to obtain an even surface.

PB 5.1.11 Building in Brickwork

Ends of timbers, hold-fasts, cramps, gratings, air bricks, dowels, etc., shall be built-in in cement mortar.

Door and window frames and the like shall be set up in positions for building in and securely strutted to prevent distortion whilst the brickwork, lintels, etc., are being built.

Pressed steel door frames shall be grouted in solid at back with cement mortar as the work proceeds.

Wood slips, fixing bricks, hoop iron, roof ties, etc., shall be built in as the work proceeds.

Ventilators shall be built into openings formed in the walls, in 3:1 cement mortar, and grouted in solid with similar mortar and wall finishes made good if disturbed.

Wood frames to doors, windows, etc., shall be set up in position for building in as described and built in as the work proceeds with cramps to jambs of 1,6 mm thick galvanised hoop iron, 32 mm wide, with ends turned 50 mm up against stiles of frames and each twice screwed to frame, and built 450 mm into wall with end turned up into brickwork joint. Cramps shall be built in approximately 0,3 m up from bottom and approximately 0,3 m down from head of frames and intermediately at not exceeding 0,85 m apart. No frame shall have less than two cramps to each jamb irrespective of height.

Cramps to frames in 270 mm thick cavity walls shall be cranked as necessary and built into inner and outer thicknesses of walls alternately.

The stiles of wood door frames, and similar frames not having sills framed in, shall be doweled to concrete, brick, stone and similar thresholds with 10 mm diameter mild steel dowels 75 mm long, one to each stile.

PB 5.1.12 Securing of Roofs

Roof trusses shall be fixed at each support to walls with ties of 1,2 mm thick galvanised hoop iron, 30 mm wide, built 750 mm deep into brickwork or embedded 300 mm deep into concrete or wrapped around bottom layer of reinforcing in a reinforced concrete beam and, unless otherwise specified, wrapped over truss and fixed with four galvanised nails, 60 mm long and taken up to and lapped round the nearest purlin and well spiked thereto.

PB 5.1.13 Bedding and Pointing

All door, window and similar frames shall be bedded and pointed in 3:1 cement mortar. All wall plates shall be set true and level and bedded in 4:1 cement mortar.

Steel door and window frames shall be carefully pointed all round and made perfectly watertight. Where steel door and window frames are specified to be pointed with mastic compound, they shall be pointed all round externally with an approved waterproof compound, of such composition that it will not stain surrounding surfaces, and that it will adhere tenaciously, remain plastic without sagging or running, be capable of accommodating any normal movement of the joint sealed, and will receive paint without "bleeding". The pointing material shall be forced into the joints, which shall have been previously prepared to receive same, by means of a pressure gun, or by other suitable method, all in accordance with the manufacturer's instructions.

PB 5.1.14 Faced Brickwork

Faced brickwork shall be built fair and the joints shall be square recessed to a depth of approximately 6 mm, formed with a square jointing tool well pressed into the joints as the work proceeds.

The Contractor shall construct a test section of 10 m² which shall be approved by the Engineer, before continuing with faced brickwork.

Face bricks shall be sorted by the brick manufacturer at his yard or by the Contractor on the site, to ensure that proper mixing of the bricks within the colour range of each type of facing brick being used is obtained; sudden changes in the general colour of face work in any one type of facing brick will not be acceptable.

Sand in mortar for all faced brickwork shall all be from one source.

Faced brickwork shall be kept perfectly clean and rubbing down of the brickwork shall not be allowed. Scaffold boards shall be turned back during rain to avoid splashing. Soiled brickwork shall be cleaned at the Contractor's expense, and the cleaning method shall be approved by the Engineer.

PB 5.1.15 Fibre Cement Sills

Sills shall be in single lengths cut between reveals, fitted with fixing lugs and solidly bedded in 3:1 cement mortar with a slight projection beyond the finished wall face below.

Internal sills shall be level. External sills shall be set sloping on cut brickwork or on fine concrete filling under.

PB 5.1.16 Laying of Quarry Tiles

Joints to paving shall be continuous in both directions.

Tiles shall be solidly bedded and jointed in 3:1 cement mortar with joints, unless otherwise specified, 6 mm wide and slightly pointed with a round jointing tool. Tiles shall be well soaked in water before fixing and thoroughly cleaned off after fixing.

Tiles in sills, copings, etc., shall be set with slight projection over finished wall face, and where full tiles do not fit into the length, two cut tiles shall be used, symmetrically placed as directed.

PB 5.1.17 Installation of Electrical Service

The Contractor shall embed in the concrete and/or brickwork, as the work proceeds, all conduits, boxes, etc., which will be fixed in position by the electricians, and must cut all necessary chases and holes in walls for conduits and form recesses in walls for distribution boards, all in the positions directed, notwithstanding whether the installation of the electrical service is carried out by the Contractor or under a separate contract. Alternatively, distribution boards may be built into walls as the work proceeds, providing prior approval is obtained from the Engineer.

The Contractor shall afford every facility and shall render reasonable assistance to the electricians in carrying out their work, and shall make good where necessary, in all trades, after installation has been completed.

PB 5.1.18 Installation of Mechanical Equipment

Where the installation of mechanical equipment is carried out under a separate contract the Contractor shall arrange for the building in of special fittings, leaving holes and openings or forming chases in floors, walls, etc., for pipes, cables etc., and for the building in of pipes, sleeves, pipe clips, bolts, etc., as required or directed.

All cutting of holes through finished floors, walls, etc., after the concrete or mortar has set, must be avoided as far as possible, and the Contractor must give ample notice to the Engineer who will ascertain the exact positions where pipe sleeves, pipes, pipe clips, etc., are to be built in.

PB 5.1.19 Protect and Clean Down Brickwork, Etc.

Angles of face brickwork, reveals, steps, etc., liable to damage shall be covered up and protected during the progress of the remaining work, and any damage done shall be made good at the Contractor's expense and to the satisfaction of the Engineer.

Face brickwork and brick and tile sills, copings, etc., shall be cleaned down as the work proceeds, and surfaces liable to be soiled by mortar or plaster splashes during the progress of the remaining work shall be covered with paper, pasted on, or by other approved means. At completion of the works the coverings shall be removed and the surfaces again cleaned down to the satisfaction of the Engineer.

Any detergent or other materials used in the cleaning down of face brickwork, etc., shall be of such nature that will not harm adjoining paint and other finishings in any way.

All tiles and other paving shall be thoroughly cleaned off after laying to remove all traces of mortar and other substances, covered up and protected from damage during the progress of the works, and again cleaned off at completion.

PB 5.2 TILER

PB 5.2.1 Laying of Glazed Ceramic Wall Tiles

The tiles shall be fixed direct to walls in 3:1 cement mortar with horizontal and vertical joints continuous, and shall have all joints rubbed in solid with neat white cement grout. Tiles shall be well soaked in water before fixing and thoroughly cleaned off after fixing.

Unless otherwise specified, the wall tiling shall project approximately 4 mm beyond face of adjoining plaster with all exposed edges finished with glazed rounded edge tiles.

Tiling shall be returned into reveals of openings and on to window sills, and shall be butted at internal angles and provided with glazed rounded edged tiles to external angles, unless otherwise specified. All necessary cutting to tiles shall be properly performed. Walls shall be well wetted before tiling is commenced.

PB 5.2.2 Laying of Ceramic Floor Tiles

Ceramic tiles shall be bedded to a true and even surface on 3:1 cement mortar and with joints not exceeding 2 mm wide.

After the tiles have been allowed to set for a period of not less than twenty-four hours the joints shall be grouted in to with approved epoxy compound, or acid proof cement mortar.

PB 5.3 PLASTERER AND PAVIOR

PB 5.3.1 Cement Plaster

Cement plaster for one coat work on walls shall be composed of four parts of sand and one part of cement for internal work, and five parts of sand and one part of cement for external work, all by volume, and mixed as described for cement mortar in clause 5.1.1.

Cement plaster on concrete surfaces shall be composed of three parts by volume of sand and one part by volume of cement.

PB 5.3.2 Forming Key to Concrete for Plaster Finish

All surfaces of concrete receiving plaster, or similar finishings, shall be well wetted and wire brushed immediately after the formwork is removed and slushed over with 2:1 cement grout to form key for

the finish, to the approval of the Engineer. The slushing to be allowed to set hard before the finish is applied.

Other methods may be used if approved by the Engineer.

Particular care shall be taken in forming the key for plaster where steel shuttering is used, and if considered necessary the surface of the concrete shall be hacked.

PB 5.3.3 Thickness of Plaster

Plaster on walls shall be not less than 12 mm or more than 20 mm in thickness, and plaster on concrete ceilings and beams shall be not less than 9 mm or more than 16 mm in thickness, unless otherwise specified.

PB 5.3.4 Application of Plaster

Walls shall be well wetted before plastering is commenced.

The surfaces of internal plaster shall be steel trowelled to a smooth, even and true finish. External plaster shall be finished to a true and even surface with a wood float. All plaster surfaces shall be free from blemish.

Plaster shall be returned into reveals and soffits of openings, and all angles shall be true and straight with salient angles slightly rounded.

The rendering coat of plaster in two coat work shall be approved by the Engineer before the setting coat is applied, and notice shall be given to the Engineer when it is ready for inspection.
All cracks, blisters and other defects shall be cut out and made good and the whole left perfect at completion.

NB - See clause 5.3.2 for forming key for plaster on concrete.

PB 5.3.5 Normal Screeds to Floors

Concrete sub-floors finished with wood mosaic, vinyl sheeting and tiles, and similar finishings, shall be screeded with 3:1 cement mortar, of thickness required, but in no case less than 12 mm, and steel trowelled to a true and smooth surface suitable to receive finishings.

The screeding shall be laid before the concrete sub-floors have matured otherwise the exposed surfaces of concrete shall be thoroughly cleaned with a wire brush, and a coat of neat cement grout applied immediately before the screeding is laid.

The screeding shall be laid in good time to allow of it being perfectly dry when the finishings are laid.

No traffic shall pass over nor shall any building operations take place on the screeding without proper covering first being provided.

PB 5.3.6 Granolithic Screeds

Granolithic screeds shall be composed of two parts by volume of cement and three parts by volume of aggregate with sufficient water added to obtain a consistency as dry as may be practicable. The screed shall be rendered with a wood float and struck off with a steel trowel after set has commenced.

Granolithic screeds to floors, treads of steps, thresholds, and similar horizontal surfaces unless otherwise specified, shall be not less than 25 mm thick. Granolithic screeds to stair risers, sides of

kerbs, and other vertical surfaces, shall, unless otherwise specified, be not less than 20 mm thick. Exposed salient angles of granolithic screeds shall be neatly rounded to approximately 20 mm radius, unless otherwise specified.

The granolithic screeds shall be laid before the concrete sub-floor has matured otherwise the exposed surface of concrete shall be thoroughly cleaned with a wire brush, and a coat of neat cement grout applied immediately before the granolithic screed is laid.

The granolithic screeds shall be laid in panels not exceeding 9 m2 in area, and joined to lines of panels and lined into smaller squares as directed with sunk V-joints. The joints between the panels shall coincide with joints in the concrete sub-floor where possible.

Where granolithic screed is to be tinted it shall be laid in two layers, a lower layer laid to within 6 mm of the finished level, and an upper layer into which the requisite quantity of approved colouring pigment shall have been mixed. No dusting on of colouring material will be allowed.

All granolithic work shall be done by experienced workmen, and shall be protected from injury caused by rain or other extreme weather for twelve hours after being laid, and against too rapid drying whilst hardening, by being covered with wet sacks, or other suitable material, and shall be protected from injury and discolouration during the progress of the remaining work.

Edges of granolithic floors butting against different floor finishings, and edges of margins, etc. shall be true and sharp, and shall be protected by fixing temporary wood strips, which shall remain, in position until the commencement of the laying of the adjoining flooring material.

PB 5.3.7 Reedings to Steps, Etc.

The treads of granolithic finished steps and upper surfaces of granolithic finished external thresholds shall be rendered non-slip by reading same near front edges for a width of 100 mm stopped 100 mm from ends.

PB 5.3.8 Power Floated Finish

Power floated finish to floors etc., unless otherwise specified, shall be floated mechanically to smooth and even surfaces before the concrete has set. Small surfaces and inaccessible places to be floated by hand in a similar way. Under no circumstances is cement mortar to be added while floating the concrete.

PB 5.3.9 Laying of Concrete Paving Slabs and Paving Bricks

Concrete paving slabs and paving bricks shall be bedded and jointed on a layer of 30 mm clean dry river sand. Joints shall be 6 mm wide, continuous in both directions, filled solidly with 3:1 cement mortar and slightly pointed with a round jointing tool. Lengths in excess of 10 metres shall be provided with expansion joints.

PB 5.4 WATERPROOFING

PB 5.4.1 Damp-Proof Course in Walls

The damp-proof course shall be the full thickness of walls above foundations and shall be laid without longitudinal joints. At end joints, angles and intermediate junctions the sheeting shall be lapped 150 mm.

Where so specified all laps in the damp-proof course shall be sealed over the whole area of laps, to an approved method. Care shall be taken not to tear or otherwise damage the sheeting.

PB 5.4.2 Damp-Proof Membrane

The damp-proof membrane under floors, etc., shall be laid in the widest practical widths to minimise joints and shall be turned up, dressed to load bearing walls and if applicable lapped with the damp-proof course in the walls. All joints shall be sealed with pressure sensitive tape applied over the leading edge of the joint.

PB 5.4.3 Expansion Joints

Expansion joints shall be at least 10 mm wide and filled in with approved bitumen impregnated soft board or closed cell expanded polyethylene strip. Expansion joints shall be sealed with a two-component poly-sulphide joint sealer, 12 mm deep, according to instructions of the manufacturers.

PB 5.5 CARPENTER AND JOINER

PB 5.5.1 Protection of Timber on Site

Timber stored on site shall be properly stacked when received, and adequately protected against extremes of weather and exposure to the sun, until required for use.

PB 5.5.2 Wrought Faces

Exposed woodwork, unless otherwise specified, shall be wrought to a smooth surface, and properly sand-prepared to remove all machine or other tool marks.

For each wrought face on structural timber, an allowance will be made off the "nominal" dimensions specified or stated on the drawings, as follows:
a) 2,5 mm for "nominal" dimensions up to and including 76 mm;
b) 3,5 mm for "nominal" dimensions over 76 mm.

For each wrought face on joinery timber, an allowance will be made off the "nominal" dimensions specified or stated on the drawings, as follows:
a) 3 mm for "nominal" dimensions up to and including 76 mm;
b) 5 mm for "nominal" dimensions over 76 mm.

The above will be the nett allowances permitted off the "nominal" dimensions specified or stated on the drawings and will not be additional to the tolerances specified for sawn timbers.

All exposed angles of wrought woodwork, unless otherwise specified, shall be arris rounded. The term "arris rounded" denotes that the angles shall be rounded off to approximately 3 mm radius.

Angles of wrought woodwork specified to be angle rounded shall be rounded off to 6 mm radius, unless otherwise shown on the drawings, and shall include, in framed joinery, for housed and mitred joints.

PB 5.5.3 Lengths of Timbers and Methods of Jointing

Plates, purlins, battens, laths, slats, etc., shall be in single lengths, but where this is not possible the end joints will be formed as described below. The jointing of plates, battens, etc. at junctions and angles shall also be formed as stated hereunder, viz:

a) Wall plates shall be halved at joints and well spiked together, and also at junctions and angles;

b) Purlins shall be splayed or spliced at joints and, unless otherwise specified, using timber side plates of the same dimensions as purlins, not less than 600 mm long and four times bolted with M10 mild steel bolts, with two washers each. Adjacent purlins shall not be splayed or spliced in the same bay or on the same rafter;

c) Sawn battens, laths, slats, etc., shall be butt jointed at heading joints and angles, and wrought battens, laths, slats, etc., shall be splayed at heading joints and mitred at angles, all over points of support and where adjacent, shall not be jointed on the same rafter.

PB 5.5.4 Joints in Roof Trusses

a) The number of connecting devices to be used at each intersection between two members at any heel joint or any splice in a truss shall be determined from the following table:

SPAN m	3 (90 x mm) NAILS PLUS M10 BOLTS AS SPECIFIED BELOW	M16 BOLTS ONLY	50 mm TOOTHED RING CONNECTIONS
3	2	2	1
4	3	2	1
5	3	2	2
6	4	3	2
7	5	3	2
8	5	3	2
9	6	4	3
10	6	4	3

b) In the case of any joint other than a heel joint or splice, one M10 bolt plus three 90 x 4 mm nails shall be used.

PB 5.5.5 Prefabricated Roof Trusses

Prefabricated timber roof trusses shall be constructed of South African pine as described in clause 3.17 to the designs shown on the detail drawings. The timber shall be of cross-sectional dimensions shown, cut to correct lengths with ends square or cut to the required angle, and shall be assembled in truss fabricating jigs with the truss having the proper camber, and tightly clamped together and joints secured with approved connector plates of galvanised steel sheet, pressed into the timber simultaneously on both sides of the truss with hydraulic press capable of exerting such pressure as will ensure complete penetration of the teeth into the timber. The connector plates shall be of such size as will ensure that the joints so made will adequately withstand the forces exerted on the joints, and to have at least two coats Epoxy Tar finish for coastal areas.

PB 5.5.6 Valleys in Roofs

Valleys in roofs covered with galvanised steel or fibre roofing sheets or with roofing tiles shall each be formed with two 228 mm x 25 mm sawn boards, spiked down to roof timbers, and purlins fixed along outer edges where in galvanised steel and fibre sheet covered roofs and battens along outer edges where in tile covered roofs.

PB 5.5.7 Purlins

Unless otherwise specified, purlins shall be 50 mm x 76 mm and shall be securely nailed to roof timbers at not exceeding 1,14 m centres, ranging perfectly straight and square to the roof with but joints at heading joints and angles and in the case of wrought purlins splayed joints at heading joints and mitred joints at angles.

PB 5.5.8 Brandering to Ceilings

The brandering shall be 38 mm x 38 mm, securely spiked up to the supporting timbers with 88 mm wire nails at 380 mm centre-to-centre. Cross brandering shall be cut in between the longitudinal brandering and securely skew nailed to same with 75 mm wire nails at joints in ceilings and at edges where required for fixing of cornices.

PB 5.5.9 Steel Roofing Sheets

The sheets shall be secured to wood purlins with approved galvanised iron roofing screws each provided with a plastic or asphalt felt washer and a galvanised steel cup washer over the plastic or felt washer and secured to steel purlins with M6 galvanised hook bolts, provided with similar washers under nut.

Screws and bolts at ends of sheets and at end laps shall be spaced at not exceeding two corrugations apart wherever possible, but in no case more than three corrugations apart, and at intermediate purlins at not more than four corrugations apart; screws or bolts shall, in all cases, be provided in the outermost corrugations of the upper sheets.

All necessary cutting to sheets shall be properly performed. Cut edges at sides of valleys, and elsewhere exposed, shall be perfectly straight.

At exposed verges of roofs, the iron shall be finished with neatly formed rolls.

The sheets shall have side laps of not less than one and a half corrugations. The minimum roof slopes and sheet end laps shall be, unless otherwise specified, as prescribed in Table 2 of Schedule 2 of Part L of the National Building Regulations and Building Standards Act, 1977.

PB 5.5.10 Metal Ridging for Steel Covered Roofs

The ridging shall be 450 mm girth with roll top and bent down edges, and shall be lapped 225 mm at end joints, cut and properly lapped and fitted at intersections of ridges, hips and valleys, and close beaten into corrugations of roofing iron. Roll shall be closed at feet of hips and at end of ridging.

Ridging shall be fixed with screws to wood purlins and hook bolts to steel purlins, with washers under heads and nuts, respectively, all as described for fixing roofing sheets, and spaced at not exceeding 300 mm centres.

PB 5.5.11 Fibre Cement Roofing Sheets

The sheets shall be mitre-cut at corners as necessary and laid with smooth surface on top, and shall be secured to wood purlins with 7 mm diameter galvanised drive screws not less than 114 mm long, and to steel purlins with M8 galvanised hook bolts, each provided with a plastic or asphalt felt washer and a galvanised steel cupped washer over the plastic or felt washer.

Screw and bolt holes in sheets shall be drilled (not punched), and shall be 0,2 mm larger than the diameter of screws and bolts.

The fixing screws, and nuts on fixing bolts, shall not be tightened more than is necessary for the holding down of the sheets and for the proper seating of the washer over the corrugations, so as to allow for slight movement between the sheets and the supporting structure. On no account shall sheets be deflected at the intermediate purlins in an attempt to make the sheets bear on such purlins.

The side laps of sheets shall be sheltered from the prevailing wind by laying the sheets from left to right, or from right to left, depending on the direction of the prevailing wind, the sheets being laid in the opposite direction to that of the wind.

All necessary cutting to sheets shall be properly performed. Cut edges at sides of valleys, and elsewhere where exposed, shall be perfectly straight.

The minimum roof slopes and sheet end laps shall be, unless otherwise specified, as prescribed in Table 1 of Schedule 2 of Part L of the National Building Regulations and Building Standards Act, 1977.

The manufacturer's instructions regarding laying and fixing of sheets, including side laps, mitring of corners and spacing of screws or bolts, shall be followed in all cases.

One month after fixing, the roof covering shall be thoroughly examined, any defects made good and loose screws or bolts tightened.

Roof boards shall be used by all workmen for safety and to avoid damage to the sheeting.

PB 5.5.12 Adjustable Fibre Cement Ridging

The ridging shall be secured to wood purlins with screws and to steel purlins with hook bolts, passed through the roofing sheets, and provided with plastic or felt and steel washers, all as described for fixing fibre cement roofing sheets.

The manufacturer's instructions regarding laying and fixing of the ridging, including spacing of screws or bolts, shall be followed in all cases.

PB 5.5.13 Fascias and Barge Boards

Fascias and barge boards of pressed fibre cement boards shall be butt jointed with 75 mm wide x 3 mm thick galvanised steel plates four times bolted with M6 galvanised bolts over joints.

PB 5.5.14 Fibre Cement Flashings

Fibre cement flashings shall be secured to wood purlins with screws and to steel purlins with hook bolts, passed through the roofing sheets, and provided with plastic or felt and galvanised steel cupped washers, all as described for fixing fibre cement roofing sheets.

The manufacturer's instructions regarding fixing of the flashings, including spacing of screws or bolts shall be strictly adhered to.

PB 5.5.15 Fibre Cement Gutters

Fibre cement gutters shall be bedded in approved bituminous mastic compound and secured with M6 galvanised gutter bolts with heads of bolts on inside of gutters and each bolt provided with asphaltic felt and galvanised steel washer under head and nut, all in accordance with the manufacturer's instructions. The inside surfaces of sockets and the outside surfaces of spigot ends shall be coated with a thin solution of bitumen to enable the compound to adhere fast when applied, and surfaces of

washers in contact with each other and with gutters hall be coated with bitumen. After tightening the bolts, all surplus compounds from the joints shall be removed, and the joints externally finished with neatly trowelled fillets of 2:1 cement mortar.

The spigot ends of gutters shall be lapped on to the socket ends in the direction of the flow wherever possible.

The gutters shall be fixed with proper falls on gutter brackets of the fascia type where fixed to fascia boards and of the purlin type where fixed to purlins. Brackets shall be securely screwed to the roof timbers, at not exceeding 1 m centres, and with extra brackets at angles and outlets.

Gutters shall be provided with all necessary angles, stopped ends, outlet nozzles, etc., jointed to gutters as described above.

PB 5.5.16 Fibre Cement Rainwater Down Pipes

Fibre cement rainwater downpipes shall be jointed with tarred hemp rope gasket caulked into each joint, and the joint filled with a suitable bitumen compound and finished off with neatly trowelled fillet of 2:1 cement mortar.

The pipes shall be fixed to walls with holderbats, bolted around pipes immediately below the socket, and with tails builds into walls in 3:1 cement mortar.

Rainwater downpipes shall be provided with all necessary swan necks, branch pieces, plinth bends, radius bends, shoes, etc., jointed to pipes as described above.

PB 5.5.17 Concrete Roofing Tiles

Tiling shall be "straight or broken bond", and vertical joints between tiles and bottom edge of each course of tiles shall range perfectly straight. Unless otherwise specified, interlocking tiles shall be laid to a lap of at least 100 mm and plain tiles to a lap of at least 62 mm.

Half tiles in the case of interlocking tiles, and tile and a half in the case of plain tiles, shall be provided as required at abutments and at verges of roofs. Plain tile roofs shall be provided with double course at eaves.

Unless otherwise specified, each tile in every third course in the case of interlocking tiles, and in every fifth course in the case of plain tiles; all tiles in eaves courses and ridge courses; end tiles in every course at each side of hips and valleys; all tiles adjoining bonnet hip tiles in plain tile roofs; half tiles, full tiles and tile and a half at verges, and all tiles to open eaves and open overhanging verges, shall be fixed to the battens with galvanised nails of such length as will penetrate the battens to a depth of at least 25 mm.

Tiling shall be carefully cut and dressed at hips and valleys and, where necessary at abutments, etc. Mitred portions of tiles at hips and valleys shall be holed and properly secured.

Hip and ridge tiles for interlocking tile roofs shall be socketed V-type, shall match general tiling, and shall be bedded solid in 3:1 cement mortar with strip of approved bituminous sheeting laid under the mortar bedding, of such width as will give a lap of at least 25 mm on to the roof tiling at each side, and lapped not less than 75 mm at end joints. Socketed joints of hip and ridge tiles shall be bedded in mortar as above and pointed with neatly recessed joints, and hip iron of 25 mm x 4,5 mm mild steel 300 mm long, suitably bent, twice holed and securely nailed to hip rafter, shall be provided at foot of each hip. The mortar bedding shall be trowelled smooth at open ends of ridges.

Ridge tiles for plain tile roofs shall be as above but half-round and but jointed and neatly pointed in tinted 3:1 cement mortar, and hip tiles shall be round pattern bonnet type, to course and bond in with general tiling, and with each tile bedded and neatly pointed in mortar as above and nailed to hip rafter with galvanised nail.

Hip and ridge tiles shall be neatly cut and fitted together at junctions between ridges and hips or valleys, and shall be bedded solid and neatly pointed in tinted 3:1 cement mortar with approved bituminous sheeting under the mortar bedding, cut to shape required and with lap of 25 mm on to the roof tiling.

PB 5.5.18 Covering to Ceilings

a) Gypsum plasterboard ceilings with plaster finish

The ceiling boards shall be in 900 mm or 1 200 m widths, with board at ends of ceilings of widths required to suit length of ceilings. Ceiling board shall be in single lengths to the width of ceilings wherever possible.

The boarding shall be nailed to the brandering, with GREY surface to underside, with 2 mm diameter galvanised or cadmium plated clout headed nails, 38 mm long, spaced at not more than 100 mm apart at edges of boards and 150 mm apart along the intermediate brandering.

The joints between boards shall be loose butt joints and covered with wire gauze strips nailed through the boarding to the brandering at 400 mm centres with 38 mm galvanised clout headed nails.

The bonding plaster shall be applied in two layers by the trowel-float-method to a total thickness of not less than 6 mm, and well pressed into the wire scrim over the joints between the ceiling boards, and finished smooth, even and true.

b) Fibre cellulose board ceilings

The ceiling boards shall be in the same widths, and fixed as specified for gypsum plasterboard ceilings in paragraph (a).

The joints between the boards shall be covered with 25 mm half-round wood cover beads fixed with 38 mm long nails spaced at not exceeding 300 mm.

PB 5.5.19 Cove Cornices to Ceilings

a) Gypsum plasterboard cornices

Cove gypsum plasterboard cornices shall be nailed through the ceiling boards to the brandering and to wall plugs, at not exceeding 200 mm centres, with 2 mm diameter galvanised or cadmium plated clout headed nails, 38 mm long, or fixed to walls with hardened steel nails driven into the brickwork.

Cornices shall be scribed at internal angles and mitred at external angles and shall be in long lengths with splayed heading joints where necessary.

b) Timber cornices

Scotia's shall be fixed to walls with hardened steel nails driven into the brick-work.

PB 5.5.20 Trapdoors in Ceilings

Openings for trapdoors in ceilings shall be formed with 38 mm x 38 mm brandering all around each opening, spiked together and to bottom edge of the supporting timbers. Size of opening, unless otherwise specified, shall be 650 mm x 650 mm.

Trapdoor shall be formed with skeleton frame of 50 mm x 38 mm brandering, covered on underside with boarding as for ceiling, and hung on a pair of 75 mm steel butts and fitted on underside near closing edge with 100 mm brass bow handle. Soffit of trapdoor shall be flush with soffit of ceiling when closed, and trapdoor shall flap back on to top of the brandering, between tie beams or ceiling joists when open.

When trapdoor is closed it shall rest on 50 mm x 19 mm fillets, fixed on soffit of ceiling all around opening, mitred at angles and securely screwed up to the trimmers. Fillets shall project 12 mm into the opening to carry the trapdoor.

Trapdoors larger than 650 mm x 650 mm shall each be provided with 38 mm x 38 mm brandering across centre, spiked to the skeleton frame.

PB 5.5.21 Ceiling Insulation

Ceilings shall be insulated, where so specified, with approved resin bonded or stitched fibre glass or mineral wool insulation blanket 38 mm thick, cut to size and laid over brandering between ceiling joists and tie beams, etc.

Where insulation is to be in two thicknesses a total thickness of 76 mm is required and the joints shall be staggered.

PB 5.5.22 Framed Joinery

Where the word "Framed" is used it is to include for all mortice and tenon joints, dovetail joints, grooves, stop grooves, rebates, stop rebates, housings, notchings, etc., including housing ends of shelves, divisions, etc.

PB 5.5.23 Joinery

Joinery work shall be put in hand immediately after the order has been given to commence work, or after the receipt of detail, where such are to be supplied, and shall not be wedged or glued up until just before fixing in the building.

No framed joinery for services situated inland shall be manufactured in the humid coastal belt, and no framed joinery for the services situated in the coastal belt shall be manufactured inland. This applies to both purpose made and stock joinery.

All exposed softwood timber in joinery which is not to be painted shall be free from large, loose or dead knots, knot holes, checks, splints, wane or other defects, and in joinery which is to be painted shall be free from all defects other than those which can be filled or otherwise made good in such a way as will not impair the paint finish. All exposed hardwood joinery timber shall be free from all knots, knot holes, checks, splints or other defects and, unless otherwise specified, shall also be free of sapwood.

Purpose made joinery shall be manufactured strictly in accordance with detail drawings.

Stock joinery shall be of approved quality. Joinery shall not be primed until it has been inspected and approved.

Skirting, rails and the like shall be in long lengths. Heading joints where necessary shall be splayed. Counter tops, table tops, drainers, and the like, shall be formed with wide boards, jointed with grooved, cross-tongued and glued joints or with grooved rebated and glued joints of approved type; cross-tongues shall be stopped 25 mm back from ends where ends are exposed to view. The boards shall be in single lengths to top, etc., but where this is not possible the heading joints shall be staggered and jointed as above.

Skirting, rails, angle moulds and beadings of all kinds, shall be close fitted, mitred or scribed at angles, and securely fixed; skirtings, rails and the like shall be fixed with hardened steel or other suitable nails driven into the brickwork or shall be nailed to wall plugs spaced at not more than 700 mm apart. Glazing beads and the like shall be mitred at angles and, unless otherwise specified, shall be fixed with panel pins.

PB 5.6 METALWORK

PB 5.6.1 Manufactured Steelwork Generally

Welding is to be done electrically in the most up to date manner by skilled workmen and cleaned off on completion.
All welds are to be welded with welding rods of the same chemical composition as the tubes, rods, bars, etc., to be welded and all external welds are to be filed clean and smooth.

Welding to be continuous fillet welding to all exposed edges unless otherwise described.

No scaffolding shall be allowed to rest on or fixed to steel windows, doors, frames, etc., in any way.

PB 5.7 RESILIENT FLOOR FINISHINGS

PB 5.7.1 Laying and Fixing

Vinyl sheeting and tiles and such like floor finishings shall be laid in strict accordance with the manufacturer's instructions, on a perfectly dry and clean screeded surface, using an adhesive supplied or recommended by the manufacturer of the flooring material, and rolled with a suitable roller to ensure complete adhesion of the material. The flooring shall be cut where required and neatly fitted against adjoining floors, thresholds, etc. Vinyl skirtings shall be close fitted to floors and walls, butted at end joints, neatly mitred at internal angles and dressed round external angles, and fixed with adhesive as for flooring.

Unless otherwise described, sheet flooring shall be in standard widths with cut sheets at sides of floors as necessary.

PB 5.8 GLAZIER

PB 5.8.1 Fixing of Glass

Glass fixed with glazing beads in unpainted hardwood doors shall be bedded on strips of rubber, velvet, leather, or felt turned over on to both sides of glass in the rebates to form a soft packing between the glass and the woodwork. In all other cases the glass shall be well bedded in back putty in the rebates.

Glass rebates, other than in unpainted hardwood doors, shall be primed before glazing.

Glass panes exceeding 0,5 m2 in surface area and fixed with putty only in wood doors, sashes and the like shall be secured in addition with glazing sprigs, and in steel windows and doors with glazing pegs or clips inserted in holes in the steel framing.

Glass panes shall have adequate clearance between the edges of glass and the rebates.

Putty shall be carefully trimmed and cleaned off with front putty worked to within 3 mm of the sight lines.

PB 5.9 PAINTER

PB 5.9.1 Preparatory Work

a) General

All floors must be swept clean and walls dusted down, and surfaces not being painted such as face brickwork, sills, floors and stained woodwork covered up and protected against spotting, before any painting is commenced.

No sweeping or dusting shall be done whilst painting is in progress or whilst paint is still wet.

b) On woodwork

Woodwork being painted shall be well brushed down, knots treated with knotting, and all surfaces primed, stopped with hard stopping and rubbed down to an even surface ready to receive the paint.

Woodwork being oiled or stained shall have all plaster stains, pencil marks and other surface discolourations and blemishes carefully removed, and stopped with tinted stopping and well rubbed down.

c) On metalwork

All metal surfaces being painted, except steel structures shall be cleaned of all rust, scale and dirt by scraping or by means of steel wire brushes; also, all oil and grease shall be removed and a perfectly clean surface obtained. If necessary, the surface shall be decreased immediately before applying the priming coat, by the use of a suitable grease-removing solvent; any salt deposits on the metal surfaces as may occur in industrial and marine atmospheres shall be removed by the use of a suitable detergent and the surface then thoroughly rinsed and allowed to dry.

New galvanised metal surfaces and surfaces of all non-ferrous metals, which are to be painted, shall be cleaned down as above and given one coat of wash primer (metal etch primer).

Protective coatings on new galvanised metal surfaces, applied by the manufacturers to prevent storage stain and white rust, shall be completely removed by the use of a suitable cleaning agent and the surfaces thoroughly rinsed and allowed to dry, before the surfaces are primed or painted.

After cleaning off rust on metalwork those portions so affected shall be treated with an approved rust inhibitor.

d) On plaster

All plastered wall, ceiling and such like surfaces being painted or distempered shall be filled where necessary with suitable stopping or patching plaster and the whole rubbed down ready to receive the finishings.

e) On ceilings

Boarded ceilings, cover strips and cornices being painted or distempered, shall be filled where necessary with suitable stopping and all nail heads in ceilings, cover strips and cornices being distempered shall be primed with flat paint.

PB 5.9.2 Surfaces to be Dry

All plastered wall, ceiling and similar surfaces shall be perfectly dry and in a fit state to receive the finishings, before the work is put in hand.

PB 5.9.3 Priming

Wood, metal and other surfaces normally primed before being painted shall be prepared and primed as before described in readiness to receive the specified paint system.

Backs of wood door and similar frames and surfaces of other new or re-fixed joinery in contact with brickwork, etc., and built in as the work proceeds, shall be primed before building in whether the articles are to be painted or not, to prevent moisture seeping into the wood from the mortar bedding. Wood surfaces shall be knotted, primed and stopped before being coated with emulsion paint or distemper.

Tongued and grooved and rebated edges of boards in batten doors, and other suchlike inaccessible parts of joinery shall, before the joinery is assembled, be primed or where the joinery is to receive a finish other than paint, be given one coat of such other finishing material.
Priming to external structural timbers shall be applied before the timbers are fixed in position and shall include all wrought surfaces, such as backs of fascia and barge boards.

PB 5.9.4 Application of Paint

All coats of paint shall be thoroughly dry before subsequent coats are applied and rubbed down where necessary.

All work shall be finished to colour approved by the Engineer. The tints of undercoats shall approximate those of the finishing colour and in order to indicate the number of coats applied and to avoid misses when applying a succeeding coat, a slight difference shall be made in tint of each coat.

Priming on wood surfaces shall be by brush application. Priming on surfaces other than wood shall be by brush application or if in the opinion of the Engineer, the primer and the surfaces are considered suitable for roller application, the primer may be so applied. Priming applied by brush application shall be well brushed in to obtain maximum penetration.

Undercoat and finishing coats may be applied by brush or roller.

The use of spray gun on site for application of paint will not be permitted, except in the case of cellulose and other special cases where spraying is the accepted method of application; in cases where spraying is permitted all surrounding surfaces shall be properly masked.

The finishing coat on woodwork and metalwork, unless otherwise specified, shall be of high gloss paint. All materials shall be used in strict accordance with the manufacturer's instructions.

PB 5.10 PROTECTION AND CLEANING OF WORKS

The Contractor shall provide all necessary dust sheets, covers, etc., and shall exercise all necessary care to prevent marking surfaces of walls, floors, ceilings, glass, electrical fittings, etc., and shall keep all parts of the works perfectly clean and free at all times from spotting, accumulation of rubbish, debris or dirt arising from the operations. Any surface disfigured or otherwise damaged shall be completely renovated or replaced as necessary, to the Engineer's approval, by the Contractor at his own expense.

The Contractor shall test all doors, fanlights and windows and all other fittings for proper operation and effect the required rectification prior to the handing over of the building.

The premises shall be left clean and fit for occupation at the completion of the work.

PB 6 TOLERANCES

PB 6.1 BASIS OF MEASUREMENT

PB 6.1.1 General

Permissible deviations will apply in the case of linear dimensions, position, and level. The Contractor shall construct each of the various parts of the works within the limits of the applicable permissible deviations set out in clause 6.2 unless some other degree of accuracy is required in terms of the project specification or is shown on the drawings.

PB 6.1.2 Methods of Measurement of Deviations

Certain deviations will be measured as set out below:
Any deviation from flatness of a plane surface, will be measured as the maximum deviation of the surface from any straight line of length 3 m joining two points on the surface, determined by means of a straight edge the ends of which are supported on identical blocks of suitable thickness placed one over each of the points.

Any abrupt change in a continuous surface, including a local depression or peak in a floor or wall, will be measured as specified above.

Out-of-squareness of a corner or an opening or an element such as a column will be measured by taking the longer of two adjacent sides as the base line, and determining any departure from the perpendicular of the side at either end of this base line.

PB 6.2 PERMISSIBLE DEVIATIONS

The permissible deviations for elements or components shall be as follows:

a) Position on plan of any edge or surface measured from the nearest grid line or agreed centre line: ± 25 mm
b) Linear (other than cross-section) dimensions: ± 30 mm
c) Cross-section dimensions: -10 + 20 mm
d) Level (deviation from designed level with reference to the nearest transferred datum (TD) of the upper or lower surface, as may be specified, of any slab or other element or component): ± 10 mm
e) Out-of-squareness of a corner or an opening or an element such as a column (See clause 6.1.2(c)) for short side of length:

i) up to and including 0,5 m: ± 5 mm
ii) over 0,5 m up to and including 2 m: ± 15 mm
iii) over 2 m up to and including 4 m: ± 20 mm

f) Exposed surface (including floor slabs and paving):
i) Flatness of plane surface: ± 5 m
ii) Abrupt changes in a continuous surface: ± 5 mm

g) Exposed surface to be plastered or receive normal or granolithic screeds:
i) Flatness of plane surface: ± 10 mm
ii) Abrupt changes in a continuous surface: ± 5 mm

h) Surface of plaster and normal or granolithic screeds: ± 5 mm

PB 7 TESTS

PB 7.1 GENERAL

The Engineer shall have free access to the works for taking samples and carrying out tests. The Contractor shall render any assistance necessary. If so required, the Contractor shall provide storage and protection of such samples on site.

PB 8 MEASUREMENT AND PAYMENT

PB 8.1 GENERAL

PB 8.1.1 All items in this section will be measured by number, square metre or linear metre completed and the tendered rates shall include full compensation for the supply, delivery, handling and installation of all materials, the provision of all necessary labour and supervision, transport, plant, equipment and incidentals necessary to complete, protect and maintain the works as specified or as shown on the drawings.

PB 8.1.2 Where a lump sum is required for a complete structure the tendered rate shall include all items and contingencies, as specified in this section or as shown on the drawings.

PB 8.2 SCHEDULED ITEMS

PB 8.2.1 Brickwork……..Unit: m²

Brickwork will be measured on the centre line of the walls. Areas occupied in walls by windows and doors will be excluded from the areas measured, and corners and intersections common to more than one brick wall will be measured once only.

The rate shall cover the cost of brickwork complete as specified, including test sections where specified, pointing, providing brick lintels, brick reinforcement and ties, etc., the building in of conduits, beams, pipe sleeves, doors and windows, the raking out of joints and the filling of cavities in cavity walls and walls constructed of hollow concrete masonry units, below floor level and elsewhere where specified.

The test section for faced brickwork as specified in clause 5.1.14 shall only be paid for if approved by the Engineer and, if rejected, shall be removed at the Contractor's expense.

PB 8.2.2 Air Bricks

a) External air bricks……..Unit: No
b) Internal air bricks……Unit: No

The rate shall cover the cost of providing and building in the air bricks as specified.

PB 8.2.3 Bagged Finish to Brickwork……..……Unit: m²

The rate shall cover the cost of providing rough sacking, additional cement grout as required and finishing the bagging as specified.

PB 8.2.4 Window Sills

a) External (describe)……...……..……..Unit: m
b) Internal (describe)……..……Unit: m

The rate shall cover the cost of providing and building in face bricks, fibre cement sheets or any other material prescribed, as well as all accessories specified.

PB 8.2.5 Tiling……..……Unit: m²

The rate shall cover the cost of providing all material and the laying and grouting of tiles, complete as specified.

PB 8.2.6 Plaster Work……Unit: m²

The rate shall cover the cost of the construction of the plaster work, including the supply of all materials, mixing, applying, finishing, forming reveals, joints, etc., complete as specified.

PB 8.2.7 Floor Screeds

a) Normal screeds……Unit: m²
b) Granolithic screeds……Unit: m²

The rate shall cover the cost of the construction of the floor screeds, including the supply of all materials, mixing, laying, finishing, the forming of nosings, reedings, skirtings, etc. and, where the concrete sub-floor has matured, of the brushing and applying a cement grout, complete as specified.

PB 8.2.8 Paving……..……...Unit: m²

The rate shall cover the cost of providing paving slabs or bricks, sand bedding and joint filling and expansion joint material and of constructing the paving.

PB 8.2.9 Waterproofing

a) Damp-proof course in walls……..Unit: m
b) Damp-proof membrane under floors……..Unit: m²

The unit shall be the net length or area of waterproofing installed. The length or area of overlaps shall not be measured for payment.

The rate shall cover the cost of providing and laying all material as specified, including the sealing of all laps and joints, complete as specified.

PB 8.2.10 Expansion Joints……Unit: m

The rate shall cover the cost of providing and installing all filling and sealing material and of the forming of expansion joints, complete as specified.

PB 8.2.11 Structural Timber

a) Wall plates (indicate size)……..……..Unit: m
b) Beams (indicate size)……..……..Unit: m
c) Joists (indicate size)……..……Unit: m
d) Rafters (indicate size)……..……..Unit: m
e) Purlins (indicate size)……..……..Unit: m
f) Brandering (indicate size)……..……..Unit: m
g) Roof trusses complete (indicate drawing number)……..……Unit: No

The rate shall cover the cost of the supply of all materials, manufacture, cutting, waste, laps, joints and fixing of the timber as indicated, including nails, bolts, nuts, washers, hoop irons, ties and other fixtures required, complete as specified.

PB 8.2.12 Roof Covering……Unit: m²

The rate shall cover the cost of providing and fixing all roof covering material as prescribed, including all flashings, soakers, valleys, ridge coverings, roofing screws and all other fixtures required to complete the work, as specified.

PB 8.2.13 Fascias and Barge Boards……..…Unit: m

The rate shall cover the cost of providing and fixing of all material, fixtures, screws, bolts, nuts, washers and other accessories required to complete the work, as specified.

PB 8.2.14 Gutters and Rainwater Down Pipes

a) Gutters……Unit: m
b) Rainwater downpipes……..……Unit: No

The rate shall cover the cost of supply and building in of all material including angles, stopped ends, outlet nozzles, gutters, gutter brackets, etc. for gutters and swan necks, branch pieces, plinth bends, radius bends, shoes, brackets, etc. for rainwater downpipes, including all bolts and sealants, complete as specified.

PB 8.2.15 Ceilings

a) Ceilings……..Unit: m²
b) Cornices to ceilings……...Unit: m

The rate shall cover the cost of supply and installation of all material including cover strips to joints, nails, trapdoors and gypsum plaster where prescribed, complete as specified.

PB 8.2.16 Ceiling Insulation……..……..Unit: m²

The rate shall cover the cost of supply and installation of all material, as specified.

PB 8.2.17 Joinery

a) Doors (type and size indicated)……Unit: No
b) Skirtings (size indicated)……..……..Unit: m
c) Other items (describe or indicate drawing number)……..Unit: No or m

The rate shall cover the cost of the supply of all material, manufacture, cutting, waste, fixing and installation of the joinery items, complete as specified.

The rate for doors shall also cover the cost of the door frames and all accessories, such as hinges, hooks, bolts, locks, latches, etc., and of damp-proof course on both sides and above door frames in cavity walls, as specified.

PB 8.2.18 Metalwork……..……Unit: No

The rate shall cover the cost of supplying all material, manufacture, applying priming coat of paint or galvanising, as specified, delivery and building in of units, including burglar proofing where specified, locks, catches, glazing, etc., and of damp-proof course under all windows and on both sides and above frames in cavity walls, as specified.

PB 8.2.19 Resilient Floor Finishings

a) Vinyl-fibre, PVC, or thermoplastic floor tiles (specify)……Unit: m²
b) Vinyl cove skirting……..Unit: m

The rate shall cover the cost of supplying all material and adhesives required and the laying of the floor finishings.

PB 8.2.20 Painting……..……..Unit: m² or Sum

Only the surface covered by the final finishing coat shall be measured.

The rate shall cover the cost of surface preparation, supplying and applying all the coats of paint, repairing any damaged surfaces, and all materials necessary for completing the work.

PB 8.2.21 Electrical Installation……..……Unit: Sum

The rate shall cover the cost of supplying and building in of all equipment such as switchboards, conduits, wires, cables, sockets, light fittings, etc., cutting recesses, chases and holes in walls as required and repairing any damaged surfaces after installation, including testing of the installation.

PB 8.2.22 Miscellaneous……Unit: No, Sum or m

The rate shall cover the cost of all workshop detail drawings, where prescribed, material, plant, tools and labour to complete the scheduled items complete, as detailed, including corrosion protection and/or painting, as specified, and building in.

PSM: PROJECT SPECIFICATIONS – MECHANICAL EQUIPMENT

PSM 1 DESCRIPTION OF THE WORKS

The work to be carried out in accordance with this Tender comprises the supply and installation of mechanical and electrical equipment for the Golf Course Pump Station in Wesselsbron/Monyakeng. The Mechanical/Electrical will be a nominated sub-contractor under the main civil Contractor.

Civil and building work will be completed under separate Contracts. All mounted platforms and foundations, etc, for mechanical/electrical equipment of this Tender will be constructed by the Civil Contractor to the specification of this Tender.

The Tenderer of this Tender shall be solely responsible for the correct installation of his equipment and the protection of this equipment during grouting in of holding down bolts, pipes, etc, by the Civil Contractor. This Tenderer shall furthermore be responsible for the supervision of this work.

PSM 2 DESCRIPTION OF THE SITE AND ACCESS

PSM 2.1 Location

The site of the works is situated ±1,2km North of Wesselsbron/Monyakeng as shown on the drawings.

PSM 2.2 Site Conditions and Services

PSM 2.2.1 The following climatic and general conditions are prevalent on site and the specified capacities of the equipment provided under this Tender shall be applicable under these conditions:

Maximum Ambient Temperature	:	40°C
Minimum Ambient Temperature	:	-5°C
24-Hour Maximum Temperature	:	30°C
Altitude (meters above sea level)	:	1 300m
Humidity	:	Up to saturation point
Atmosphere	:	Dusty and highly corrosive with some organic acids from works
Solar	:	Lengthy periods of sunshine cause High temperature in outdoor enclosures, High breakdown Occurrence due to effect of ultra violet rays on outdoor synthetic materials
Lightning	:	High lightning rate

PSM 2.2.2 Water required for installation purposes will be available on Site, but the Tenderer will be responsible to connect onto these services and be responsible for the usage cost as determined by the Local Municipality.

PSM 2.2.3 Eskom is the power supply authority in the area, The Contractor shall, subject to the approval of the Engineer, make any necessary arrangements with the relevant authority for the connection(s), and shall provide in his tender for the payment of all charges and costs that are associated with making electricity available for purposes of constructing the Works. The distribution of electricity shall be in accordance with the applicable bylaws and regulations of the supply authority.

PSM 2.2.4 The Tenderer shall supply all transport, off-loading and handling facilities as well as all installation and testing equipment required for this Tender.

PSM 2.2.5 The Tenderer shall be held responsible for the receiving and storing of all items prior to erection, The responsibility for the protection and maintenance of such items during the storage periods rests solely with the Tenderer.

PSM 2.2.6 The Tenderer shall keep the Site in a neat and orderly manner to the satisfaction of the Engineer.

PSM 2.2.7 All earthworks and appurtenant civil structures requires for this installation will be executed under other Contracts. Various Contractors and Sub-Contractors will consequently be involved on the Site at the same time and it is essential that these Contractors co-operate as closely as possible. Possible differences that may arise must be solved between the Contractors themselves.

PSM 2.2.8 The Tenderer shall make his own arrangements for housing.

PSM 2.2.9 Should any sanitary services be required on Site, it shall comply with the regulations of the Employer and be positioned to the Engineer's approval. Such services shall be removed when not required and conditions restored to the Engineer's approval.

PSM 3 GENERAL DESCRIPTION OF TENDER

This Tender comprises the supply, delivery, installation, testing, commissioning, painting and maintenance during the Defect Liability Period of the following mechanical equipment:

PSM 3.1 One Submersible Drainage Pump and pipe work for sewage pump station

PSM 3.2 7 channel, wall mounted Sluice Gates

PSM 3.3 Number of Puddle Pipe Assemblies

PSM 3.4 One Mechanical Screen for sewage pump station

PSM 3.5 Two Hand Screens for sewage pump station

PSM 3.6 One Impact Screw Compactor for sewage pump station

PSM 3.7 One De-gritting Spiral Conveyor for sewage pump station

PSM 3.8 Two Sewage Pumps for sewage pump station

PSM 3.9 Two Archimedean Screw Pumps for sewage pump station

PSM 3.10 One Pista Trap Paddler for sewage pump station

PSM 3.11 One Skip Bin for sewage pump station

PSM 4 PROGRAM

Tenderers shall submit a program and make allowance for the civil contractor's progress.

PSM 5 QUALITY CONTROL

PSM 5.1 All the work undertaken in this Tender shall be executed in accordance with the requirements of SABS 0157.

PSM 5.2 The successful Tenderer shall be required to submit the following for approval by the Engineer prior to commencement of any manufacturing:

- Code Data Book Index
- Quality Plan

During manufacture a Code Data Book must be completed on a continuous basis and be available for inspection by the Engineer at all times.

PSM 5.3 An assessment report from an independent QA/QC Authority approved by the Engineer on the Tenderers quality management and control system shall be submitted with his tender.

PSM 5.4 The Tenderer shall at all times satisfy the Engineer that he has adequate specialist staff to control material quality used by him or his Sub-Contractor.

PSM 5.5 Tenderers shall be required to submit full particulars of a QA/QC Authority to be appointed, should the Engineer give written instructions to that extent. A provisional item will be included in the Schedule of Quantities to provide for such an Inspection Authority.

PSM 6 GOVERNMENT ACT AND REGULATIONS

As a whole all work shall be carried out in accordance with the relevant Government Acts and Regulations or other Codes specified and in particular the Machinery and Occupational Health and Safety Act (Act No, 85 of 1993) as amended.

PSM 7 INFORMATION REQUIRED

It is specific requirement that information of all equipment offered must be supplied at the time of tendering.

Such information will include at least the following:

a) The country of origin,

b) Make and description of equipment,

c) Capacity of the units,

d) Material of the components,

e) Working pressures,

f) Layout drawings of all units,

g) Spares to be carried by the Client,

h) Full details of all pipe work and valves including internal protection.

PSM 8 OPERATION AND MAINTENANCE MANUAL

Three copies of the Operating and Maintenance Manual shall be supplied by the Contractor not later than at the time of commissioning of the installation. The manual will be a prerequisite for final acceptance of the plant and a separate manual shall be compiled for each installation.

Contents

The manual shall cover the following aspects in detail, with illustrations and drawings:

a) Index: Each volume shall have an index following the title page. If there is more than one volume, the first volume shall contain a master index.

b) A brief description of the plant and installation.

c) Pre-commissioning checks: These shall be clear, concise, easy to follow and shall include pre-start checks (e,g, Check oil and water, remove locking pin, etc,), safety checks (e,g, personnel cleared from vicinity of water outlets, guards in place, etc).

d) Detailed operating instructions: These shall be clear, concise, easy to follow and shall include starting procedure, running checks (e,g, no vibration, pressures normal), shut-down procedure, emergency shut-down procedure and action to be taken in response to alarm signals.

e) Proposed preventative maintenance schedules and program covering all plant and equipment; the Maintenance chart.

f) Fault diagnosis and repair procedures: These shall include details of all servicing, replacement and repairs which Artisans or Operating personnel would be expected to carry out on Site. In this section the reader may be referred to supplier's brochures elsewhere in the Manual for specific detail.

g) Schedule of manufacturing drawings.

h) Detailed schedule of plant components giving material specifications, part numbers, etc. Where possible, drawings shall be positioned opposite the appropriate text.

i) Sub-contractor's/Supplier's brochures and instructional literature.

The requirements for the Operation and Maintenance Manual for electric motors and covered elsewhere.

Non availability

Acceptance Tests will not be performed and payments may be deferred if complete and final Operating and Maintenance Manuals are not available.

Drawings and Documentation

The drawings included in the Tender Documents are the Engineer's proposal for the plant layout. Proposed alternatives by the Tenderer indicated on drawings submitted by the Tenderer, shall be considered in allocating the contract.

Before any work is carried out by the Contractor, the Contractor shall submit detailed working drawings to be approved by the Engineer. Approval of these drawings does not relieve the Contractor from his responsibility for the correctness of the drawings.

Fully dimensioned outline and layout drawings of all plant and equipment shall be supplied including ancillary equipment, giving fully particulars as to the sizes and positions of all anchor bolts, bolt holes and other recesses, vents and drains, oil, gland cooling and service water, anchor blocks, supports, foundations and embedded parts, including all necessary clearances around items of equipment and the lifting requirements and any other information which may affect the construction of the Pump Station structure.

The magnitude and direction of the thrust forces to be resisted by the foundations or anchor blocks shall be clearly given.

Detailed dimensioned outline drawings of each electric motor, junction box and control console shall be included, showing the position of each panel, clearance space required and the height of each cable gland above the floor.

The above-mentioned information shall be binding once it has been approved by the Engineer. All costs due to alterations made after this approval will be invoiced to the Contractor. The Contractor will be required to formally approve the civil drawings made by others.

The Tenderer shall hand over to the Engineer three sets of the Operation and Maintenance Manual for the installation not later than one month after commissioning of the installation. These Manuals are a prerequisite for the final take-over of the Plant.

The Operation and Maintenance Manual will be printed on durable paper and will consist of two parts.

The first part will contain sections on:

a) Brief description of the plant and installation.

b) Concise operation instructions.

c) Routine maintenance instructions.

d) Precautionary measures, elementary trouble location, rectifying measures and emergency actions.

The second part will contain sections on:

a) Detailed information on equipment.

b) Lists of spare parts including names and addresses of suppliers.

c) All technical information of the installation.

d) Details and ratings of motors.

e) Layout drawings showing pipe runs.

f) Drilling diagrams for all equipment.

PSM 9 DRAWINGS

The drawings included in the Tender documents are the Engineer's proposal for the plant layout. Drawings submitted by the Tenderer with the Tender indicates alternatives as proposed by him and will be considered in allocating the Tender.

Before any work is carried out by the Contractor, the Contractor shall submit detailed working drawings to be approved by the Engineer. Approval of these drawings does not relieve the Contractor from his responsibility for the correctness of the drawings.

PSM 10 TRANSPORT TO SITE

The Contractor shall be responsible for the transportation, (including all permits required) off-loading, positioning, stacking and storing of all equipment under this Contract, including all necessary supervision, labour and equipment for the purpose. The tendered rates shall include all the above transportation costs to the Site.

The Employer shall be indemnified against all damage or demurrage charges as a result of unloading and shall be entitled to charge for the use of own equipment and labour in the event of failure of the Contractor to complete off-loading successfully.

Payment for equipment will only be made once the equipment is delivered to Site or pre- approved site of storage until installation.

PSM 11 GUARANTEE OF MATERIAL AND EQUIPMENT

By signing this Tender, the Tenderer guarantees all items supplied against poor materials and workmanship. Should it be established on installation, commissioning or during the Defect Liability Period that any item supplied under this Contract is defective due to poor materials or workmanship, the Contractor shall be held responsible not only for replacing or repairing the defective item, but also for all other labour, material, transport, etc. That may be involved in remedying the defect.

The Engineer will notify the Contractor of a defect and the Contractor shall within 24 hours of each notice, attend a Site inspection where the Engineer will establish the cause of the defect. Should the Contractor be dissatisfied with the Engineer's decision, the dispute will be determined by action instituted by the Contractor in terms of Clause 49 in the General Conditions of Contract for use in connection with Electrical and Mechanical Engineering Works. Should the Contractor dispute his responsibility to repair a defect on being served with a notice, he will repair the defect immediately and then institute action afterwards. Should the Contractor not be represented at the inspection of the defect, the Engineer's decision as to the responsibility for the defect will be binding.

The guarantee shall be effective for at least one year after commissioning of the plant and not only one year after commissioning of equipment supplied under this Tender.

PSM 12 MAINTENANCE OF EQUIPMENT

The Contractor shall maintain his equipment in good working order during the twelve months Defect Liability Period.

The Employer reserves the right to undertake any emergency repair work on the scheme during the Defects Liability Period without the prior consent of the Contractor. The Engineer has the right to decide whether an emergency exists and shall notify the Contractor accordingly. Should this emergency repair work be necessitated by poor material, faulty workmanship or neglect on the part of the Contractor, the employer may deduct the cost of the repair work from the outstanding retention money owing to the Contractor.

Should the Contractor dispute such a decision, he may institute action in terms of Clause 49.3 of the General Conditions of Contract for use in connection with Works of Electrical and Mechanical engineering, The ruling of the mediator will be final and binding on both parties.

PSM 13 PROVISIONAL AND PRIME COST ITEMS

When items in the Schedule of Quantities are marked as Provisional Items, the Contractor shall not order any material or do any work before written confirmation is obtained from the Engineer that such items are required.

Provisional Items are included in the Schedule of Quantities to strip, inspect, check, quote for maintenance required and re-assembling.

Prime cost items are included in the Schedule of Quantities to provide for repair work to be carried out to existing equipment. The Contractor will report and price for this during the Contract stage under items included in the Schedule of Quantities for cleaning and inspection. Repair work quoted under the PRIME COST ITEMS shall only be carried out on the written acceptance of the quotation and instructions from the Engineer to proceed.

PSM 14 APPLICABLE SPECIFICATIONS

PSM 14.1 Standard Specifications

The Contractor shall comply with the latest issue of all SABS, BS or other specifications as specified.

PSM 15 FIXING OF EQUIPMENT

All holding down bolts supplied under this Contract for fixing equipment to concrete structures shall be manufactured from Grade 304 Stainless Steel.

Where Stainless Steel bolts are used to fix other metal surfaces, satisfactory insulating washers/bushes shall be supplied between the different metal surfaces to prevent any electro-chemical reaction to take place.

Holding down bolts for all equipment shall be included in the price of the equipment.

PSM 16 CORROSION PROTECTION

As per equipment requirements and particular specifications.

PSM 17 MECHANICAL SCREEN (SEWAGE PUMP STATION)

PSM 17.1 Scope

Manufacture, supply, deliver, transport, handle, protect, store, install, commission and uphold during the Defects Liability Period a mechanical screen for the new sewage pump station: Golf Course Pump Station, Wesselsbron,

PSM 17.2 Equipment Requirements

1)	Material to be screened	:	Raw sewage
2)	Average dry weather flow	:	400 m^3/day
3)	Peak dry weather flow	:	850 m^3/day
4)	Maximum weather flow	:	2 420 m^3/day
5)	Bar aperture	:	6 mm

6) Channel width : 800 mm

7) Channel depth : 1 505 mm

8) Design for sufficient raking capability to keep screen field clean and clear.

9) Rated screenings to be discharged into the screenings conveyor/washer.

10) Adequate chute and cover plates to prevent spillage, spaying or splashing.

11) Mechanical screen design to integrate with layout of other mechanical equipment at inlet works.

PSM 17.3 Drawings

1) Refer to list of drawings for details of civil structures.

2) Supply equipment drawing as per PSM 9.

PSM 17.4 Material of Equipment

1)	Main frame	:	304 S/S
2)	Bars and Rakes	:	304 S/S
3)	Drive chain	:	304 S/S or 3CR12
4)	Shaft and Bearings	:	as per design
5)	Covers, chutes, bolts, nuts, washers	:	304 S/S

PSM 17.5 Electrical Equipment

Control to operate the equipment automatically, AUTO selected, and shall have a local and remote stop-push button.

The mechanical screen will be controlled with an ultrasonic level instrument, also to be supplied under this contract.

An over-ride timer will activate the screen to run, if the differential level instrument cycle time is longer than a preset time. The screen will run for a preset time and stop.

PSM 17.6 Technical Data Sheet

1) Mechanical Screen

a)	Manufacturer	:	……
b)	Country of Manufacture	:	RSA
c)	Bar aperture	:	6mm
d)	Bar thickness	:	Tapered bar 8 x 4 mm
e)	Screen field width	:	800mm
f)	Screen field height	:	Full channel depth
g)	Speed of rake(s)	:	……
h)	Head loss trough screen field	:	……

2) Gearbox

a) Manufacturer : ……

b)	Country of Manufacture		:	.....
c)	Type		:	.....
d)	AGMA rating (kW)		:	.....
e)	Thermal rating (kW)		:	.....
f)	Input speed (rpm)		:	.....
g)	Output speed (rpm)		:	.....
h)	Maximum torque (Nm)		:	.....
i)	Over torque switch		:	Yes
j)	Maximum radial load (N)		:	.....
k)	Maximum bending measured (Nm)		:	.....
l)	Minimum service factor		:	1.5 on installed power

3) Electrical Motor

a)	Manufacturer		:	.....
b)	Country of Manufacture		:	.....
c)	Installed power (kW)		:	.....
d)	Class of insulation		:	.....
e)	Type of motor		:	.....
f)	Type of frame		:	.....
g)	Splash protection		:	IP.....
h)	Speed of rotation		:	.....
i)	Power factor at	- full load	:	.....
		- 75% load	:	.....
		- 50% load	:	.....
j)	Motor protection		:	.....

4) Equipment Material

(Specify equipment material)

.....

.....

.....

5) List of Special Tools and Spares

.....

.....

.....

NAME OF TENDERER: ..... DATE: .....

SIGNED BY OR ON
BEHALF OF TENDERER: .....

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PSM 18 HAND SCREEN

PSM 18.1 Scope

Manufacture, supply, deliver, transport, handle, protect, store, install, commission and uphold during the Defects Liability Period a hand screen for the new sewage pump station: Golf Course Pump Station, Wesselsbron,

PSM 18.2 Equipment Requirements

1)	Material to be screened	:	Raw sewage
2)	Bar aperture	:	15 mm
3)	Channel width	:	800 mm
4)	Channel depth	:	1 505 mm

5) Raked screenings to be dipped dry on a perforated plate.

6) Each hand screen to be supplied with special designed hand rake.

PSM 18.3 Drawings

1) Refer to list of drawings for details of civil structures.

2) Supply equipment drawing as per PSM 9.

PSM 18.4 Material of Equipment

1)	Bars, frame and perforated plate	:	304 S/S
2)	Rake	:	304 S/S
3)	All bolts, nuts and washers	:	304 S/S or 3CR12

PSM 18.5 Electrical Equipment

No electrical equipment required.

PSM 18.6 Technical Data Sheet

1) Hand Screen

a)	Manufacturer	:	.....
b)	Country of Manufacture	:	.....
c)	Bar aperture	:	.....
d)	Bar thickness	:	.....
e)	Screen field width	:	800mm
f)	Screen field height	:	Full channel depth

2) Equipment Material

(Specify equipment material)

……...

……...

……...

……...

……...

3) List of Special Tools and Spares

……...

……...

……...

……...

……...

NAME OF TENDERER: …….. DATE: ……...

SIGNED BY OR ON
BEHALF OF TENDERER: ……..

PSM 19 SCREENINGS COMPACTOR (NEW SEWAGE PUMP STATION)

PSM 19.1 Scope

Manufacture, supply, deliver, transport, handle, protect, store, install, commission and uphold of one screenings compactor for the new sewage pump station: Golf Course Pump Station, Wesselsbron.

PSM 19.2 Equipment Requirements

1) Material to dewater and compact : All screenings from mechanical screen
2) Compactor must efficiently dewater and compact screenings received from conveyor/washer, to minimize volume and, organic content of screenings.
3) Water and organic mixture must be returned to head of mechanical screen's main flow.
4) Provide sufficient spray to be adjustable of wash water in compactor, water supplied by wash water booster pumps.
5) Screening of water organic mixture return pipe must be provided, Sufficient provision to clear clog gable items.
6) Adequate provision for discharge of compacted, dewatered screenings into waste bin, no spillage, or wastage.
7) Compactors design to integrate with layout of all mechanical equipment of inlet works.

PSM 19.3 Drawings

1) Refer to list of drawings for details of civil structures.
2) Supply equipment drawing as per PSM 9.

PSM 19.4 Material of Equipment

1)	Main frame/body	:	304 S/S
2)	Compacting/Dewatering mechanism	:	as per design
3)	Covers, chutes, pipes, bolts, nuts and washers	:	304 S/S

PSM 19.5 Electrical Equipment

Control to operate the equipment automatically, AUTO selected, and shall have a local and remote stop-push button.

The conveyor will be activated with a signal from the mechanical screen and will start after a preset delay time. The conveyor will continue to run until the preset time has elapsed.

PSM 19.6 Technical Data Sheet

1) Compactor

a)	Manufacturer	:	.....
b)	Country of Manufacture	:	RSA
c)	Compactor Type	:	Screw Press
d)	Wash Water Spray Type	:	.....
e)	Type of return pipe screening	:	.....
f)	Return pipe's size	:	.....
g)	Capacity	:	To suit application (min 1 m3/hr)
h)	Number of return pipes	:	.....
i)	Discharge tube length	:	.....
j)	Discharge tube discharge height	:	(min. 1600 mm) .....

2) Gearbox

a)	Manufacturer	:	.....
b)	Country of Manufacture	:	.....
c)	Type	:	.....
d)	AGMA rating (kW)	:	.....
e)	Thermal rating (kW)	:	.....
f)	Input speed (rpm)	:	.....
g)	Output speed (rpm)	:	.....
h)	Maximum torque (Nm)	:	.....
i)	Maximum radial load (N)	:	.....
j)	Maximum bending measured (Nm)	:	.....

3) Electrical Motor

a)	Manufacturer		:	.....
b)	Country of Manufacture		:	.....
c)	Installed power (kW)		:	.....
d)	Class of insulation		:	.....
e)	Type of motor		:	.....
f)	Type of frame		:	.....
g)	Splash protection		:	.....
h)	Speed of rotation		:	.....
i)	Power factor at	- full load	:	.....
		- 75% load	:	.....
		- 50% load	:	.....
j)	Motor protection		:	.....

4) Equipment Material (Specify)

.....

.....

.....

.....

.....

.....

.....

5) List of Special Tools and Spares (Specify)

.....

.....

.....

.....

.....

.....

.....

NAME OF TENDERER: ..... DATE: .....

SIGNED BY OR ON
BEHALF OF TENDERER: .....

PSM 20 DE-GRITTING SPIRAL

PSM 20.1 Scope

Manufacture, supply, deliver, transport, handle, protect, store, install, commission and uphold of one de-gritting spiral for the pista trap at the new sewage pump station: Golf Course Pump Station, Wesselsbron.

PSM 20.2 Equipment Requirements

1) Settled grit inside the pista trap must be spiralled from the pista trap, out into the same waste bin as for the screenings.
2) Continuous operation, periodically, will keep the pista trap de-gritted.
3) Provide adequate chute and/or covers to discharge grit into the bin without wastage or spillage.
4) De-gritter design must integrate with layout of all mechanical equipment at inlet works.

PSM 20.3 Drawings

1) Refer to list of drawings for details of civil structures.
2) Supply equipment drawing as per PSM 9.

PSM 20.4 Material of Equipment

1)	Main frame/body	:	304 S/S
2)	Compacting/Dewatering mechanism	:	as per design
3)	Covers, chutes, pipes, bolts, nuts and washers	:	304 S/S

PSM 20.5 Electrical Equipment

Control to operate the equipment automatically, AUTO selected, and shall have a local and remote stop-push button.

The de-gritter will be activated with a signal from a timer and continue to run until the preset time has elapsed.

PSM 20.6 Technical Data Sheet

1) De-gritter at Sewage Pump Station

a)	Manufacturer	:	……
b)	Country of Manufacture	:	RSA
c)	De-gritter Type	:	Screw
d)	Length of De-gritter	:	……
e)	Spiral Diameter	:	150mm
f)	Spiral Thickness	:	……
g)	Spiral Height	:	……

2) Gearbox

a)	Manufacturer	:	……

b)	Country of Manufacture		:	.....
c)	Type		:	.....
d)	AGMA rating (kW)		:	.....
e)	Thermal rating (kW)		:	.....
f)	Input speed (rpm)		:	.....
g)	Output speed (rpm)		:	.....
h)	Maximum torque (Nm)		:	.....
i)	Maximum radial load (N)		:	.....
j)	Maximum bending measured (Nm)		:	.....

3) Electrical Motor

a)	Manufacturer		:	.....
b)	Country of Manufacture		:	.....
c)	Installed power (kW)		:	.....
d)	Class of insulation		:	.....
e)	Type of motor		:	.....
f)	Type of frame		:	.....
g)	Splash protection		:	.....
h)	Speed of rotation		:	.....
i)	Power factor at	- full load	:	.....
		- 75% load	:	.....
		- 50% load	:	.....
j)	Motor protection		:	.....

4) Equipment Material (Specify)

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5) List of Special Tools and Spares (Specify)

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NAME OF TENDERER: ..... DATE: .....

SIGNED BY OR ON
BEHALF OF TENDERER: .....

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PSM 21 PISTA TRAP PADDLER

PSM 21.1 Scope

Manufacture, supply, deliver, transport, handle, protect, store, install, commission and uphold of one paddler for the pista trap at the new sewage pump station: Golf Course Pump Station, Wesselsbron.

PSM 21.2 Equipment Requirements

1) The purpose of the paddlers will be to establish an optimal rotation flow speed through the pista trap for effective grit settling, minimizing organic settling.
2) Raw, 6mm screened, sewage will pass through the pista traps.
3) Guideline for rotation speed of paddler : 33.0 rpm

PSM 21.3 Drawings

1) Refer to list of drawings for details of civil structures.
2) Supply equipment drawing as per PSM 9.

PSM 21.4 Material of Equipment

1) Paddler and shaft : 304 S/S
2) Covers, chutes, pipes, bolts, nuts and washers : 304 S/S

PSM 21.5 Electrical Equipment

Control to operate the equipment automatically, AUTO selected, and shall have a local and remote stop-push button.

The paddler will be activated with a signal from a timer and continue to run until the preset time has elapsed.

PSM 21.6 Technical Data Sheet

1) Paddler at Sewage Pump Station
   a) Manufacturer : ……
   b) Country of Manufacture : RSA
   c) Number of paddles : 2
   d) Paddle height : ……
   e) Paddle width : ……
   f) Shaft diameter : ……
   g) Shaft length : ……
   h) Rotation speed of paddle (rpm) : 33.0 rpm
2) Gearbox
   a) Manufacturer : ……
   b) Country of Manufacture : ……
   c) Type : ……

d)	AGMA rating (kW)		:	……
e)	Thermal rating (kW)		:	……
f)	Input speed (rpm)		:	……
g)	Output speed (rpm)		:	……
h)	Maximum torque (Nm)		:	……
i)	Maximum radial load (N)		:	……
j)	Maximum bending measured (Nm)		:	……

3) Electrical Motor

a)	Manufacturer		:	……
b)	Country of Manufacture		:	……
c)	Installed power (kW)		:	……
d)	Class of insulation		:	……
e)	Type of motor		:	……
f)	Type of frame		:	……
g)	Splash protection		:	……
h)	Speed of rotation		:	……
i)	Power factor at	- full load	:	……
		- 75% load	:	……
		- 50% load	:	……
j)	Motor protection		:	……

4) Equipment Material (Specify)

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5) List of Special Tools and Spares (Specify)

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NAME OF TENDERER: …….. DATE: ……...

SIGNED BY OR ON
BEHALF OF TENDERER: ……..

PSM 22 PUMP STATION DRAINAGE PUMP AND PIPE WORK

PSM 22.1 Scope

Manufacture, supply, deliver, transport, handle, protect, store, install, commission and uphold of one submersible sump pump to drain the pump station if and when necessary.

PSM 22.2 Equipment Requirements (per pump)

1) Material to be pumped, a wide range of water and solid containing liquids.
2) Main delivery pipe diameter : 60 mm
3) Flow (1 Pump pumping) : 2 – 5 l/s
4) Maximum static head : 5 – 7,5 m
5) Maximum friction head loss : 0,5 m
6) Maximum local head loss : 0,25 m
7) Submersible, manual handled sump pump.

PSM 22.3 Drawings

1) Refer to list of drawings for details of civil structures.
2) Supply equipment drawing as per PSM 9.
3) See list of drawings for schematic layout of pump and pipe work.

PSM 22.4 Material of Equipment

1) Pump and base plate : as per supplier
2) Pipe work : Mild steel, HDG
3) Bolts, nuts, washers, pipe supports : Mild steel, HDG

PSM 22.5 Electrical Equipment

Control to operate the equipment automatically, AUTO selected, and shall have a local and remote stop-push button.

The pump will be activated with a signal from its own manufacture fitted, adjustable float switch.

PSM 22.6 Technical Data Sheet

1) Submersible Pumps
   a) Manufacturer : .....
   b) Country of manufacture : .....
   c) Pump type : .....
   d) Pump model : .....
   e) Operating speed : .....
   f) Impeller diameter : .....
   g) Solids handling (mm) : .....
   h) Shaft diameter : .....
   i) Bearing type : .....

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

j)	Seal type		:	.....
k)	Pump performance data		:	.....

2) Electrical Motor

a)	Manufacturer		:	.....
b)	Country of Manufacture		:	.....
c)	Installed power (kW)		:	.....
d)	Class of insulation		:	.....
e)	Type of motor		:	.....
f)	Type of frame		:	.....
g)	Splash protection		:	.....
h)	Speed of rotation		:	.....
i)	Power factor at	- full load	:	.....
		- 75% load	:	.....
		- 50% load	:	.....
j)	Motor protection		:	.....

3) Equipment Material (Specify)

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4) List of Special Tools and Spares (Specify)

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NAME OF TENDERER: ..... DATE: .....

SIGNED BY OR ON
BEHALF OF TENDERER: .....

PSM 23 SEWAGE PUMPS AND PIPE WORK (2 of)

PSM 23.1 Scope

Manufacture, supply, deliver, transport, handle, protect, store, install, commission and uphold of two sewage pumps and pipe work for the Golf Course Pump Station in Wesselsbron.

PSM 23.2 Equipment Requirements (per pump)

1) Material to be pumped, raw sewage, pretreated, screened and de-gritted.
2) Main suction pipe diameter : 200 mm
3) Main delivery pipe diameter : 160 mm
4) Flow (1 Pump pumping) : 14 l/s
5) Maximum static head : 9,5 m
6) Minimum static head : 6,75 m
7) Maximum suction head : 1,2 m
8) Minimum suction head : -1,5 m
9) Maximum friction head loss : 21 m
10) Minimum friction head loss : 7 m
11) Maximum local head loss : 0,1 m
12) Minimum local head loss : 0,1 m
13) Dry wall, self-priming, solids handling type pump.
14) Automatic air release and drain piping.
15) Connection for quick capable universal pressure gauge.

PSM 23.3 Drawings

1) Refer to list of drawings for details of civil structures.
2) Supply equipment drawing as per PSM 9.
3) See list of drawings for schematic layout of pump and pipe work.

PSM 23.4 Material of Equipment

1) Pump and base plate : as per supplier
2) Pipe work : Mild steel, HDG
3) Bolts, nuts, washers, pipe supports : Mild steel, HDG

PSM 23.5 Electrical Equipment

Control to operate the equipment automatically, AUTO selected, and shall have a local and remote stop-push button.

The duty pump will be started with a “1 pump level” signal from the ultrasonic level instrument, also supplied under this contract, The duty pump will pump until a “pumps off level” signal is sent by the ultrasonic instrument. In the event that a “2 pump level” signal, above the “1 pump level”, is sent by the ultrasonic level instrument, the stand-by pump will be activated with the duty pump and both pumps will continue to pump until the “pumps off level” signal is send. An “emergency high level’ signal from the ultrasonic level instrument will activate an audible alarm.

PSM 23.6 Technical Data Sheet

1) Pumps

a)	Manufacturer		:	.....
b)	Country of manufacture		:	.....
c)	Pump type		:	.....
d)	Pump model		:	.....
e)	Operating speed		:	.....
f)	Impeller diameter		:	.....
g)	Shaft diameter		:	.....
h)	Bearing type		:	.....
i)	Seal type		:	.....
j)	Pump performance curves		:	.....

2) Pump/Motor Coupling

a)	Type		:	.....
b)	Ratios		:	.....

3) Electrical Motor

a)	Manufacturer		:	.....
b)	Country of Manufacture		:	.....
c)	Installed power (kW)		:	.....
d)	Class of insulation		:	.....
e)	Type of motor		:	.....
f)	Type of frame		:	.....
g)	Splash protection		:	.....
h)	Speed of rotation		:	.....
i)	Power factor at	- full load	:	.....
		- 75% load	:	.....
		- 50% load	:	.....
j)	Motor protection		:	.....

4) Equipment Material (Specify)

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Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

5) List of Special Tools and Spares (Specify)

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6) Weight of Equipment

Total mass of complete unit (equipment/motor/gearbox/base plate): ……...

NAME OF TENDERER: …….. DATE: ……...

SIGNED BY OR ON
BEHALF OF TENDERER: ……..

PSM 24 SCREW PUMPS (2 of)

PSM 24.1 Scope

Manufacture, supply, deliver, transport, handle, protect, store, install, commission and uphold of two screw complete with Archimedean screws, bearings, drive unit, screw trough and splash plates.

PSM 24.2 Equipment Requirements (per pump)

1) Screw pumps will pump raw sewage from Wesselsbron.
2) ADWF : 390,0 m^3/day
3) PDWF : 850,0 m^3/day
4) PWWF : 980,0 m^3/day
5) Angle of screw with horizontal : 36°
6) Screw length : ± 10 m
7) Pump lift : 5,425 m
8) Pump will run continuously, 24 hours/day to keep sewage reticulation network empty.
9) Make provision in design for sufficient reliable bottom bearing lubrication.
10) All parts of screw pump must be maintained under necessary conditions.
11) Screw must not be able to rotate in reverse direction under hydraulic pressure after power off.
12) Drive unit must be adequately sized for when and if, after a power failure, the sump TWL will be raised, depending on time of power failure. Due to the raised water level in the sump, very high hydraulic loads can be expected. Thus, the drive unit may be highly overloaded during the startup period, can take up to 30 – 60 min to clear all sewage.

PSM 24.3 Drawings

1) Refer to list of drawings for details of civil structures.

2) Supply equipment drawing as per PSM 9.

PSM 24.4 Material of Equipment

1)	Screw pump and accessions	:	Mild steel, copon coated or similar
2)	Drive unit	:	as per supplier
3)	Cover, plates	:	Mild steel, HDG
4)	Bolts, nuts, washers, etc.	:	304 S/S

PSM 24.5 Electrical Equipment

Control to operate the equipment automatically, AUTO selected, and shall have a local and remote stop-push button.

The pumps will be activated with a signal from a timer and continue to run until the preset time has elapsed. The timer must be adjustable over a 24-hour period, in 1-hour intervals, to 7-day period, in 6-hour intervals.

An emergency high level will shut down any duty screw pump and re-start the duty pump when a reset level has been sent. These signals will be monitored and sent by an ultrasonic level instrument, to be supplied under this contract.

PSM 24.6 Technical Data Sheet

1) Pumps

a)	Manufacturer	:	……
b)	Country of manufacture	:	……
c)	Outside screw diameter	:	……
d)	Screw length	:	……
e)	Max. flow	:	……
f)	Average flow	:	……
g)	Head	:	……
h)	Rotating speed	:	……
i)	Top bearing	:	……
j)	Bottom bearing	:	……

2) Drive Coupling Details

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……...
……...

3) Gearbox

a)	Manufacturer	:	……
b)	Country of Manufacture	:	……

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

c)	Type		:	.....
d)	AGMA rating (kW)		:	.....
e)	Thermal rating (kW)		:	.....
f)	Input speed (rpm)		:	.....
g)	Output speed (rpm)		:	.....
h)	Maximum torque (Nm)		:	.....
i)	Maximum radial load (N)		:	.....
j)	Maximum bending measured (Nm)		:	.....

4) Electrical Motor

a)	Manufacturer		:	.....
b)	Country of Manufacture		:	.....
c)	Installed power (kW)		:	.....
d)	Class of insulation		:	.....
e)	Type of motor		:	.....
f)	Type of frame		:	.....
g)	Splash protection		:	.....
h)	Speed of rotation		:	.....
i)	Power factor at	- full load	:	.....
		- 75% load	:	.....
		- 50% load	:	.....
j)	Motor protection		:	.....

5) Equipment Material (Specify)

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6) List of Special Tools and Spares (Specify)

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NAME OF TENDERER: ..... DATE: .....

SIGNED BY OR ON
BEHALF OF TENDERER: .....

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PSM 25 SLUICE GATES

PSM 25.1 Scope

Manufacture, supply, deliver, transport, handle, protect, store, install, commission and uphold of all channel sluice gates, manually activated.

PSM 25.2 Equipment Requirements

1) Material to be isolated with sluice gates: raw sewage, pre-treated sewage, MLSS, digested sludge and water.
2) Sluices will be manually operated.
3) Maximum of 100 N free per hand, on the tip of the hand wheel will be allowed to open/close the sluice gates.
4) All sides must close water tight.
5) When open, sluice frame must be flush with channel walls and floor.
6) High quality, 304 S/S sewage type sluice gates will be approved.
7) See Table under item 25.5 for sluice dimensions.

PSM 25.3 Drawings

1) Refer to list of drawings for details of civil structures.
2) Supply equipment drawing as per PSM 9.

PSM 25.4 Material of Equipment

1)	Sluice and Frame	:	304 S/S
2)	Spindle	:	304 S/S
3)	Sealing material	:	non-bio-degradable
4)	Bearings	:	304 S/S
5)	Hand wheel, spindle support, nuts, bolts and washers	:	304 S/S

PSM 25.5 Sluice Gate Dimensions (mm)

Item	Description	Type	Frame Inside Size (L x W)	Sluice Size (L x W)	Spindle Length	Spindle Travel	Manual or Actuated
1	Mech. Screen inlet	Channel	2000 x 800	1000 x 950	1850	1000	Manual
2	Hand Screen inlet	Channel	2000 x 800	1000 x 950	1850	1000	Manual
3	Mech. Screen outlet	Channel	2000 x 500	1000 x 650	1850	1000	Manual
4	Hand Screen outlet	Channel	2000 x 800	1000 x 950	1850	1000	Manual
5	Pista Trap inlet	Channel	2000 x 250	1000 x 400	1850	1000	Manual
6	Pista Trap bypass	Channel	2000 x 450	1000 x 600	1850	1000	Manual
7	Pista Trap outlet	Channel	2000 x 700	1000 x 850	1850	1000	Manual

PSM 25.6 Technical Data Sheet

1) Channel Sluice Gates

a)	Frame section thickness	:	……
b)	Frame material	:	……
c)	Sluice/gate thickness	:	……
d)	Sluice/gate material	:	……
e)	Seal method	:	……
f)	Seal material	:	……
g)	Spindle diameter	:	……
h)	Spindle material	:	……
i)	Bearing type	:	……
j)	Hand wheel diameter	:	……
k)	Hand wheel material	:	……
l)	Bolts, nuts and other material	:	……

2) Equipment Material (Specify)

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3) List of Special Tools and Spares (Specify)

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NAME OF TENDERER: …….. DATE: ……..

SIGNED BY OR ON
BEHALF OF TENDERER: ……..

PROJECT SPECIFICATIONS – ELECTRICAL EQUIPMENT

ELSPEC-01-LVCAB:
LOW-VOLTAGE CABLES AND TRENCHING SPECIFICATIONS

1. INTRODUCTION

This specification relates to the supply, installation, testing of Low voltage cables for usage in the distribution/control network scenario.

This specification also includes the trenching methods to be utilized.

2. SUPPORTING CLAUSES

2.1 Scope

This standard covers the general requirements for a low voltage cable distribution system.

A low voltage cable system would typically consist of all or part of the following:
a) Mini-substations feeding LV meter kiosks and meter panels;
b) Ground-mounted transformers feeding meter panels with supplies up to 500 kVA;
c) LPU and SPU meter panels;
d) SPU meter kiosks;
e) Secured meter kiosks;
f) LV feeder cables, service cables and customer cables; and
g) LV feeder cables between customer distribution boards and sub distribution boards.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs:

2.2.1 Normative

1) NRS 074-1, Low-voltage (600/1000 V) cable systems for underground electrical distribution – Part 1: Cables
2) NRS 074-2, Low-voltage (600/1000 V) cable systems for underground electrical distribution – Part 2: Cable accessories
3) SANS 1507, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V).
4) SANS 10142-1, The wiring of LV premises – Part 1 Low-voltage installations.
5) SANS 10198-1, The selection, handling and installation of electric power cables of rating not exceeding 33kV – Part 1 Definitions and statutory requirements.
6) SANS 10198-2, The selection, handling and installation of electric power cables of rating not exceeding 33kV – Part 2 choice of cable type and methods of installation.
7) SANS 10198-3, The selection, handling and installation of electric power cables of rating not exceeding 33kV – Part 3 Earthing systems – General provisions.
8) SANS 10198-4, The selection, handling and installation of electric power cables of rating not exceeding 33kV – Part 4 Current ratings.
9) SANS 10198-5, The selection, handling and installation of electric power cables of rating not exceeding 33kV – Part 5 Determination of thermal and electrical resistivity of soil.
10) SANS 10198-6, The selection, handling and installation of electric power cables of rating not exceeding 33kV – Part 6 Transportation and storage.

11) SANS 10198-7, The selection, handling and installation of electric power cables of rating not exceeding 33kV – Part 7 Safety precautions.
12) SANS 10198-8, The selection, handling and installation of electric power cables of rating not exceeding 33kV – Part 8 Cable laying and installation.
13) SANS 10198-9, The selection, handling and installation of electric power cables of rating not exceeding 33kV – Part 9 Jointing and termination of extruded solid dielectric-insulated cables up to 3,3 kV.
14) SANS 10198-13, The selection, handling and installation of electric power cables of rating not exceeding 33 kV – Part 13 Testing, commissioning and fault location.
15) SANS 10292: Earthing of low-voltage (LV) distribution systems.
16) SANS 61238-1, Compression and mechanical connectors for power cables with copper or aluminium conductors: Part 1 – Test methods and requirements.
17) VC 8075, Compulsory specification for the safety of electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V).
18) SANS 10142-1, The wiring of premises Part 1: Low-voltage installations
19) Occupation Health and Safety Act (OHS Act) No 85 of 1993 – Construction, Electrical Machinery and Explosives Regulations Explosives Act No 26 of 1956

2.3 Definitions

Definition	Description
Compacted Crown	A layer of compacted soil above the natural ground level along the trench.
Customer cable	The customer's cable, used to connect the customer's plant to the supply at the metering point. The customer cable uses a separate neutral and earth conductor, so it may be three core armoured cable (for a single-phase customer) or four core armoured cable with a separate earth continuity conductor for a three-phase supply.
Low Voltage	A voltage of r.m.s. value not exceeding 1000 V.
LV feeder cable	The supplier's three-phase, LV cable used to distribute electricity from the miniature substations to the metering kiosks. LV Feeder cables use a combined neutral and earth system, so four core armoured cables are used. No Customers are supplied directly from a LV Feeder.
LV service cable	The supplier's LV cable, used to supply electricity from the metering kiosk to a customer's premises. The service cable uses a combined earth and neutral, so it may be a two-core armoured cable (for single-phase supplies) or a four-core armoured cable (for three-phase supplies).
Meter panel	It is the enclosure for mounting plate for meters, moulded case circuit breaker (MCCBs), plugs, and other accessories (but not for busbars)
Metering Kiosk	It is the enclosure used to provide a safe and convenient point at which to connect multiple customer cables to the bus bar and feeder cable via meters and circuit breakers
Miniature substation (or mini-substation)	A factory-assembled and tested free-standing unit that is suitable for use in an area accessible to the public, that comprises a transformer, an equipped medium-voltage compartment and an equipped low-voltage compartment and that is suitable for connection to underground cables (NRS 004).

3. CABLE AND CABLE ACCESSORIES FOR LOW VOLTAGES

3.1 Rated voltage

The rated voltage of the cable shall be 600/1000V

3.2 Materials and Construction

3.2.1 Conductors

a) The conductors shall be copper stranded or aluminium stranded
b) Conductor dimensions/ratings shall be calculated as per SANS 10142-1 with de-rating factors.

3.2.2 Cores and Identifications

The number of cores shall be specified as per drawings and the typical cores and core identification shall be as per below table:

PHASES	CORES	COLOURS OF PHASE CORES	COLOUR OF NEUTRAL CORE
1	3	Red or Yellow or Blue	Black
2	3	Red and Blue	Black
3	3	Red Yellow and blue	nil
3+N	4	Red Yellow and blue	Black

3.2.4 Bedding

The cable shall have a PVC bedding

3.2.5 Armouring

Single and multicore cables shall have galvanised steel wire armouring.

3.2.5 Outer Sheath

The cables shall have PVC outer sheath. The outer sheath shall be UV radiation stabilised

3.2.5 Fire rating and requirements

The cables shall be flame retardant (red stripe) unless otherwise specified, the cable shall have a reduced halogen or zero halogen emission property.

The use of cables having a reduced halogen (blue stripe) or zero halogen (white stripe) property are normally restricted to Generation applications only.

3.2.6 Bare stranded copper conductor

a) Bare stranded copper conductors shall be used as earth continuity conductors.
b) The conductors shall be of hard drawn stranded copper compliant to SANS 182.
c) The bare stranded copper conductors shall be supplied and delivered in rolled lengths.

3.3. Markings

3.3.1 Conductor

a) Each individual conductor shall be marked with a unique and traceable identification system.
b) The manufacturer shall keep a secure database of all uniquely marked conductors supplied to the customer.
c) The conductor identification system shall comply with the following minimum requirements:
d) The identification code shall consist of any of the following options:
   - Alpha-numeric, alpha - or numeric characters,
   - Client name,
   - Client logo,

- Coloured yarn,
- Marks,
- Groove.

e) The identification code shall be marked at intervals not exceeding 500 mm
f) Where applicable for alpha-numeric characters the algorithm used to generate the identification code shall be unique for each manufacturer.
g) Details of the proposed conductor identification system shall be submitted with the tender documentation.

3.3.2 Cable

Cables shall be legibly marked in accordance with the requirements of SANS 1507, but the marking shall include the specification number to which the cable has been manufactured, the year of manufacture, rated voltage, the conductor size in mm2, the number of cores, conductor material e.g. Cu (Copper), the client name.

A typical legend would be:
- "CABLES 2017 600/1000 V 70 mm2 4C Cu SANS 1507"

a) The cable shall bear the SABS mark,
b) The gap between the end of one legend and the beginning of the next shall not exceed 275 mm.
c) The cable shall be sequentially marked at one metre intervals with the legend 000 m, 001 m etc. starting with 000 m at the barrel of the drum and finishing with the number indicating the length of cable on the drum at the outer end of the cable. The error in the length marking shall be less than 1 %,
d) Cables shall have a colour coded stripe in accordance with SANS 1507.

3.3.3 LV cable accessories, joints and terminations

LV cable accessories shall comply with the requirements of NRS 074-2 and this specification. Joints shall be the cold pour resin (cast resin) and or heat shrink type. Where conflicting requirements arise, the requirements of this specification shall take precedence.

All accessories shall be suitable for use in the following installation conditions:
- Ambient air temperature: −10 °C to 45 °C,
- Maximum solar radiation: 1000 watts/m2,
- Ultraviolet radiation: high,
- Relative humidity: 10 % to 95 %, and
- Joints shall be suitable for buried or above ground installation.

3.3.3.1 Joints

a) Heat shrink or resin joints shall be suitable for use with single or multi-core 600/1000 V PVC or XLPE insulated, PVC bedding, steel wire armoured and PVC sheathed cable complying with SANS 1507 as described in NRS 074-2.
b) For single core armoured cables earth braids are required for earth continuity in the joint, the number and size of earth braids shall be 3X70 mm2.
c) For resin joints the shell/mould shall be transparent to allow for visual inspection of clearances.
d) Mechanical torque shear connectors suitable for the range specified in NRS 074-2 shall be provided with joint kits where the conductor size is equal to or bigger than 16 mm2.
e) Mechanical torque shear connectors shall be suitable for jointing copper and aluminium conductors.
f) For joint kits where conductor sizes are smaller than 16 mm2, suitable copper crimp ferrules shall be supplied by the user for the size of copper conductor to be jointed.

Joints in underground cables, and terminations, shall be made by means of approved epoxy-resin pressure type jointing kits or products equally approved by the Engineer. Joints must be made by competent cable jointers and entirely in accordance with the manufacturer's instructions using only the materials stipulated in such instructions. Each end of the cables to be jointed must have a minimum of 1000mm of slack disposed in a loop without stress. Backfilling under joints must be firmly tamped to prevent any subsequent settling. LV

cables shall be made off with sealing glands and materials specially designed for this purpose in compliance with SANS 10198-9.

3.3.3.2 Outdoor terminations

All outdoor terminations shall comply with the requirements specified in NR 074-2:

a) Mechanical torque shear connectors suitable for the range specified in NRS 074-2 shall be provided with outdoor termination kits where the conductor size is equal to or bigger than 16 mm2.
b) Mechanical torque shear connectors shall be suitable for terminating copper and aluminium conductors onto brass or copper equipment terminals.
c) For termination kits where conductor sizes are smaller than 16 mm2, suitable copper crimp lugs shall be supplied by the user for the size of conductor to be terminated.

3.3.3.3 Indoor termination

The crimp lugs for indoor terminations shall be ordered and supplied separately.

Note: Crimp lugs are used for terminations intended for use in moulded case and miniature circuit breakers. These crimp lugs are only allowed for terminating copper conductor cables.

3.3.3.4 Cable glands for armoured cable

a) Glands to be used for terminating PVC/PVC/SWA/PVC cables shall be of the adjustable type.
b) Glands shall be suitable for general purpose 600/1000V grade 4-core cable with steel armouring.
c) The glands shall be made of nickel-plated bronze.
d) The glands shall consist of a barrel carrying a cone bush screwed into one end and a nickel-plated brass nipple carrying a nickel-plated brass or a heavy galvanized steel locknut screwed into the other end. The galvanizing shall comply with SANS 121.
e) Non-watertight glands must be easily converted to watertight glands by means of a waterproofing shroud and inner seal kit. On the cable entry side of the barrel a concave groove shall be provided to accommodate the top rim of the waterproofing shroud.
f) The shrouds shall be made of non-deteriorating neoprene or other synthetic rubber, and shall be resistant to water, oil and sunlight. The shrouds shall fit tightly around the glands and cable.
g) Glands shall be provided with ISO threads and shall be suitable for the specified cable sizes.
h) Glands shall be brands approved by the engineer in accordance with SANS 1213.
i) Each gland shall be supplied with a shroud and water-proofing kit.

3.3.3.5 Cable termination lugs

Termination lugs shall be tinned copper brand for copper conductors, approved by the engineer. All cable lugs and ferrules shall comply with NRS 028 and IEC 61238.

3.3.3.6 Cable hoods

a) Cable hoods for the protection of the cable terminations at tap-offs from the overhead ABC conductors to an underground cable shall be used (from 35mm² up to 50mm² x 4-core cable, for cable sizes above 50mm² cable boots shall be used.
b) The tenderer must include specifications of the cable hood offered.
c) The cable hood shall be suitable for mounting onto a wood pole.

4. HANDLING AND LAYING OF UNDERGROUND CABLES UP TO AND INCLUDING 33KV.

4.1 General

Cable work shall be done in accordance with SANS 10198 and to the satisfaction of the Client and the Engineer. The storage, transportation, handling and laying of underground cables shall conform to SANS 10198 and to BS 6004, and the Contractor shall have adequate and suitable equipment (SANS 10142) and labour to ensure that no damage is done to cables during such operations. Twisted or kinked cables, or

cables damaged in any other way, will be rejected.

4.2 Cable routes and positioning

The contractor shall follow the routes indicated on the specification drawings as accurately as possible. Deviations from the routes laid down shall not be made without the engineer's approval. The final position of cable relative to kerbs, boundaries, and other services shall, where necessary, be indicated to the contractor by the engineer on site and shall be strictly adhered to. The cable route drawings issued with the inquiry documents are for tender purposes only and the routes may be amended before work on any particular section of the route commences. In general, where obstacles not provided for in the specification drawings are encountered, cables shall circumvent such obstacles by being laid in as smooth a path as possible around the obstacles and by retaining maximum separation between cables. Laying depths of cables specified are to final levels of the streets and sidewalks. All levels shall be obtained by the contractor from the Local Authority.

4.3 Handling and laying of cables

The contractor must satisfy himself that the levels of the trenches excavated are suitable and are wide enough to enable him to carry out the work in accordance with SANS 10198-8. The contractor shall be responsible to draw in, lay, thread through pipes, circumvent obstacles, fix in position clamp and saddle where required to walls, poles or switch gear all cables set out in the contract. Best accepted practice is to be adopted in the handling and laying of cables and the work shall be carried out by persons experienced in the class of work. In particular, attention is drawn to the following:

a) Cable drums shall not be dropped off transport vehicles but shall be hoisted off with approved equipment.
b) Cable shall be rolled off drums in the indicated direction, the drums being supported on approved equipment.
c) When cables are laid out, it shall be supported at points at such a distance apart that the cable is not dragged along the ground and that it is not kinked.
d) Cables shall be drawn into position or laid, using a sufficient number of rollers and suitable equipment, for negotiating corners to avoid excess bending or damage to the cable.
e) Cables shall be drawn through cable pipe sleeves so as to ensure minimum damage to cables. Approved equipment, including suitable cable harnesses, shall be used.
f) Cables shall not be bent in any event to radii smaller than 15 times the overall diameter of the cable.
g) Cables shall be rolled off drums in the same direction, to prevent corresponding phase cores being crossed at joints.

4.4 Trenching

11kV cables shall generally be laid at a minimum depth of 1000mm below ground level. Main LV feeder cables, unless otherwise instructed, shall be laid at a minimum depth of 600mm below ground level.

Trenches shall not be less than 400mm wide for single and multiple LV service connection cables, and the trench width shall be increased where more than two LV feeder or service connection cables are laid together so that the cables may be placed at least 150mm apart throughout the run.

Streetlight cables buried in trenches under un-tarred roads shall be buried in a trench with minimum depth of 600mm and 400mm wide.

Trenches under tarred roads shall be buried a minimum of 500mm deep, and normally in HDPE corrugated sleeving of applicable size, quantity and required spare quantities. Where the nature of the ground does not permit the excavation of the cable trenches to the specified depth, the engineer may authorize trenches not less than 500mm deep. Such authority shall be given in writing.

The Contractor must take all the necessary precautions to prevent trenching work being in any way a hazard to the public, and to safeguard all structures, roads, railways, sewer works or other property from any risk of subsidence and damage. Soil type shall be graded by the engineer. The engineer's decision shall be final.

The following table represents the minimum standards to be applied in respect of 11, 22 and 33kV, 400V feeder, 400V Street light and 230V service connection cables.

TRENCH DETAIL FOR CABLE SETUP NEEDED	CABLE TRENCH DEPTH	TRENCH WIDTH	Width between 11,22,33kV Cable	Width between 400V Cable
Single 11,22,33kV	1000mm	500mm	n/a	n/a
2 Parallel 11,22,33kV	1000mm	800mm	600mm	n/a
3 Parallel 11,22,33kV	1000mm	1400mm	600mm	n/a
Single 400V Feeder	600mm	400mm	n/a	n/a
2 parallel 400V Feeder	600mm	600mm	n/a	150mm
3 parallel 400V Feeder	600mm	800mm	n/a	150mm
Single/multiple service connections	600mm	300mm	n/a	None
Streetlight– Un-tarred	600mm	400mm	n/a	None
Streetlight– Tarred	600mm	400mm	n/a	None
Combination of Multiple Cables	600mm	1200mm	500mm	150mm
Combination of single cables	600mm	700mm	n/a	150mm

4.4.1 Excavation of joint chambers

Jointing pits shall be excavated to a depth of 1.2m and shall be rectangular in shape and large enough for the cable jointer to work comfortably and in an efficient manner. The minimum size of a joint pit shall be 2.5m long x 1.5m wide, the pit shall be 3m x 2m for two joints.

The cost to excavate joint chambers shall be allowed for in the trenching rate as part of the Bill of Quantities and shall be based on a quantity to be same as the measured through joints.

4.4.2 Excavations and soil classifications

To account for soil conditions that may vary along an excavation, rates for 3 different types of soil will be used- “soft”, “intermediate” and “Hard”. Hard excavation will be measured as “Normal” with the use of necessary compressor and/or other mechanical equipment being measured as an extra over rate. The types of excavation are defined as follows:

- Soft Excavation: Material that can be loosened and removed using pick and shovel (such as grass covered sand, soft clay, dry earth, small stones in sand which can be removed by hand, or thin layers of “koffieklip”).

- Intermediate Excavation: Material that is difficult to loosen and remove using pick and shovel such as large layers of “koffieklip”, hard dry clay, ground containing boulders and layers of tar or where progress is slow and other services are affected. The cost of any mechanical plant used to assist in loosening the material is to be included in the given rate.

- Hard Excavation: A solid mass of material, 1m or longer, that can be broken only using a paving breaker, or jackhammer and/or blasting and where progress is very slow.

The Engineer must authorize any intermediate or hard excavation before it may be claimed. Excavations must be carried out in a neat and workmanlike fashion.

The Contractor must remove tar pieces, stones and sharp objects from the excavated soil and ensure that such material is removed from site daily. No stones, tar pieces or sharp objects may be put back in the trench. No excavations or holes shall be left open for longer than 3 days or over a weekend. Excavated material may not be dumped or stored against boundary walls or on landscaped gardens unless the prior consent of the property owners is obtained. The Contractor shall be responsible for the restoration of defaced property.

Where excavated material is placed on road surfaces, care must be taken not to block storm water drains or open channels.

Where grass sods or plants are removed, they must be neatly packed adjacent to the trench. The Contractor must keep the grass sods or plants damp after removal by watering or otherwise to ensure that they remain alive. The Contractor must ensure that all vegetation is replanted after the trench is properly backfilled and compacted. The Contractor must make good at his own cost any vegetation damaged during the excavation and not restored to its original condition.

Brick paving must be removed neatly and stacked adjacent to the area excavated at a location that is acceptable to the user of such brick paved surface. The Contractor shall be responsible for replacing any bricks that are broken. The Contractor must reinstall the removed bricks to the satisfaction of the user. The same method of operation shall apply for paving slabs.

When excavating through kerbs, channels, edgings or any other edge unit, these shall be carefully removed up to the nearest whole unit and replaced. If these units are damaged, they shall be replaced with similar approved new units for the cost of the Contractor. Any water accumulating in excavated trenches or holes, either as a result of rain or due to the level of the water table, must be pumped out by the Contractor to make work inside the trench or hole possible.

Care must be taken to ensure that effective barriers are erected around all excavations to ensure the safety of the general public. In this regard the contractor must install an orange meshed barrier screen (or other type of barrier if deemed by the Contractor to be more effective) up to at least a metre in height around the entire excavated area.

The barrier must be secured in such a way that it will not be disturbed by adverse weather conditions. Where the public requires access across the excavation, suitable, safe crossings must be provided. The Contractor must detail in his safety plan the measures that will be taken to safeguard the public. The Contractor shall be responsible for any liability arising out of his activities. This includes the safety of the public while the trenches are open. The Contractor must consult the owners of properties who may be affected by the activities of the Contractor e.g. driveways, well maintained verges or gardens.

Where the surface to be excavated will require a permanent re-instatement by a local authority or contractor the surface cut shall be made with an edged tool and shall be cut as cleanly and evenly as possible.

Where the cable route is located parallel to and under the road surface, the edge of the trench and joint bays shall be at least 200 mm from the road kerbing.

Where necessary (i.e. where the excavation is in unstable material), trenches shall be shored with close timber to full depth with a projection of 200 mm above ground level. The shoring shall be suitable for the trench dimensions and the ground conditions and shall only be removed once the cable-surrounding blanket soil has been installed.

A professional civil/structural engineer shall design the shoring for excavations that exceed 1,5 m in depth. The design shall take into account the specific ground conditions and details of the trench supports shall be provided.

The Project Engineer shall approve any variations from the depth specified in the detail drawings.

Where the presence of existing services makes it necessary to increase the depth of the trench, the trench shall be returned to nominal depth as soon as is practical. Where the presence of a number of services makes it necessary for deep trenching for a prolonged distance, measures shall be taken to ensure the required cable rating is maintained by back filling with soil having low thermal resistivity (that has been tested in accordance with SANS 10198-5) or by increasing the spacing between circuits.

For road or rail crossings, the depth of cable shall be increased in accordance with detail drawings.
Where the cable route is located parallel to and under the road surface, the depth of the cable shall be increased in accordance with detail drawings. The cable shall be de-rated accordingly. Unless otherwise

specified by the project engineer, concrete slabs shall be installed above the cable in accordance with detail drawings.

Where a change in trench level is necessary, the bottom of the trench shall rise or fall gradually and smoothly. Trenches shall be kept as straight as possible and the radius of bends shall be tight, however never less than the minimum bending radius of the cable given in below table

4.5 Bedding and Blanket

All cables shall be laid in a bedding of soft sand (river sand) or sifted soil, 150mm below and 150mm above the
cable.

4.6 Laying

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 short 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 the drawing in of the cables.

4.7 Backfilling

Backfilling after bedding 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.

4.8 Protection of cables

a) Danger tape to specification shall be placed 300mm below final ground surface level all MV and main feeder cables along the entire length of the trench. Where so directed by the Engineer, a concrete layer shall be placed over the bedding layer in order to give the cable additional protection.
b) At road crossings, cable sleeves shall be installed at a minimum depth of 1000mm, and as instructed by the Engineer.
c) The danger tape shall be 150mm wide yellow plastic with skull and crossbones printed onto the tape at intervals.
d) The tape shall comply with SANS 1091.

4.9 Road Crossings

Cable sleeves for road crossings shall not be installed less than 1000mm below the final street level. Unless otherwise specified two additional sleeves all of the same size shall be installed for future use at each road crossing. Galvanized steel draw wire, 2.0mm in diameter shall be installed in all sleeves and shall protrude 1500mm on each side of the sleeve. On completion of the installation of sleeves all ends shall be sealed to prevent the ingress of dirt and moisture, after installation of the cables the sleeves shall be resealed. After installation of the sleeves the trench shall be backfilled and tamped down in layers of 50mm to achieve a density of 95% modified AASHTO. Sleeve end positions shall be marked with an approved cable marker, a letter “E” shall be cut on either side of the road on the kerbstones where these are in existence.

4.10 Opening up of existing cables

Where it is necessary to expose existing buried cables for any purpose, or when excavating in the vicinity of existing buried cables, pipes, etc., every care is to be exercised and only labourers experienced in such work, and duly warned by the Contractor, shall be employed thereon. The Contractor shall be responsible for making good any damage caused by his work.

4.11 Sleeves/cable ducts

a) HDPE flexible ribbed Nextube type sleeve pipes shall be used as sleeves/cable ducts, for example under roads.
b) The pipe shall be supplied in 6m lengths or rolls.
c) each end of each pipe and bend shall have a female coupling so that pipes can be easily joined.
d) One spare sleeve per cable duct is to be installed and plugged with PVC sheeting.

4.12 Capacity of cable conduits (sleeves)

Where cables are to be drawn into sleeve pipes separate cable conduit runs are to be provided for each main distribution cable. The maximum number of cable to be accommodated in a single cable conduit shall be 3 plus the trench earth i.e. 3 service cables or main cable plus street lighting and/or service cable.

4.13 Kick pipes

a) 110mm dia galvanised steel pipes shall be used as kick pipes for distribution cables on poles. Suitable diameter pipes shall be supplied in 4m lengths.
b) 20mm x 0.72mm stainless steel bandit strapping shall be used for fixing of kick pipes against poles.
c) Galvanized steel saddles shall be used for fixing of cables against poles.

4.14 Trench earth wires

Bare copper earth wire is to be run with all underground cables constituting part of a low voltage distribution system. The BCEW shall have a cross-sectional area equal to at least half that of one phase conductor of the cable, but shall not be less than 16mm².

The earth continuity conductor is to be bonded to the cable armouring at each termination of the cable, as well as to local earth bars.

4.15 Sealing of ends

Where cables are cut and not immediately made off, the ends are to be sealed without delay.

4.16 Cable markers

Cable route markers of approved manufacture shall be provided at each end of an underground cable route and at all points where such routes deviate from a straight line. Joints in the cable shall be marked and the maximum distance between route markers shall not exceed 100m.

The cable markers shall be tapered blocks cast from concrete in accordance with approved detail drawings Each cable marker shall be buried with its upper face 100mm above the natural ground level. Marking of cable markers shall also be in accordance with approved detail drawings.

5. INSTALLATION OF EARTHING SYSTEMS FOR UNDERGROUND CABLES.

Refer to SANS 10198-7 for earthing requirements regarding the following cable components:

- Metal Sheaths – Multi Core Cables
- Metal Sheaths – Single Core Cables
- Metal Screens
- Armour
- Cross Bonding

Refer to SANS 10198-7 for requirements regarding Protective Multiple Earthing Cables as well as Combined / Neutral Cables.

6. CABLE SCHEDULES.

The contractor shall refer to this specification in conjunction with the cable schedules as indicated on the drawings attached.

ELSPEC-02-LVDBMCC: LOW-VOLTAGE DISTRIBUTION BOARDS AND MOTOR CONTROL CENTRES

1. INTRODUCTION

This specification relates to the supply, installation, testing of Low voltage distribution boards and motor control centers.

2. SUPPORTING CLAUSES

2.1 Scope

This standard covers the general requirements for distribution boards and motor control centres.

A Distribution board and MCC system would typically consist of all or part of the following:

a) Wall/Surface mounted DB/MCC
b) Floor mounted DB/MCC
c) Switchgear
d) Busbars
e) Terminals
f) Control and PLC circuits

This specification is not limited to above.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

SANS 152	Low-voltage air-break switches, air-break disconnectors, air-break switch disconnectors, and fuse-combination units
SANS 156	Moulded case circuit-breakers
SANS 172	Low Voltage Fuses
SANS 1019	Standard voltages, currents and insulation levels for electricity supply
SANS 1091	National colour standards for paint
SANS 1973	Low-voltage switchgear and control gear assemblies
SANS 9000	Quality management systems
SANS 10108	The classification of hazardous locations and the selection of apparatus for use in such locations
SANS 10142	Standard Regulations for Wiring of Premises.

SANS 60044	Instrument Transformers
SANS 60146	Semiconductor converters: General requirements & line commutated converters
SANS 60186	Voltage Transformers
SANS 60204	Safety of machinery. Electrical equipment of machines.
SANS 60269	Low-voltage fuses.
SANS 60439	Low-voltage switchgear and controlgear assemblies
SANS 60529	Degrees of protection provided by enclosures (IP Code)
SANS 60730-2-15 & -2-18	Automatic electrical controls for household and similar use
SANS 60742	Isolating transformers and safety isolating transformers
SANS 60947	Low-voltage switchgear and controlgear
SANS 61000	Electromagnetic compatibility (EMC)
SANS 61643-1	Low-voltage surge protective devices Part 1: Surge protective devices connected to low-voltage power distribution systems
SANS 61800	Adjustable speed electronic power drive systems
SANS 61131	Programmable Controllers.
IEC 157-1	Low voltage switchgear and control gear: Circuit breakers.
IEC 416	General principles for the creation of graphical symbols
BS 88	Cartridge fuses for voltages up to and including 1000 V AC and 1500 V DC
BS 142	Electrical protective relays
BS 159	Busbars and busbar connections
BS 1433	Copper for electrical purposes. Rod and bar.
BS 2950	Cartridge fuse links for telecommunication and light electrical apparatus.
BS 3938	Current transformers
BS 4794	Control switches (Switching devices, including contactor relays, for control & auxiliary circuits, for voltages up to & including 1000 V AC &

	1200 V DC)
BS 5378	Safety signs and colours.
BS 5472	Low voltage switchgear and control gear for industrial use. Terminal marking and distinctive number. General rules.
BS 5486	Low voltage switchgear and Controlgear assemblies
BS 6231	Specification for PVC insulated cables for switchgear & control gear wiring.
BS 7671	Requirements for electrical installations. IEE Wiring Regulations.
BS EN 418	Safety of machinery. Emergency stop equipment, functional aspects. Principals for design.
BS EN 954	Safety of machinery. Safety related parts of control systems.
BS EN 50082-1	Electromagnetic compatibility. Generic immunity standard; residential, commercial and light industry.
BS EN 60051	Direct acting indicating analogue electrical measuring instruments and their accessories. Definitions and general requirements common to all parts
BS EN 60073	Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators.
BS EN 60831	Shunt power capacitors of the self-healing type for AC systems having a rated voltage up to and including 1kV. General. Performance, testing and rating. Safety requirements. Guide for installation and operation.
SANS 61439-6	Busways/busbar trunking
SANS 61084-1	Cable trunking and ducting for electrical installations
SANS VC 8031	Coatings applied by the powder-coating process.
SANS 783	Baked enamels.
SANS 10142	The wiring of Premises

3. DISTRIBUTION BOARDS AND MOTOR CONTROL CENTRES REQUIREMENTS.

3.1 DB/MCC Enclosures and Construction

3.1.1 General

Assemblies shall be designed and constructed to facilitate inspection, cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance. The arrangement of all circuit

components / functional units shall be to the approval of the Engineer.

3.1.2 Enclosures

All conductors and terminals shall be enclosed within the enclosure. An earth stud shall be provided for each section/compartment of the panel.

All boards, panels and cubicles shall be vermin and dust proof and the minimum degree of IP54 protection shall be implemented.

Where heat is generated within the panel, it shall where possible be designed to dissipate naturally from the enclosure surface. Where this is not possible, ventilation openings shall be provided that maintains the highest practicable IP rating of the enclosure, subject to a minimum of IP42.

Where cooling air is drawn into the enclosure, dust filters shall be provided where practicable. Particular attention shall be given to the ventilation of outdoor mounted boards, to eliminate build-up of excessive heat inside the boards caused by the sun or internal heat generation.

The Assembly and its constituent equipment and components shall be designed, manufactured, and installed so as to provide a minimum operating life of 20 years, under full load conditions.

Any internal partitions necessary to provide inter-compartmental segregation within the enclosure shall be of the same material as the sides of the enclosure

All the surfaces of the enclosure, and of its constituent equipment and components shall be suitably protected against the effects of any likely atmospheric corrosion present at the operating location.

Purpose-made gland plates shall be protected against corrosion by electro-plating, and shall not be painted.

3.1.3 Materials Construction

It shall be constructed from steel with a structural frame permanently clad with side plates, so as to provide a structure that is rigid with all doors and covers removed, and such that it will not deform during erection. The enclosure doors and covers shall themselves be suitably braced so as to be rigid and not deform or flex when fully equipped and handled.

Each compartment formed within the enclosure shall be provided with dedicated mounting plates, which when removed do not expose any other compartment or live parts.

Cabling shall only be terminated on or in the enclosure at gland plates provided for that purpose

The minimum metal thickness of the enclosure's constituent parts shall be as follows:

- structural frame: 2.0mm
- side plates and compartment sides: 1.6mm
- doors and covers: 1.6mm
- gland plates and component mounting plates: 1.6mm

Assemblies higher than 1500mm shall be floor mounted, and shall be fixed to a separate removable rigid channel plinth at least 100mm high.

The maximum height of any Assembly (including its plinth) shall be 2200mm above finished floor level.

Compartment single doors shall have vertical hinges mounted on their left hand side, and all doors shall have an angle of opening that is limited to 95 degrees by a robust door stay.

Where specifically agreed with the Engineer, a compartment single door on a front access only.

Assembly may be hinged on the right hand side if this will reduce the number of dropper / cable way chambers required.

Wide compartments with dual doors shall open in wardrobe style, such that the second door is interlocked with the first.

Doors and any covers shall be fixed to the enclosure using captive bolt type fasteners, and each hinged door shall be capable of being removed, following disconnection of the electrical and earthing connections. Compartment doors shall be provided with securing catches; at least one

The Assembly shall be constructed assuming that front and rear access is available. Where detailed otherwise in the drawings, the enclosure shall be designed for front access only; i.e. it shall be possible to gain access to every component, item of equipment, busbar and cable from the front (or for busbars; the top) of the enclosure

Any apertures between compartments (including busbar compartments) through which the copper-work or cabling passes, shall be effectively closed off to minimise the possibility of any fault products propagating between compartments.

Fixings for components, component mounting plates, etc. shall not penetrate another compartment containing live parts. Where self-tapping screws are used for component fixing they shall be of the thread forming or thread rolling type. Components, wiring, labelling, etc., shall only be located within compartments on a removable mounting plate, and in such a manner that facilitates easy inspection, maintenance, or removal and replacement, and without necessitating the removal or dismantling of any other components or wiring, or the use of special tools.

Unless detailed otherwise in the drawings, the Assembly shall be constructed so as to facilitate future extension by the addition of extra full height sections at either end. To accommodate this, any covers, fixings, etc. shall be flush with the end faces of the enclosure, and the end sections of busbars and earth bars shall be prepared for future extension.

The Assembly shall be constructed so as to permit it being split into sections of less than approximately 1750mm long and 1250kg in weight, in order to facilitate transportation and subsequent site erection. Each transportable section shall be labelled as to its shipping weight, shall be equipped with lifting eyes, which shall be removed on completion of the site erection.

All Assemblies, including motor control centres, shall in addition to the specified items, make provision for at least 30% spare unequipped spaces complete with busbars, partitioning into compartments etc for future extensions.

3.1.4 Power Distribution

The power distribution and circuit protective arrangements within an Assembly shall be designed so as to co-ordinate with the characteristics of the electrical system(s) connected to the incoming terminals of the Assembly, including emergency or temporary supplies; and specifically noting the following:

a) maximum prospective RMS short circuit current from all simultaneously available sources of supply, together with any fault contribution from large motors directly connected to the Assembly.
b) type of system earthing (i.e. TN-S, TT, etc.), the maximum available earth fault current, and the maximum earth fault loop impedance.
c) up-stream protective device ratings and settings.

Where this information is not stated in the Data Sheets, it shall be obtained from the Engineer before the design of the Assembly is progressed.

The design and construction of the Assembly and its busbar systems shall be directly based on that of a Type Tested Assembly, where the maximum prospective RMS short circuit current from all simultaneously

available sources of supply, together with any fault contribution from large directly connected motors, exceeds 16kA.

Where such a Type Tested Assembly is provided, it shall be used with the same incoming protection devices, arrangements of copper work, and functional unit combinations to which the Type Tests applied, and copies of the Type Testing documentation shall be provided.

Where the maximum prospective RMS short circuit current is 16kA or less, the design and construction of the Assembly and its busbar systems shall be based upon that of a Partially Type Tested Assembly. Documentation shall be provided to indicate which parts of the Assembly are of a Type Tested design, and which parts have been extrapolated or calculated from such a design.

The Contractor shall provide documentary evidence that the design of the Assemblies offered has been fully type-tested and complies in all respects with the requirements of SANS 10973.

3.1.5 Isolation

The Assembly shall be provided with separate incoming isolation for every electrical power system (including emergency or temporary supplies) connected to it.

The connection from the Assembly power distribution system into every compartment shall be terminated on a short circuit protection device, which may also incorporate a compartment isolating device

Every compartment shall be provided with a door interlocked isolation device, which shall isolate all sources of supply above 50V that enter the compartment.

Where a functional unit; e.g. a motor starter, etc., comprises a group of interlocked compartments, the isolation device shall be located in the compartment receiving the supply.

Every compartment containing a distribution board or low voltage transformer shall be provided with an isolation device, which may be located in an adjacent compartment. For some compartments housing power monitoring equipment or instrumentation and process control equipment, it may be appropriate to provide a means of isolation within the compartment.

Unless separate fuses are used as the short circuit protection device, the isolation device and short circuit protection device shall be combined.

Isolating devices shall be suitable for on-load switching and for interrupting overload and starting currents. They shall be capable of being padlocked in the isolated / ‘off’ position at the compartment door, and at the isolating mechanism with the compartment door open. Any isolator mechanism extension shafts shall be provided with guide brackets as necessary to prevent excessive shaft deflection.

The compartment door shall be mechanically interlocked such that it shall not be possible to open the door when the isolating device is in the ‘on’ / ‘closed’ position or when the operating handle is padlocked in the ‘off’ / ‘open’ position. Where the means of isolation is only accessible from within the compartment, it shall be totally enclosed in an enclosure protected to IP4X.

The following types of devices may be used:

a) Air circuit breaker (ACB) or moulded case circuit breaker (MCCB) or miniature circuit breaker (MCB)
b) Switch disconnector
c) Changeover and rotary switch disconnectors

All field circuits connected to a functional unit (e.g. valve actuators, limit switches, etc.) shall be capable of isolation either by or within that functional unit.

Where safety interlock keys are provided; e.g. to control device operation or to restrict access, they shall only

be released in the safe condition, and shall be unique across that Assembly and any other Assembly supplied to the same site.

3.2 Electrical Equipment

3.2.1 Circuit Breakers

DB and MCC equipment shall be of the type specified on the drawings and shall be of the CBI type

This shall have a rated fault making and breaking capacity not less than that of the maximum prospective fault level anticipated at the point of connection in the power system.

An ACB or MCCB or MCB'S shall include either in-built or external protection equipment, that will discriminate with both up-stream and down-stream protective devices; as appropriate to the application.

ACBs for incomer and feeder applications shall be fitted with adjustable electronic protection. MCCBs for incomer and feeder applications shall be fitted with thermal-magnetic, adjustable thermal-magnetic or adjustable electronic protection.

An ACB shall incorporate padlockable cover(s) to permit the securing of the open, close, and trip actuators against inadvertent or unauthorised manual operation.

Where an ACB or MCCB has electrically operated control circuits; e.g. opening, closing, tripping, spring charging, indication, etc., they shall be provided with individual fuse or MCB protection.

Devices fed by a power transformer rated at 500kVA and above, and all ACBs, shall be triple pole, latching and of a withdrawable pattern.

A withdrawable ACB or MCCB shall be provided with clearly indicated carriage position indication, and shall be capable of being secured in each position. Mechanical interlocks shall be provided that only permit movement of the carriage whilst the main circuit contacts are in the 'OFF' position. It shall be possible to test the control circuits of an ACB with it partially or fully withdrawn.

As a withdrawable ACB or MCCB is being withdrawn, padlockable safety shutters shall automatically cover over the supply side and the load side fixed connections. These shutters shall be capable of independently being opened for testing purposes.

One (only) handling truck shall be provided suitable for each type of withdrawable ACB or MCCB supplied as a part of the Assembly, or as a part of any other Assembly supplied to the same site.

Special maintenance tools, where required, shall be provided with each breaker.

Cable connected terminals will generally not be permitted. Adequately sized busbar extensions shall be employed to provide the circuit breaker with means of dissipating heat generated internally as well as at the terminal.

The breakers shall comply with the requirements of SANS 156 and/or IEC 157-1.

3.2.2 Switch Disconnectors

Double break isolation shall be provided for each pole.

The switch shall be suitable for the continuous rated duty of the circuit it controls.

The utilisation category of the switch disconnector shall be AC23 for motor starting duties, and AC22 for power distribution only duties.

Rotary switch disconnectors shall be provided with a 'break-before-make' operation for each pole. The rotary switch, or changeover switch formed by the proprietary interlocked interconnection of two switch disconnectors or fuse switches, shall incorporate a centre 'off' position.
Switch disconnectors for motor starter or variable speed drive duties, that incorporate a test position, shall enable the control circuit supplies while ensuring isolation of the main supply.

3.2.3 Operating Handles

Switch operating mechanisms shall include operators for fuse switches, switch disconnectors, moulded case circuit breakers and motor protection circuit breakers for Assemblies.

Switch operating mechanisms shall be door mounted and the switches shall be fixed mounting. Switch operating mechanisms shall positively engage with the switch shaft when the door is fully closed and shall be so interlocked with the door so that:

a) It shall not be possible to gain access via a cover or door to any live points unless the switch is in the open position.
b) It shall not be possible to re-close the door or cover unless the switch is in the open position. Operation of the switch with the door open is permissible.

Clear indication shall be given, both with the access cover or door open or closed, as to whether the switch is in the open or closed position. Colour indication alone will not be acceptable. Operating handles shall be pad lockable in the "off" / "open" position. The mechanisms shall accept not less than two padlocks each having a shackle diameter of 6 mm. Any isolator mechanism extension shafts shall be provided with guide brackets as necessary to prevent excessive shaft deflection.

3.2.4 Contactors, Relays and Timers

Contactors and relays shall be selected so as to be suitable for the foreseeable operating duty (utilisation category) and operational frequency. They shall operate reliably under reduced voltage conditions by closing (i.e. pulling in and holding) at 85%, and remaining closed at 60%, of the rated coil voltage, and shall be suitable for continuous operation at 110% of the rated coil voltage.

Contactors shall comply with SANS 60947-4-1, and shall be electro-magnetically operated airbreak multi-pole block type construction. They shall readily accept a wide variety and configuration of auxiliary contact blocks, which shall have their terminals protected to IP2X.

Relays and timers shall be totally enclosed plug-in devices. The bases shall be keyed in order to differentiate between differing relays and timers, and their differing coil / electronics operating voltages, and to prevent incorrect insertion. Bases shall be fitted with retaining clips, and each relay / timer shall have its pin configuration printed on the side of its casing.

Relay / timer bases shall have screw clamp type terminals protected to IP2X, which shall be accessible with a screwdriver whilst the relay / timer is plugged in.
Relays shall be provided with a transparent enclosure, visual indication that the relay is in the energised and closed state, and a manual test button.

Timers shall operate electronically or be synchronously driven, and shall be provided with linearly calibrated time interval scales. The smallest indicated time interval shall be 10% (or less) of full scale, with a repeatability of 1% (or better) of full scale. Timers shall be provided with 'energised' and 'timed out' indicators.

Where timers require to be viewed by operators, they shall be flush front of panel mounted behind a transparent lockable cover.

Contactors shall satisfactorily withstand the thermal and dynamic effects arising from the magnitude and duration of through fault currents dictated by the characteristics of the associated protective devices and shall

be selected in accordance with the kW/current rating.

Contactors shall be triple-pole electromechanically operated air-break type, held in or latched pattern as specified.
Contactors shall be classified as utilisation category AC3 uninterrupted duty for motor starting and as utilisation category AC1 intermittent duty, Class 1, 60% for heater duty.

Contactors shall be fitted with the required auxiliary contacts as indicated on the drawings. These shall be rated at not less than 6 A and shall be positively driven in both directions.

Auxiliary relays for control purposes shall be of the multiple pole type and shall preferably possess the feature of field convertible contact configuration.

Plug-in type relays shall have:

a) Positive-acting mechanical retaining clips. Contact friction alone as a retaining method is unacceptable.
b) A keyed member on plug and socket sides to prevent incorrect insertion.
c) Clear and indelible markings on both the relay and its base indicating the circuit reference in conformity with the associated circuit and connection diagrams.

Auxiliary time delay relays shall be of electronic or synchronous motor-driven type and the time setting shall be infinitely adjustable over the range of 5 - 100 % of the maximum delay. Timing relays deriving the delay function by thermal or pneumatic means will not be acceptable.

Auxiliary relays shall have a minimum of 4 individual contacts and shall preferably have the facility to add an extension block with an additional four (4) individual contacts.

3.2.5 Control Switches and Pushbuttons

Control selector switches shall be of a rotary spring-loaded type, with an AC11 rating, and shall have clearly identified switch positions. Where switches are lockable, the key shall be held captive in the abnormal or over-ride position.

Pushbuttons shall comply with SANS 60947-5-1 and shall be of a 22mm diameter, flush bezel type.

Emergency stop pushbuttons shall be of a mushroom headed push to stop, stay-put and twist to-release type. Key type release buttons shall not be used.

Pushbuttons shall be coloured as per drawings.

Pushbuttons shall be of the one-hole fixing, oil tight pattern.

Operators (and the mating holes) shall be keyed to prevent rotation of the assembly in the panel.

Contacts shall be adequately rated for the circuit duty but shall not be less than 10 A, 230 V AC or 120 V DC rating.

In addition, the operator shall carry an internationally acceptable symbol indicating its function or shall have mounted immediately above it a clear legend of its function or action.

Operators initiating a motion or circuit closure shall be flush with the surrounding bezel, while operators stopping a function or opening a circuit shall project beyond the bezel.

Operators providing a selective function e.g. local/remote or auto/manual, shall operate in a semi-rotational manner with equal angular displacement about an imaginary vertical centre line.

3.2.6 Indicating Lamps

Indicating lamps shall be suitable for use on either 230 V AC or 24 V DC control supplies, and shall be based on the use of light emitting diodes (LEDs). Lamps suitable for use on 230 V AC shall incorporate a step-down transformer. Indicating lamps shall be continuously rated for a voltage of 10 % in excess of the rated voltage.

Lamps shall comprise 22mm diameter units incorporating either a multi-cluster array of 7No. LEDs or a single high intensity surge protected LED; replaceable from the front of panel without any special tools.

Indicating lamps shall render good visibility under conditions of an ambient illumination level of 400 Lux.

Lamps shall be provided with one of two indicator lamp colour coding schemes as follows:

a) a primary colour coding scheme, in compliance with BS EN 60073, or
b) a secondary colour coding scheme; which although not standard, is required in order to harmonise with existing operational equipment.

Indication lights colour shall be as per drawings.

3.2.7 Power Measuring Instruments and Current Transformers

The drawings shall identify which functional units shall be provided with power measuring instruments, the type, and the facilities required.

Display instruments used to indicate voltages and currents shall normally be analogue instruments, shall comply with BS EN 60051, be of the low-impedance type and have an accuracy class of 1.5. They shall be flush front of panel mounted with a 90° quadrant minimum scale length, and be DIN96 size for power distribution functional units, and DIN96 or 72 sized for motor starter functional units.

External zero adjustment shall be possible on all indicating instruments to facilitate adjustment without dismantling the instrument.

Instruments shall be scaled to 120% of the anticipated designed indication. Ammeters shall be provided with compressed scales to accommodate motor starting or other in-rush currents, and ammeters monitoring motor currents shall be provided with an adjustable red pointer to indicate full load current.

Meters and relays shall be capable of withstanding, without damage, the secondary currents associated with the maximum available through fault current.

Instruments shall be provided with shrouded connections to their rear, and ammeter circuits with a full-scale deflection in excess of 25A shall be connected via current transformers (CTs). Apart from CT and ammeter circuits, instrument circuits shall be fused.

Instruments used in power distribution circuits shall be flush front of panel mounted and shall provide selectable front of panel digital display of the following quantities:

- voltage between phases and between phases and neutral
- current in each phase
- power (kW)
- kVA
- power factor
- consumption (kWh)

They shall provide data output signals for presentation to PLC, SCADA, telemetry, etc.

Where the Data Sheets indicate that instruments shall provide software connectivity with a control system, this shall be via an open field device network compatible with the proposed PLC system. An interface device

integrated within the instrument shall be used so as to provide remote network access to the full range of the unit's measurement facilities.

Hours run meters shall be of a 5-digit minimum non-re-settable odometer type, with visual indication of operation, and a minimum resolution of one hour.

Current transformers (CTs) shall be air insulated, shall comply with BS 3938, and shall have short circuit ratings in excess of those prevailing at the point of connection. They shall bear individual rating plates, which shall clearly identify the winding polarities (primary or secondary), together with the connection details of any multi-ratio windings.

Current transformer accuracy classes shall be selected as follows:

Type of circuit	Class	Comments
Indication	3 or 5	To match the % accuracy of the instrument.
Measurement	0.5 or 1	To match the % accuracy of the instrument.
Motor protection	10P10	Or as required by protection device manufacturer.
Power system protection (e.g. IDMTL)	10P20	Or as required by protection device manufacturer.
Power system protection (high accuracy; e.g. REF, generation, unit protection)	X	As specified by protection device manufacturer.

One pole of the secondary winding of each CT (or group of CTs) shall be connected to earth via a link. All connections to the CT secondary winding shall be made via a proprietary shorting terminal test block. Provision shall be made for attaching test links.

Current transformers shall be of the low-impedance type and shall, where ratio, class and output requirements permit, preferably be of the ring-type bar-primary design.

Current transformers shall be rated to withstand the thermal and magnetic stress resulting from the maximum available through fault current.

Bridging terminals for current transformers shall be provided at the outgoing terminals where external connections are required. In addition, terminal blocks shall be provided to permit secondary injection tests on protective relays.

3.2.8 Control-Circuit and Auxiliary Supply Transformers

Voltage transformers shall be designed, constructed and tested in accordance with the requirements of SANS 60044 and SANS 60186.

Voltage adjustment over the range 95 - 105% of nominal ratio shall be provided by off-circuit tappings.

Transformers shall be provided with isolating switches on the HV side and with protection on Voltage transformer primary and secondary windings shall be protected by fuses. The protection on the HV. side shall be rated sufficient to withstand inrush currents.

Control transformers shall be rated as follows:

(a) (Sum of sealed-in burden of all contactors, relays, timers and lamps fed from that unit); plus
(b) (Pickup burden of largest Contactor fed from that unit); plus 10%.

The regulation on closing the largest circuit with all the loads except that of the largest load, or if there is more than one, one of the largest loads, imposed on the transformer, shall not exceed 5%.

One side of the transformer secondary winding, or the star point thereof, shall be connected to earth via a removable bolted link.

Voltage transformer nameplates shall be fixed in a position so that details can easily be read when fitted in the cubicle.

3.2.9 Motor Starters

The number, size, and type of motor starting functional units required shall be as detailed in the Drawings, and all equipment, components, and wiring shall be included to achieve the specified functionality. The following methods of motor starting shall be considered, with the requirements for special or retrofit methods of starting (e.g. rotor resistance, induction regulator, etc.) being as detailed on the drawings:

(a) direct on line (DOL)
(b) reversing
(c) star-delta
(d) soft starters and variable speed drives using power electronics

The type of starter shall be selected by taking into consideration the expected load pattern to ensure no over-heating caused by slow starting.

Every stand-alone motor starter shall be considered as a functional unit, notwithstanding that its constituent components may occupy several compartments within the enclosure. Where an item of plant comprises several motor drives and a composite starter unit is required, the functional unit may incorporate the combined circuitry for a number of motor starters.

Each motor starter or composite unit shall be provided with isolation and short circuit protection. All circuits energised at above extra low voltage entering or leaving the functional unit shall be capable of being isolated from all poles of their supply. Where, due to its size, several compartment doors are used to enclose the functional unit, mechanical interlocks (or time delayed electrical interlocks) with the isolation device shall be provided.

Every motor controlled by a starter or composite unit shall as a minimum be provided with an individual line contactor and an overload, controlling each pole of the circuit. The short circuit protective device, the line contactor, and the overload shall be selected so as to provide Type 2 Co-ordination in accordance with SANS 60439-4-1. The minimum starter utilisation capacity shall be AC3.

Contactors used where simultaneous closure would be dangerous; e.g. in reversing, star-delta, or closed transition, etc. applications, shall be provided with both mechanical and electrical interlocks.

Where components with short time ratings are used; e.g. resistors, transformers, etc., they shall be provided with hardwired temperature monitoring circuits, arranged to trip the line contactor if their thermal limits are reached.

Withdrawable starters shall be provided with suitable interlocks to prevent chassis withdrawal or insertion when the starter isolator is in the “on” position.

3.2.9.1 Starter Requirements

Every individual motor starter shall include all equipment, components and wiring necessary to safely and reliably operate the driven plant item. This shall be capable of being manually operated from the front panel of its functional unit, notwithstanding any failure or de-selection of any automatic control system, networking / communication facility, PLC, SCADA, or telemetry system. In order to achieve this, the appropriate push buttons / keypads and indicators shall be provided front of panel.

If the power supply fails whilst a motor is running, the line contactor shall open. On restoration of the power supply, the motor starter shall immediately be made available to re-start the motor without manual attendance or intervention; on receipt of a start command (be it initiated manually or automatically). However, where a hardwired automatic control facility is available, a power-on delay timer (adjustable between zero and 60s) shall be provided in the hardwired circuit.

Where an automatic control facility is required and software connectivity between the functional unit and the automation equipment is not applicable, the motor starter shall contain a 24V DC 'auto run' relay in its 'auto' control circuit, which shall provide the interface with any hardwired automatic / PLC control scheme.

Where a 'healthy' signal is required, it shall confirm that the functional unit isolation device is closed, the starter control supply is healthy, no-fault condition exists, emergency stop(s) are released, the local isolator (where fitted) is closed. The 'healthy' signal shall be used to provide the drive available input signal to any automatic control schemes; including automatic duty selection routines.

Each functional unit shall provide any automatic control schemes (including auto duty selection routines) with a 'drive running' signal, which shall only be arranged to indicate once the starting sequence has been completed (e.g. on achieving 'delta', 'top of ramp', etc.). In addition, a composite 'drive tripped' signal shall be provided, which shall be initiated by the operation of any one of the protective features provided.

Each motor starter shall be provided with an emergency stop circuit, which together with its components shall comply with BS EN 418. A field 'twist to reset' emergency stop button shall be provided. On operation of the emergency stop circuit, the motor line contactor shall immediately open, and the emergency stop circuit shall lock out until it is reset via the front of panel fault reset push button. A front of panel 'emergency stop operated' indication lamp shall be provided. A composite starter may have a common emergency stop circuit controlling all of its constituent drives.

Where identified on the drawings, specific process or driven plant interlocks shall be hardwired into the motor starter, and when operated, shall stop and inhibit the drive.

Front of panel pushbuttons shall be provided for manual start (forward, and where applicable; reverse), and manual stop. A front of panel control selector switch shall be provided for 'Manual / Off / Auto' or 'Remote / Manual / Off / Auto' as appropriate.

Front of panel indicator lamps shall be provided for 'running' and 'common fault', and an ammeter shall be provided for motor circuits of greater than 5.5kW; other front of panel indications; e.g. other individual trips lamps (in lieu of the 'common fault' lamp), hours run meter, number of starts counter, etc. shall be as stated on the drawings.

3.2.9.2 Motor Protection

As a minimum, every motor starter circuit shall be provided with a thermal overload unit connected to monitor the current in each energised winding of the motor.

Thermal overloads shall be scaled and adjustable such that the motor designed full load current is mid-range, and shall provide a temperature compensated thermal element for each supply phase to the motor. The unit shall provide single phasing protection, and incorporate auxiliary tripping contacts with a manual test facility. The unit shall be capable of being manually or automatically reset (set to auto).

Electronic overload units shall incorporate the features required of a thermal overload, together with provision for the adjustment of tripping and reset times. In addition, stalled rotor protection shall be provided, together with integral thermistor protection where required. Where applicable, electronic overloads shall be suitable for use in conjunction with power electronics.

Where the drawings indicates that the motor starter shall provide software connectivity with a control system, this shall be via an open field device network compatible with the proposed PLC system. An interface device

integrated within the electronic / digital overload unit shall be used so as to provide remote network access to the full range of the unit's control and monitoring facilities.

Electronic underload protection shall be provided for all centrifugal pump, fan, or directly driven mixer motor circuits. When detecting underload, the device shall measure the true motor power (and not just the phase angle), shall be configured to detect an unloaded running motor condition, and shall incorporate start delay, motor trip, and manual / auto reset (set to auto) facilities. The unit shall incorporate a digital percentage load display.

Where submersible motor protection circuits are required, they shall indicate and alarm on sensing bearing housing moisture, and shall indicate and trip on operation of the over temperature thermostat.

All protection devices shall operate in a minimised failure to danger mode via electrically maintained relays which de-energise on a fault condition. On sensing a trip condition, the devices and relays shall electrically lock-out the emergency stop circuit, and shall be reset manually using a front of panel common fault reset pushbutton. In addition, they shall automatically reset on control supply switch on and upon power restoration in the event of a power loss.

Electronic and digital overload and underload devices which provide operator interfaces shall have front of panel mounted displays and controls.

3.2.10 Variable Speed Drives and Soft Starters

3.2.10.1 Variable Speed Drives (VSDs): General

The VSD motor starter shall include a frequency converter (i.e. an inverter module), phase shift transformer(s) (where required), and all other components necessary to provide the full speed and torque control of an AC. induction motor over the specified range of performance, at up to 125% of the motor's rated speed and up to 110% of the motor's full load current.

Standard products shall be used wherever possible; and where practicable shall comprise a self-contained invertor module or chassis mounting unit, with an operator interface incorporating a keypad and a display available front of panel. The equipment shall be suitable for normal operation throughout the power supply tolerance ranges of: voltage; +6% / -6%, and frequency; +/- 1%.

The invertor shall be designed and selected to achieve a high-power conversion efficiency, and shall embody modern technology based around established pulse width modulation (PWM) techniques; controlled using sensor-less modelling of the motor's torque requirements. Where controlled rectifier input bridges are employed, suitable power factor correction equipment shall be provided.

Every VSD motor starter shall be provided with incoming supply isolation and short circuit protection immediately adjacent to the equipment. A robust method of interlocking shall be provided between the supplies and the compartment doors giving access to the equipment.

The feed to the VSD input rectifier bridge shall be controlled by a DOL rated line contactor, and facilities shall be provided for the emergency stopping of the controlled motor in the shortest possible time. The emergency stop facility shall not be dependent on any software functions within the VSD, and shall disconnect the VSD from the supply by means of the line contactor. The VSD control panel / operator interface may remain energised after an emergency stop.

The VSD shall incorporate motor overload protection, current limiting, and motor winding thermistor protection. Unless the motor is installed within a hazardous area, thermistor protection need only be provided for a drive rated above 5kW.

Where any semiconductor or special d.c. circuit fuses are used in the VSD power circuit, a spare set shall be provided and fixed within the functional unit.

The VSD control system shall incorporate comprehensive diagnostics to identify the status of all power electronics fault conditions, and shall provide motor protection features appropriate for the motor size.

Where required by the design of the motor starter, connectivity between the VSD functional unit and other equipment or systems within the Assembly shall be via an open field device network compatible with the proposed PLC control system. It shall preferably use an interface device integrated within the VSD, so as to provide remote network access to the full range of the VSD's control and monitoring facilities.

VSDs shall incorporate programmable ramp structures; giving several adjustable ramp up, ramp down, and dwell times, and shall incorporate facilities to change the PWM pulse frequency, skip frequencies, minimum and maximum frequencies, programmable ramp function generator blocking, etc. whilst the frequency converter is in both standby and operating modes. The VSD shall be capable of riding through supply voltage dips, and be able to synchronise to and control a spinning motor.

Where several inverter modules are connected in parallel to achieve the required output rating, installation shall ensure that the resulting drive system is robust, and capable of a controlled shutdown upon the failure of a constituent module.

The Contractor shall interface his activities and products with plant suppliers to ensure that the design and construction of the VSD string (including the phase shift transformer(s), rectifiers, DC link, power modules, controllers, motors, and pump sets, etc.) avoids noise, vibration, torque pulsation, and similar undesirable effects. In order to achieve this, the above identified VSD string electrical components shall be demonstrated as being the products of one manufacturing organisation, or alternatively the Contractor shall demonstrate historical proof of design coordination for a number of drives; representative of the size in question, that have been successfully commissioned in the Water Industry within the last four years.

Basically, products shall be designed and selected to permit maximum interchangeability of such with other variable speed drives and components.

The Assembly shall permit adequate heat rejection from the VSD compartments and the Contractor shall provide estimates of the total heat rejection from the Assembly. The VSD panels will be located in a naturally ventilated Assembly room, i.e. no forced ventilation. If forced ventilation is required, the cost for the forced ventilation of the Assembly shall be included in the Assembly price.

3.2.10.2 Variable Speed Drives (VSDs): Mutual Interference

The design of the VSD shall take account of the harmonic current profile (up to at least the 19th harmonic) of the inverter under all load conditions, and shall consider the resultant power system voltage distortion when the drive is connected to a power supply of a given fault level and background harmonic distribution.

Any input harmonic filtering or line reactors necessary to control the export of harmonic distortion by an individual VSD, any radio frequency filtering needed to control emissions, sine filters, or any reactors necessary to off-set the effects of capacitance due to long motor circuit cabling, shall be included within the VSD functional unit. The additional cost for incorporating any of the above equipment shall be included in the VSD unit price, together with an estimate of the space required to accommodate the additional equipment within the Assembly.

The design of any inductive or capacitive filtering or suppression equipment shall take account of the short circuit impedance of the power supply, any background voltage distortion, any other reactances (e.g. transformers) or capacitors (e.g. power factor correction), or other filters connected to the power system, so as to avoid possible resonance problems. Inductive components shall have generous thermal ratings, and shall be appropriately constructed and mounted so to avoid the transmission of magneto strictive noise.

If harmonic filters are provided to minimise the effects of harmonics on the supply system, the design of the harmonic filter shall take into account background voltage distortion from the other sources that may be present at the time of commissioning and where required, components of adequate rating shall be provided.

The design of the harmonic filter system installation shall also take into account any power factor correction installations connected to the same low voltage power distribution system and the possibility of LC resonance with these and any upstream transformer reactance.

3.2.10.3 Variable Speed Drives (VSDs): Control

The VSD motor starter shall incorporate protection against all harmful under / over voltage and thermal conditions. Ventilation of the VSD equipment shall be sufficient to safeguard component operating temperatures at all times, and shall be designed in co-ordination with any equipment location and ingress protection constraints. The equipment shall be suitable for operation over an ambient temperature range of minus 10 ºC to plus 40 ºC. The Contractor shall provide an estimate of the anticipated heat rejection of the functional unit under worst case operating conditions.

The VSD control panel / operator interface shall be readily visible, accessible to unskilled persons, and be provided with appropriate ingress protection. Control parameter adjustment shall be easily achievable by menu driven option selections, with engineering options protected from unauthorised changes by the use of multi-level password protection. Parameters; once selected, shall be power down retentive, and an opportunity shall exist to return to factory set defaults.

All operator controls and indications shall be available front of panel; either via an operator interface / keypad, or by using discrete push-buttons and lamps, etc

The controller assembly shall incorporate on-board protection, control and monitoring features, which shall include, as a minimum, the following:

- On
- Unit Ready
- Overload
- Failure
- Current limit
- Over voltage
- manual start and stop
- raise and lower speed
- Current operating status
- speed indication

All operator controls and indications shall be available front of panel; either via an operator interface / keypad, or by using discrete push-buttons and lamps, etc.

The VSD shall be such that when set in the ‘manual’ mode, operation from the control panel / operator interface shall be as follows:

- a start command shall cause a normal ramped start up to the pre-set speed
- a stop command shall cause a normal ramped down stop and shutdown of the drive

All diagnostic and fault messages shall be stored, whether reset or not and it shall be possible to recall them from the operator’s panel

Thermistor protection may be integrated with the controller assembly.

All VSD function parameters shall be programmable from a dedicated keypad, or via a standard programming software package installed on a portable personal computer (PC). A serial communications port to RS232 / 485 standard shall be provided for dedicated communication with the VSD, and via which all programmable, control, monitoring and diagnostic functions available locally at the VSD shall be accessible.

A copy of the configuration /standard programming software shall be provided with each VSD.

The frequency converter panels will be located in a naturally ventilated MCC room, ie no forced ventilation. If forced ventilation is required, the cost for the forced ventilation of the MCC room shall be included in the

convertor price and this requirement shall be clearly stipulated in the tender covering letter.

The motors will be installed at outdoor locations and shall be designed to withstand all weather conditions including pressure hosing down of the plant.

The system shall be capable of auto restart with auto synchronisation for flying starts.

3.2.10.4 Soft Starters

Soft starters shall comprise a proprietary item of chassis mounted equipment, designed for installation within an Assembly. They shall be rated to continuously carry the intended motor full load current, and the required number of starts per hour.

The soft starter shall be thermally designed to carry the motor current until the motor protection operates, and where this cannot be guaranteed, high speed semiconductor fuses shall be provided to protect the power electronics. Where such fuses are used, a spare set shall be provided and fixed within the compartment.

Soft starters shall be of a digital energy optimising design and shall incorporate appropriate motor protection, and where pumping circuits are being controlled, soft stop features shall be included. When the soft starter has completed the ramped application of motor voltage, a 'top of ramp' signal shall be generated.

Soft starters shall incorporate a built-in by-pass contactor rated for the full load running current of the motor, such that on receipt of the 'top of ramp' signal, the by-pass contactor shall close and divert the motor current away from the power electronics. When running in the by-passed condition, the motor shall continue to be provided with the full protection and monitoring features afforded by the motor starter. When a controlled stop command is received, the by-pass contactor shall be de-energised, in such a manner that the control of the motor is transferred to the power electronics.

Facilities shall be provided for the emergency stopping of the controlled motor in the shortest possible time. The emergency stop facility shall not be dependent on any software functions within the soft starter or its associated equipment and shall disconnect the soft starter from the supply by means of a full load rated line contactor fitted between the compartment isolation / protective device and the soft starter.

Where required by the design of the motor starter, connectivity between the soft starter functional unit and other equipment or systems within the Assembly shall be via an open field device network compatible with the proposed PLC control system. It shall preferably use an interface device integrated within the soft starter, so as to provide remote network access to the full range of the soft starter's control and monitoring facilities.

3.2.11 Programmable Logic Controllers (PLCs)

3.2.11.1 PLC Hardware

PLCs shall be of a recognised type, approved by the Engineer; from a major international manufacturer, with a comprehensive and established South African based technical and logistical support operation.

The PLC shall interface with other devices and systems as follows:

- control circuit components, equipment, and plant devices:
- conventional digital and analogue hard-wired input / output (I/O) cards
- remotely connected I/O blocks
- an open field device network
- other process controllers (e.g. PLCs, 3 term controllers, dedicated equipment control systems or networks), and operator interfaces (e.g. Human Machine Interfaces (HMIs)):
- SCADA systems, remote terminal units (RTUs), and telemetry systems:

The hardwired I/O and network communication cards, together with the processor and power supply cards, shall all be housed in racks of one or more chassis units. Where chassis units are provided with spare slots

for hardware expansion, these shall be protected by proprietary blanking plates. Any spare communications ports shall likewise be protected with dust covers or plugs.

The processor memory shall be sufficient to operate the as-installed programme with 20% spare capacity, and the installed I/O cards shall be sufficient to operate the as-installed programme plus 10% spare capacity of each I/O type used.

Once the program has been entered into the processor memory, it shall remain resident and unaltered, including under power down conditions, until it is deliberately modified by use of a programming terminal. The processor shall contain a readily replaceable memory backup battery.

The PLC shall be suitable for use with an IBM compatible portable personal computer (PC) as its programming terminal, and the PLC shall be provided with all interfacing hardware and software; ready loaded and configured, to permit full access to the programme (including reprogramming) via the standard serial communications port of a PC.
The processor shall incorporate the following indications as a minimum: running, processor watchdog healthy, and I/O is being forced. The processor watchdog signal shall be configured to alarm out on failure to the associated HMI and to SCADA or telemetry (where such exists).

3.2.11.2 PLC I/O

The I/O cards shall be keyed or otherwise configured to prevent maloperation if placed in the wrong position in a PLC rack, and each I/O card shall be capable of being individually removed or replaced without disturbing the wiring to adjacent cards.

Each I/O card shall be provided with an individually fused power supply feed, and an I/O card malfunction or power supply failure shall be recognised by the PLC hardware or software and alarmed out.

Conventional PLC I/O cards shall be limited to a maximum of 16 No. points per card, and each I/O point shall be provided with an I/O status indicator.

The I/O wiring shall be segregated between input and output cards, and all I/O (including spare I/O) shall be loomed from the PLC card down to knife-edge (‘swinging blade’) disconnect type interface terminals, where it shall interface to the compartment wiring. Where available, proprietary pan-out connector / termination assemblies shall be used to connect between the I/O card terminations / edge connectors and the compartment wiring.

Where it is necessary to maximise plant availability; e.g. with a duty / standby plant configuration, and more than one input card is available, the duty plant inputs shall be assigned to a separate card from the standby plant inputs. The same shall apply to the assignment of outputs to the plant.

3.2.11.3 PLC I/O Circuits

Digital input circuits, whether hard-wired to conventional I/O or connected via remote I/O, shall consist of volt-free contacts from control circuit components, equipment, and plant devices. These circuits shall be energised from the PLC end, and shall be “fail safe” in design, i.e. contacts shall open on alarm, and normal plant status conditions shall provide normally open contacts.

Digital outputs shall provide a changeover relay contact suitably rated for the required switching duty, and shall be provided with suppression devices when switching DC loads.

Analogue input and output cards shall operate using 4-20mA current loop signalling, with a minimum analogue to digital conversion resolution of 12 bits.

Analogue inputs shall be powered from the instrument; where the instrument is mains powered, and from a 24 V DC. power supply at the PLC end; where the instrument is loop powered. Each circuit shall be suitable for a loop impedance not exceeding 250 ohms.

Analogue outputs shall be powered from a 24 V DC supply via the analogue output card, and shall be able to drive into an impedance of up to 750 ohms. Analogue outputs shall provide a direct connection to the load (i.e. the whole primary loop).

Where an output circuit extends beyond the Assembly, it shall be fused, with a maximum of 8 No. outputs per fuse.

3.2.11.4 PLC Software

PLC application software shall be written to meet the requirements of a Control Philosophy and the PLC processor shall be capable of being programmed using simple ladder logic in accordance with SANS 61131-3. The software shall be laid out in a modular manner and structured in program files, such that similar tasks are of a similar structure and size to facilitate ease of maintenance.

The software code shall be built up using the Client's standard suite of low level drivers, or in their absence shall use the manufacturer's recommended standard function blocks.

Each line of code shall be fully documented and annotated, using mnemonics directly related to the associated item of plant. Function blocks shall be provided with descriptors e.g. analogue handling block, PID block, motor start block, etc. All data areas used shall be documented and a full memory map provided.

The PLC application software and operating data shall be held in appropriate memory locations; secured against power failure, and shall be provided with the facility for password protection against unauthorised access.

A sudden interruption of the power supply shall result in the process failing to a safe condition, and the PLC system shall not require manual attendance following a supply failure or restoration. The software control routines shall provide safe power-on and power-off sequences to ensure that the process is in a safe and controlled condition at all times.

Where a PLC forms part of a networked plant control system, it shall have a stand alone operating capability such that in the event of a network failure or disconnection, it shall be able to continue monitoring and controlling its associated plant; using any set-points and parameters available prior to any network failure, including the ability for operators to change duties, monitor alarms, etc. via any associated local operator interface.

All software necessary to programme, operate, or maintain any equipment or component within the Assembly, including any network connectivity software, shall be provided, and shall be licensed in the Client's name.

3.2.11.5 PLC Software Structure

The PLC application software controlling the plant shall be structured so as to provide, as a minimum requirement, the software routines for each key functional area as detailed in the following clauses.

Plant initiation
This key functional area shall contain routines developed to control plant start-up and restart, plant reset, and phased plant starting, after a power supply re-energisation; including a return to the control mode selected prior to powering down. Plant trips, when reset by the operator, shall reinstate normal automatic operation without the need for further operator intervention.

Plant automatic control
This key functional area shall contain all software necessary to provide automatic control of the plant process(es) and shall include alarm generation and exception handling, together with the starting-up and scheduling of any associated standby plant.

Plant shutdown
This key functional area shall contain routines developed to control plant shutdown, including under operational, power failure, and unplanned / emergency conditions.

Operator and remote interface(s)
This key functional area shall contain all software necessary to provide interfaces to the local HMI, and to SCADA or telemetry (where such exists). All digital points to / from the HMI, to / from the SCADA system, or to the telemetry system, shall be held within separate integer files or memory areas, and all analogue points to / from the HMI, to / from the SCADA system, or to the telemetry system, shall be held within separate floating point files or memory areas.

3.2.11.6 PLC Software Control Routines

The development of the PLC application software shall include as a minimum, the routines detailed in the following clauses.

For all plant items, the selection of automatic control via the auto-available input signal shall be recognised by the PLC and displayed at the associated HMI (and where appropriate, at a remote SCADA terminal). When an item of plant is selected for hand control, facilities for the rescheduling of any standby plant shall be provided.

Direct operator control via the PLC of each plant item (where that plant item is selected for automatic control) shall be provided from the associated HMI (and where appropriate, at a remote SCADA terminal). The selection of direct control shall leave the plant item state unchanged until a new control command is issued, at which time the rescheduling of any standby plant item shall take place.

Where duty / standby (or assist) plant is provided, the software control regime shall provide scheduling of these plant items through rotation of the duty / standby (or assist) functions. The duty rotation shall be dependent either upon the hours run for that item of plant selected for duty, or upon the issue of a manual duty rotate command. The required duty hours (between zero and 999) shall be entered by the operator at the associated HMI (or where appropriate, at a remote SCADA terminal). An entered value of zero duty hours shall inhibit the duty function within the associated plant item's duty rotation cycle. For those areas of plant where an apportioned wear pattern is required, an operator warning message shall be issued if the duty cycle hours entered for each item does not provide an uneven wear pattern. Where the operation of plant items is determined by upper and lower process limits, the automatic changeover of duty status shall be delayed until an appropriate point within the operating cycle.

3.2.11.7 PLC Monitoring Software

Monitoring software shall be provided to confirm the running of plant items in response to any start command, and shall use separately configurable time delays for each item of plant. If an item of plant fails to start within its configured time, the item of plant shall be deemed to have failed and an alarm shall be generated. The monitoring software shall also provide the accumulated run hours for all motor driven and proprietary items of plant.

When an item of plant fails, the control system shall automatically reschedule any standby plant item in place of the duty plant, and execute the appropriate shut-down sequence for the failed plant item. The standby plant item shall continue to operate in place of the failed duty plant item, until the plant item failure condition has been reset by the operator. Once the plant item failure condition has been cleared by the operator, the restored duty plant item shall operate and the standby plant item shall return to its standby status.

Monitoring software shall be provided to confirm the position of all valve(s) and penstock(s) in response to any open or close request, and shall use separately configurable time delays for each valve or penstock. If a valve or penstock fails to achieve the requested position, within its configured time, the valve or penstock shall be deemed to have failed and an alarm shall be generated.

Monitoring software shall be provided for the associated HMI (and where appropriate, at a remote SCADA

terminal), to generate operator message prompts where there is a need to manually exercise items of plant which remain in a static operating position or dormant state for extended periods of time. Where applicable, such plant will be identified in the Particular Specification.

The PLC application software shall check all analogue input signals for validity. An analogue input signal shall be converted to a digital value at the I/O card, i.e. the 4 - 20mA signal shall be converted to 0 - 4095 bits. The PLC software shall initially check for a conversion which equates to 3.8mA for under-range and 20.2mA for over-range. If either of these two states are set, the software shall initiate an 'out of range' alarm.

In order to prevent the operator being presented with excessive spurious alarm messages, the PLC application software shall include routines, that on the initiation of a specific event alarm, shall prevent cascade alarms from being raised i.e. a 'mains failure' alarm will mask the 'not available' alarms from individual motor starters, valves, etc.

The PLC application software shall generate totalized quantities for individual items of equipment and instrumentation, whereby a pulsed digital signal shall be received and a set amount added to a totalizer register. The set amount used to increment the totalizer shall be adjustable and stored in a register. The totalizer shall be capable of the range 0 to 999999, and the totalizer shall automatically rolling over to zero when the maximum figure has been reached. The totalizer figures shall be displayed on the associated HMI display (and where appropriate, at a remote SCADA terminal).

3.2.11.8 Human Machine Interfaces (HMIs)

Where detailed in the drawings, an operator interface shall be provided locally to the PLC, suitable for the display of plant status information and to facilitate local operator control of the plant.

The HMI shall be compatible with the PLC, and unless otherwise specified, shall be selected as follows:

(a) A single Assembly containing a PLC shall include a small text-based HMI, which shall provide:

- full operator interaction, with password protection
- plant start and stop under local HMI control
- alarm reporting
- alarm history and acceptance
- (where appropriate) system / process parameters and alarm set-points review and
- adjustment
- access to any help pages

(b) On a site comprising two or more Assemblies containing PLCs, an Assembly containing a PLC shall include a text and graphics-based HMI, which shall provide:

- facilities detailed in (a) above, plus
- site-wide alarm reporting
- site overview mimic screens
- detailed local system mimic screens
- display of process control inhibits

(c) On a large and complex site with multiple Assemblies, an Assembly containing a PLC shall include a text and graphics-based HMI, which shall provide:

- limited operator interaction, with password protection
- local plant start and stop under local HMI control
- sub-system alarm reporting
- sub-system alarm history and acceptance
- local system / process parameters and alarm set-points review
- site overview mimic screens

- detailed local system mimic screens
- display of process control inhibits
- access to any help pages

The selected HMI shall be mounted at an ergonomic viewing height on the front of, or adjacent to, it's associated PLC compartment, and shall be sealed front and rear to IP65.

Where the HMI requires graphical displays, it shall be provided with a fully configured set of mimic screens (pages) representing the process, giving access to all the PLC derived operator control functions, and displaying all the PLC generated alarms. The pages shall represent the data in a logical manner, be grouped accordingly and be as far as possible similar to the mimic screens of the SCADA (if applicable).

The HMI shall display all analogue values in engineering units, using a vertical bar-graph format where appropriate.

The HMI pages shall be formatted to show the current status of the plant, and shall provide the operator with the ability to manually stop and start drives, open and close valves, and operating levels.

3.2.12 Control Circuits

Control circuit supplies shall be 230V AC (single pole and neutral) and 24V DC. They shall be separately derived from double wound transformers, which where practicable shall have 400V primary windings. Double pole primary winding protection shall be provided by fuses or a miniature circuit breaker.

The rating of each control transformer shall exceed the sum of the foreseeable maximum continuous load (which for an electromagnetic device shall be the 'hold-in' VA) plus the in-rush current of the largest or simultaneously operating load device(s) (e.g. the 'pull-in' VA).

Control circuit supplies shall comply with SANS 60204-1, and the neutral terminal of each transformer secondary winding shall be provided with a removable link, and shall be connected to earth. Secondary winding overcurrent protection shall be provided.

One pole of every contactor and auxiliary relay coil, timer, etc. shall be connected directly to the neutral (i.e. earthed) side of the control supply. Each control circuit shall be sectionalised and arranged such that where practicable, discrimination is achieved under fault conditions.

Where possible, common controls and ICA compartment circuits shall operate at 24V DC, and shall interface with the functional unit 230V AC control circuits by means of 24V DC interposing relay(s) located in the functional units.

3.3 Busbars and Wiring

3.3.1 Busbars

The main distribution circuit through the Assembly shall comprise a main and distribution busbar system, comprising of 3 phase and neutral busbar system. The rated current of the busbar system shall match the rating of the main incomer

All main and distribution busbars, risers and droppers shall be air-insulated and shall be fabricated from hard drawn, high-conductivity copper. Aluminium busbars will not be permitted. Busbars shall be tinned for Waste Water Treatment Works (WWTW) applications. If pre-tinned copper work is provided, cut surfaces may remain bare, providing the current path is unaffected.

Main busbars shall be enclosed together within the top of the Assembly. No other conductors shall be run in the busbar compartment. Access to the busbars shall be through covers, requiring the use of a tool for removal. All internal fixings shall be held captive. No components shall be placed in a busbar compartment.

Main and distribution busbars shall be continuous over each section, extending to over the full length of the Assembly with the same current rating and cross-sectional area throughout their length.

Main busbars, distribution busbars and all flexible connections, shall be adequately sized, braced and supported to withstand any electromagnetic forces and thermal effects to which they may be subjected, including the occurrence of fault currents, up to the full fault levels specified.

The vertical power buses shall be copper full height and rated for the section total load. Small openings in the vertical barriers shall permit the plug-on control unit contacts to pass through and engage with the vertical bus bars. Unused plug-on openings in the vertical barriers shall be equipped with plastic snap-in closing plugs.

All busbar connections shall use joints secured against loosening. Joints and Tee-off connections in busbars shall be made by means of high-tensile bolts, nuts and approved locking washers. A minimum of two such bolts shall be used per joint or tee. The joints shall not be taped in order to facilitate visual inspection and checking of bolt tensions. The joint contact areas shall be smooth, very flat and polished or silver plated for dry jointing.

Busbars shall be provided with phase colour markers, red, white, blue (and black in the case of four wire systems). Such colour identification may take the form of coloured bands at intervals along the busbar run of not more than 800 mm. The combined width of the colour bands per phase shall not be less than 300 mm per 800 mm busbar length.

The maximum length of any cable connections from a busbar shall be 1000 mm.

A cabled ‘busbar’ system of the specified radial or closed ring arrangement may be offered as an alternative to a conventional system if

(a) The Assembly has a rated short-time withstand current or rated conditional short-circuit current not exceeding 10 kA; or
(b) The Assembly is protected by current limiting devices having a cut-off current not exceeding 17 kA at their rated breaking capacity.

This will generally mean that the rated current of such an Assembly will be less than or equal to 100 A.

3.3.2 Wiring

All wiring within the Assembly shall run directly between terminals, without any joints or other connections. Wiring shall be carried out using multistrand, single-core PVC-insulated copper conductor, 660/1 000 V grade (minimum), to SANS 1507, sized and derated where required for the currents to be carried. Single-strand conductor shall not be used and no conductor shall be less than 1,5 mm2 cross-sectional areas.

Field wiring connections will be identified by others using the field device tag references. This information will be provided by the Engineer, and the Contractor shall use these field identifiers when identifying the compartment field terminations.

Wiring layout shall permit alterations to individual circuits without requiring shut down of the complete Assembly.

All bus wiring and interconnections between compartments within the Assembly shall be contained within the enclosure, and shall be segregated in wire-ways separate from other compartments. Where such wiring is terminated in a compartment, it shall be segregated from all other wiring in that compartment. All wiring and cabling entering or leaving a compartment or passing through a partition shall do so via a permanently fixed bush.

Wiring between components shall be

(a) carried out in a neat and systematic manner
(b) contained in non-metallic trunking

(c) Run to compartment doors in spiral wrapping.

Any wire containment system shall securely locate the wiring, and provide 25% spare capacity on completion. Cableways shall have furthermore sufficient space to enable the installation and removal of any cable without the need to remove any other cable or component. Cableways shall incorporate adequate facilities to locate and support the cables.

Wiring on compartment doors shall be similarly supported, and shall be provided with support and protection across the door to compartment side wall transition, whilst permitting the door to be fully opened without straining the wiring. Wiring system accessories shall not deteriorate with heat or propagate flame.

Wiring shall be segregated according to need; circuits that enter the compartment without isolation shall be separately segregated and loomed with spiral wrapping and identified. Control circuits shall be wired in twisted pairs or screened cables, and together with data network cabling, shall be physically segregated from power circuits by barriers. If lightning and/or surge protection measures have been used to protect individual circuits, these circuits shall be segregated from the wiring of other unprotected circuits.

Cable-ways or chambers shall not contain any equipment or components.

Where field cables are terminated other than in the base of the enclosure, cable-ways or cable chambers shall be provided to transport the cables through the enclosure to the compartment or cable box at which they are glanded or terminated.

All wires shall be identified at both ends using colour coded alpha-numeric ferrules. Within a compartment, a wire shall have the same identifier at both ends; and this identifier shall not be duplicated within a functional unit.

Where a circuit includes a PLC I/O point, the I/O point identification shall follow through from the PLC card to the first component within a remote compartment.

Components and wiring shall be installed such that the identification of every wire is clearly visible and readily accessible on completion of the Assembly installation at site. Horizontal wiring identifiers shall be read left to right, and vertical wiring identifiers shall be read bottom to top.

All conductors shall be identified in conformity with the approved circuit and connection diagrams. No number shall be used more than once in each panel except where electrically identical. Wires/conductors shall have the same number on either

Wiring shall be terminated using crimped cable ends, lugs or any other approved method that is appropriate for the conductor size and type of termination. All of the strands forming the conductor shall be connected at the point of termination. Soldered connections shall only be used on electronic equipment where it is not practicable to use any other termination method.

Wiring with a cross-section area of less than or equal to 6 mm shall be terminated in terminals mounted on DIN rail. Wiring with a cross-section area of greater than 6 mm shall be terminated in bolted terminals

All wiring entering or leaving a compartment shall do so via terminal rails, with the exception of specialised signal or data circuits, which may be cabled directly to dedicated connections on electronic equipment located at the periphery of the component mounting plate.

The conductor shall be clamped in such a manner that the captive clamping screw does not come into contact with the conductor. Alternatively, screw-less spring clamp tensioning terminals may be used to terminate single conductors of up to 10mm2. Conductors of cross-section above 16mm2 shall be terminated using stud type
terminals; similarly mounted and grouped on DIN rail.

No more than two conductors shall be connected to one side of a terminal. Where it is necessary to connect adjacent terminals together, proprietary shorting bars or combs shall be used.

Spare cores shall be terminated at both ends or tied back, but shall not be cut short.

All terminals shall be protected to IP2X, including stud type terminals; which shall be shrouded to achieve this. Terminals shall be segregated according to function and operating voltage; by grouping or by terminal rail mounted partitions or barriers. All stud type terminals shall be provided with individual segregating barriers.

All circuit terminal rails shall include 10 % spare space.

Terminals shall be grouped together and segregated according to operating voltage and function by terminal rail mounted barriers. Stud type terminals shall be provided with individual segregating barriers.

Terminals shall face the compartment door for ease of connection.

Terminals shall be located and spaced so as to enable the easy disconnection and reconnection of conductors, whilst providing sufficient space for the looming and spreading of cable cores. Where practicable, the layout of terminal rails shall be such that cores from the same field cable are not split between non-adjacent groups of
terminals.

All wiring of external connections shall be brought out to individual terminals on a readily accessible terminal block.

3.4 Earthing and Bonding

Main incoming earth terminal
The Assembly shall incorporate facilities for connecting to the main incoming earth terminal, subject to its location being clearly identified and easily and safely accessible with the Assembly energised. The Assembly earthing system may comprise either, an earth bar extending the full length of the Assembly or, for Assemblies with less than or equal to two (2) functional units and a supply rating of less than 100 A, a stud arrangement.

Earth bars shall:
(a) be manufactured from high conductivity copper
(b) be located in a safe and easily accessible position;
(c) have a minimum number of joints;
(d) have at least one disconnecting link;
(e) have facilities for connection to the main incoming earth terminal (the Supply Company earthing system and / or from a local earth electrode system) at each end of the bar, and
(f) be rated and tested at a minimum of 60 % of the busbar fault withstand capacity
(g) have a cross-sectional area of not be less than 500 mm2, nor less than 50 mm in width.
(h) be securely connected in each panel or cubicle to bare metal

Provision shall be made for the connection for the following connections to the fixed portion of the earth bar:
- electrical installation main cross bonding conductors
- functional earthing conductors external to the Assembly
- equipotential bonding conductors external to the Assembly
- other equipment protective conductors external to the Assembly
- the Assembly main earth bar / circuit, which shall be terminated onto the fixed portion
- an additional 2No. spare terminations

All metallic non-current carrying parts of the Assembly shall be bonded together and connected to the Assembly earth busbar.

Compartment earthing
Each compartment shall include an earth stud connected to the main earth bar or stud by separate connections or by a common vertical earth tape. Earth conductors to each compartment shall be sized to

withstand the fault level, subject to a minimum cross-sectional area of 6 mm².

The following shall be directly connected to the compartment earthing terminal by earthing conductors with a minimum cross sectional of 4 mm² or braided straps of similar rating:

- compartment door
- any removable cover
- component / equipment mounting rails and earth terminals

A compartment may contain subsidiary earth terminals or bars to which the following circuits may be specifically connected:

- 'clean' earths from instrumentation circuits and equipment
- functional earths; e.g. from telecommunications equipment
- surge protection earths; e.g. direct connections from lightning protection units

These earth terminals or bars shall be separately connected directly back to the Assembly main earth bar with 6mm2 minimum cross-section conductor.

Cable gland plates associated with a compartment shall be provided with an earth stud, which shall be connected directly to either the compartment earthing terminal, or to the main earth bar, with a conductor of 6mm2 minimum cross-sectional area.

Doors having components mounted on them shall be bonded to the main structure by means of flexible copper earth connection arranged so that it cannot be trapped as the door is opened or closed. Metal hinges shall not be considered sufficient to ensure electrical continuity.

Where cables carry low level high frequency signals, or are installed where there is a significant risk of high frequency interference; (e.g. in signal circuits connected to equipment containing power electronics), they shall, where necessary, have their screens / braids capacitively connected to earth in a proprietary manner, and proprietary means shall be included to provide 360° earthing for field cable braids / screens.

3.5 Labelling and Signage

3.5.1 General

Safety signs and labels shall be provided wherever necessary in relevant languages so as to unambiguously communicate safety and functional guidance to any person who may operate the Assembly or otherwise come into contact with any part of the electrical system forming a part of the Assembly, and shall be provided for the specific identification of every component contained within the Assembly.

Signs and labels shall be located in such a manner that:

(a) it is obvious as to the nature and location of the hazards or component(s) to which they relate
(b) when mounted on any enclosure cover or plate, there is no possibility of that cover or plate being interchanged with any similar item on that Assembly or on any other Assembly supplied to the same site
(c) they are not fixed to easily removable parts (e.g. trunking covers, etc.), unless their purpose is to warn of the consequences of removing a removable part
(d) they are at all times adjacent to the item to which they refer, and accommodate situations where components could be moved along a DIN mounting rail
(e) they will not be obscured by any equipment, components, or wiring, etc.
(f) they are legible and will remain easily read throughout the life of the Assembly

Signs and labels shall be securely and permanently fixed using an appropriate number of corrosion resistant, mechanical fixings. The fixing of labels, safety signs and notices shall not affect the IP rating of the Assembly.

Short individually fixed labels covering several items only, shall be used in lieu of long multi-legend labels; e.g. above a row of indicator lamps.

Self-adhesive, vinyl safety signs may be used if there is no requirement for special legend and propriety safety signs are available.

Safety signs and labels shall be of such size that the legend thereon is clearly legible from the operating position (or a 3m distance), and the pictograph and its accompanying text shall be chosen so as to provide the appropriate communication in an explicit and unambiguous manner.

Safety signs and labels fixed to the outside of the enclosure shall be manufactured from 1.5mm thick anti reflective polycarbonate with the legend reverse screen printed, or alternatively from 3mm thick bevel-edged clear perspex rear engraved with black characters. Internal labels may be manufactured from a laminated plastic material which shall normally provide a black legend against a white background. Where specifically agreed with the Engineer, internally mounted labels and charts, e.g. for distribution boards, etc., may be of permanently printed plastic, plastic laminated thin card, or thin card protected behind perspex.

3.5.2 Safety Signs

As a minimum, safety signs shall be fitted to removable covers over busbars and live connections, and to doors of compartments containing:

(a) incoming supply cable termination points
(b) internal switching and isolation devices
(c) incoming or internal means of isolation; stating the highest voltage controlled by the means of isolation
(d) functional units incorporating capacitors
(e) more than one supply or multiple control circuits originating elsewhere
(f) equipment located in a ‘safe area’ but associated with certified apparatus located in a hazardous area; a sign shall also be fitted at the safe area cable termination rail.

A safety sign identifying the operating voltage shall be placed in any compartment where there is equipment, components, or wiring, that can be energised at above extra low voltage.

Where there is no suitable standard symbol or pictograph, an application specific sign may be produced using simple and appropriate symbols, pictographs, and text, to indicate the hazard in a simple and straight forward manner that is acceptable to the Engineer.

Multipurpose signs shall be used where there is a need to communicate multiple hazard messages.

Where there is no suitable standard symbol or pictograph, an application specific sign may be produced using simple and appropriate symbols, pictographs, and text, to indicate the hazard in a simple and straight forward manner that is acceptable to the Engineer. Multipurpose signs may be used where there is a need to communicate multiple hazard messages.

Where there is no suitable standard symbol or pictograph, an application specific sign may be produced using recognised symbols, pictographs, and text, to indicate the hazard in a simple and straight forward manner that is acceptable to the Engineer. Multipurpose signs may be used where there is a need to communicate multiple hazard messages.

3.5.3 Labelling

The text of every label, excluding individual internal component identification labels, shall be as agreed with the Engineer.

Every Assembly shall be provided with a name plate detailing the following:

(a) Manufacturer’s name or trademark
(b) Manufacturer’s contact details
(c) Manufacturer’s type designation, serial / identification number
(d) Date of manufacture
(e) Rated operational voltages, frequencies, and number of phases

(f) Continuous busbar rating
(g) Short circuit withstand current and duration
(h) IP rating

An application name shall be prominently displayed on the Assembly, as detailed in the Particular Specification.

Each compartment shall be identified with a designation label which shall include the full plant functional name and the reference as stated on the P&I diagram, together with the nominal rating if applicable. For rear access Assemblies, a duplicate designation label, mounted adjacent to the gland box, shall also be provided at the rear of each compartment.

The material used shall be selected having regard to the size and fixing methods of the label and the label shall not warp in service. Labels mounted on the outside of the Assembly shall rectangle in form and be manufactured of either:

(a) Laminated plastic, engraved so as to produce black letters on a white background
(b) Engraved sandwich board ("Trifoliate", "Darvic" or equal)
(c) Reverse engraved acrylic material ("Perspex") with filled letters and reverse sprayed

For outdoor applications (where specified) labels shall be brass or aluminium (with letters filled in black), lightly sanded with fine grit paper and clear lacquered

Labels for door mounted components and labels used inside the Assembly shall be to the same standard or may alternatively be printed using an approved, propriety system.

Text characters shall be uniform in height, in upper case (except where standard abbreviations of units are used, e.g. kWh, kVA, etc) and of the following minimum dimensions:

- application labels: 8mm
- compartment designation labels: 6mm
- information or warning labels: 6mm
- component identification labels: 3mm

Each section and compartment of the enclosure shall be provided with an alpha-numeric reference, which shall be cross referenced to the general arrangement drawings. The alpha reference shall identify the switchboard section (tier, column), and the numeric reference shall identify the position of the compartment within the section (i.e. top to bottom, left to right).

All components shall be clearly labelled. Internal components shall be clearly identified by individual labels to indicate the equipment to which they relate. The component identification labels shall correlate with the Assembly drawings and documentation. If this is not practical due to space restrictions, common labels (e.g. diagrams may be used.

Current transformers shall be provided with separate and individual identification and rating plates.

Each distribution board shall be provided with a circuit chart laid out in a way that matches the orientation and layout of the protective devices in the distribution board.

A typed circuit chart shall be permanently fixed inside each Assembly or immediately adjacent to the distribution board. The chart shall be laid out in accordance with the physical arrangement of the protective devices that it is easy to relate the circuit chart details to the appropriate protective device. As a minimum, the chart shall be enclosed in a transparent protective cover attached to the inside of the compartment door.

4. DOCUMENTATION

NO DB'S / MCC TO BE MANUFACTURED BEFORE SHOP DRAWNG APPROVALS.

All drawings, information, and documentation shall be in the English language, and each item shall be identified with the Client's name and contact details, Client's project / scheme / contract reference title and numbers, the Engineer's name and contact details, Engineers reference numbers, and the Manufacturer's works / contract / order references. Drawings for acceptance shall be provided on A3 paper copies.

The documentation used to describe the electrical design of the Assembly shall include the following:

(a) Electrical and ICA system block diagrams and single line diagrams.
(b) General arrangement and elevation drawings, compartment door layouts, typical component mounting plate layouts, and foundation plans.
(c) Electrical schematic diagrams showing all equipment and components incorporated into the Assembly. Known circuitry outside of the Assembly and connected to it, shall be shown on all drawings. All contacts shall be cross referenced to their associated components using a grid / line reference system.
(d) Protective device grading for overcurrent, short circuit, and earth fault / leakage devices incorporated within the Assembly, together with a schedule of proposed settings that will ensure discrimination.
(e) Instrument loop diagrams, instrument data sheets, and schedules of initial settings.
(f) Schedules of labels and warning sign legends.
(g) The software design specification; and detailing the proposed software architecture and development for all programmable devices incorporated into the Assembly.
(h) Programmable device software and configuration listings; including memory maps and user display screens, etc. Software listings shall be developed from the software design specification, and shall be fully documented and annotated with purpose, function, duty, cross-references, and descriptions, etc.; sufficient to guide an unfamiliar person through the operation of the software.

The drawings and documentation detailed above shall have been submitted and agreed with the Engineer, prior to the commencement of procurement or manufacture, and prior to the incorporation of any change to the design.

A factory acceptance test (FAT) document shall be provided. This shall define the testing procedures for all items of equipment, components, hardware, and software. The FAT document shall separately cover the Manufacturer's in-house FATs, as well as those subsequently witnessed by the Client and the Engineer. Each section of the FAT document shall detail the hardware checks, the software simulation procedures, and their combined functional testing. Provision shall be made to record the results and sign off each test or check carried out.

A site acceptance test (SAT) document shall be produced, which shall detail all tests necessary to demonstrate the functionality of the Assembly following its final erection on site. This shall include details of tests and checks on all circuits disconnected for shipping, together with any equipment, components, wiring, or software altered or incorporated into the Assembly; following the completion of the witnessed FATs.

All drawings, schedules, listings, and other design documentation for acceptance shall be supplied as a comprehensive and integrated package and collated into folders; unless otherwise agreed with the Engineer. Three copies of appropriate documentation shall be submitted on each occasion that agreement is sought.

A Certificate of Compliance (COC) shall be provided for all Assemblies

The FAT, SAT, and COC shall each have been submitted and agreed with the Engineer, prior to the commencement of final testing and site commissioning.

Following the FAT of any software and prior to the commencement of the SAT, the following documentation shall be provided to the Engineer:

(a) Fully completed and signed off FAT documentation showing the results of every test routine for each individual functional activity therein detailed.
(b) A schedule of all PLC I/O.
(c) A schedule of all PLC / HMI generated alarm set points.
(d) A schedule of all HMI generated alarm messages.
(e) A schedule of all alarm set points generated by other devices and presented to the PLC as inputs.
(f) A schedule of initial process and 3 term controller set points.
(g) Network architecture or network connections drawings.
(h) A hard copy of the fully documented and annotated application programme as at completion of the FAT.
(i) A software copy on CD-ROM / DVD of the application programme as at completion of the FAT.
(j) A statement detailing the proposed revision and archiving procedures, accompanied by their associated blank documentation, for both the hardware and software.
(k) A statement detailing the proposed procedures for the documentation and rectification of hardware and software faults and failures encountered during the SAT.

4.1 Operating and Maintenance Manual

One copy of the draft operating and maintenance manual and spare parts list shall be provided at an agreed date; in advance of the date of the start of the SATs, for acceptance by the Engineer. Three copies of the final editions shall be provided to the Engineer by an agreed date following successful completion of the SATs.

The Operating and Maintenance Manual shall be bound into a suite of hard-backed ring binders, and shall be provided with an index of all drawings pertinent to the Assembly. The index shall include each drawing's origin, number, issue, status, and the Client's drawing number (where issued by the Engineer).

The Operating and Maintenance Manual shall include the following:

(a) All design drawings and documentation relating to the Assembly; as delivered and tested.
(b) 'As installed and tested' records showing verification against stated design and installation criteria, including a schedule of all the final settings for all user adjustable equipment and components, and copies of all documentation presented and completed during the FATs, the SATs, and any other specified tests on completion.
(c) Schedules of plant and equipment for each compartment / circuit; including a listing of the applicable standards, manufacturer, type number, re-order code, etc., for each item of equipment and component included within the Assembly.
(d) Manufacturers' contact details, technical information sheets for all items of equipment and components included within the Assembly. Manufacturers' catalogues may be provided subject to clear identification of the relevant components. All individual manufacturers' equipment / component test certificates and certificates of conformity, shall be included.
(e) Inspection, testing, and maintenance recommendations, including detailed and specific operation, maintenance, and diagnostic data, and safe isolation information suitable for use by maintenance personnel, shall be provided for all equipment, components, and systems incorporated into the Assembly.
(f) Schedule of spares provided with the Assembly, including manufacturer, description, part number, order code, and quantity.

The Operating and Maintenance Manual shall include detailed descriptions for use by the Client, on how the controlled plant and its management systems are intended to operate and be operated; under both manual and automatic control. Clear and detailed descriptions for each element of the Assembly shall be provided; and shall include system objectives, controlled plant start-up and shut-down procedures, automatic control, manual intervention, primary and secondary control routines, plant selection including duty and standby options, local and remote selections, operational and safety constraints, status information, alarms and control interfaces with SCADA / telemetry systems, fault routines, etc.

The Operating and Maintenance Manual shall include 'as-installed and tested' information on both the

hardware and software for each programmable device incorporated within the Assembly, including:

(a) Overview of system operation in relation to the controlled plant.
(b) System configuration.
(c) Manufacturers' literature on operation, maintenance and testing of hardware and ancillaries, programming instructions, and diagnostics.
(d) Hard copy program; with listings fully documented.
(e) Listing of the final settings of all process dependent variables.
(f) Permanent back-up copies, licensed in the name of the Client, shall be provided for all software, including operating programmes, application programs, and configuration software for all configurable devices.

Any interconnecting leads, protocol conversion modules, connectors, etc. necessary to connect and communicate with each programmable / configurable device via the 'COM 1' port of an IBM compatible portable PC shall be provided.

Manual format shall be A4 size on the filing side which shall be vertical with 20 mm margin for filing.

5. TESTING AND COMMISSIONING

General requirements for testing
On completion of manufacture, the Assembly shall be subjected to a factory acceptance test (FAT), comprising the Manufacturer's in-house tests, and the repeat tests witnessed by the Client and the Engineer.

Once the witnessed FAT has been carried out, signed off, and any remedial works have been completed and re-tested, the Assembly is ready for delivery to site. Once erected in position, the Assembly shall be subjected to a witnessed site acceptance test (SAT).

Once the SAT has been carried out and signed off, any remedial works shall be completed and re-tested. Plant installation and site cabling will then be carried out by others, and on its completion, witnessed commissioning shall commence.

The manufacturer shall allow for each test (apart from in-house tests) to be witnessed by both the Client and the Engineers simultaneously. An individual testing activity shall not be considered to have been completed until any results have been recorded, and it has been signed off by the Engineer.

The manufacturer shall provide the Client and Engineers with all reasonable facilities, including testing staff and test equipment, to carry out the inspections and tests, and to check the Assembly for compliance with all of the Client's requirements.

The manufacturer shall ensure that all testing is carried out in a safe manner, and shall protect those witnessing from danger; in accordance with the Occupational Health and Safety Act.

In order to demonstrate the functionality of each circuit, external devices shall be simulated in a representative manner. A small motor shall be used as a test load where motor starters incorporate power electronics. During development, software may be electronically verified away from the Assembly using a simulation / diagnostic package; notwithstanding this, control systems shall be witnessed tested with the software loaded into the programmable devices, and with simulation of the physical I/O devices.

Where the Assembly incorporates equipment requiring special testing facilities or procedures, the manufacturer shall ensure that appropriate resources are available; including where necessary, representatives from the equipment Manufacturer.

Factory acceptance tests
The manufacturer shall perform his in-house works tests in accordance with the proposed FAT procedures, and shall satisfy himself as to the accuracy and quality of the manufactured Assembly in accordance with the accepted design. Once the in-house FAT has been carried out, signed off by the manufacturer, and any

remedial works have been completed and retested, the tests shall be repeated and witnessed by the Client and the Engineers.
The in-house and the witnessed FATs shall check compliance with SANS 60439-1, and shall include the following:

(a) A thorough external and internal visual inspection.
(b) Confirmation of adequate earthing.
(c) Secondary injection testing of all protective circuits shall be carried out, except where discrete current transformers are used; in which case sufficient primary injection testing shall be carried out to prove the ratio and the polarity.
(d) Meggar tests shall be performed across all main and distribution busbar joints.
(e) All busbars shall be subjected to a single witnessed reduced voltage dielectric 'flash' test; the in-house test shall also be at a reduced voltage.
(f) All power circuits shall be subjected to insulation resistance tests.
(g) The operation of every mechanical device and interlock shall be verified.
(h) All circuits and their functionality shall be tested
(i) Any other test necessary to verify satisfaction with the requirements of Table 7 of SANS 60439-1.

When testing the performance of any software, it shall be demonstrated using the hardware intended to be incorporated within the Assembly, and where this is not possible appropriate operator interfaces, programming units, and terminal units, etc. shall be provided. Where it is necessary to demonstrate an interface with a piece of unavailable equipment to be supplied by others, appropriate means to replicate that equipment and simulate the interface shall be provided.

Site acceptance test
All equipment and every circuit that was altered or disturbed subsequent to the completion of the FAT, or for shipping and site erection, shall be specifically re-tested for integrity and functionality.

During the SAT, all busbar joints that are re-tightened on site shall be subjected to a further Meggar test, and all busbars shall be subjected to a single witnessed full voltage dielectric 'flash' test.

The process functionality of each aspect of the control system and its operator interface shall be demonstrated, including the correct operation of all I/O and network links external to the Assembly or not otherwise tested during the FAT.

Commissioning and other tests
The manufacturer shall provide attendance during the commissioning of the Assembly, whereby the functionality of the Assembly and its control system and software shall be proven. During commissioning the manufacturer shall make such adjustments, software modifications, and circuit changes, as are deemed necessary to provide the level of plant functionality and performance specified by the Client. All such changes shall be immediately incorporated into the 'as installed and tested' documentation and the Operating and Maintenance Manual, by the Contractor.

The manufacturer shall provide an acceptance document, to detail and record the tests and their anticipated results, and the acceptance document shall have provision for recording and signing off the results.

ALL DB'S AND MCC'S SHALL BE FULLY TESTED ACCORDING TO SANS 10142-1 AND THE ELECTRICAL CONTRACTOR SHALL ISSUE A COC TO THE CLIENT FOR EACH DB, MCC

ELSPEC-03-LVCMS:
LOW-VOLTAGE CABLE MANAGEMENT

1. INTRODUCTION

This specification relates to the supply, installation, testing of Low voltage cable management for usage in commercial, retail, industrial buildings and installations.

This specification also includes the fixing methods to be utilized.

2. SUPPORTING CLAUSES

2.1 Scope

This standard covers the general requirements for conduit, cable trays, cable trunking and power skirting system. A cable management system would typically consist of all or part of the following:

a) Wire basket cable trays,
b) Perforated metal cable trays
c) Medium duty cable ladders
d) Wiring ducting
e) Power skirting and power poles
f) Conduit, draw boxes and outlet boxes

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

SANS 61386-1	Conduit and fittings:
SANS 61386-21	rigid
SANS 61386-22	pliable
SANS 61386-23	flexible
SANS 950	PVC rigid conduit and fittings:
SANS 1085	20 mm to 63 mm dia.
	Metal conduit: 20 mm to 50 mm dia.
	Metal fittings
SANS 1085	Outlet boxes
SANS 61439-6	Busways/busbar trunking
SANS 61084-1	Cable trunking and ducting for electrical installations

SANS VC 8031	Coatings applied by the powder-coating process.
SANS 783	Baked enamels.
SANS 10142	The wiring of Premises

3. CABLE MANAGEMENT REQUIREMENTS

3.1 Wire Basket Cable Trays (Welded Wire Mesh - WWM)

3.1.1 General

All welded wire mesh cable trays shall be manufactured according to BS EN 61537:2007

All welded wire mesh cable trays shall be of the heavy-duty type.

Heavy Duty Welded Wire Mesh Cable tray straights and accessories shall be manufactured from Hard-drawn High Tensile steel wire - Ø5mm thick and then hot-dip galvanised after manufacture to SANS 121:2001 / ISO 1461:2009 (HDG).

Sidewall heights shall be 75mm.

Pitch (wire aperatures) shall be 50mm x 50mm.

Accessory bends radius shall be standard 450mm.

3.1.2 Dimensions

The standard welded wire mesh widths shall be as indicated on the drawings and shall be either one of the following:

- 150mm wide
- 300mm wide
- 600mm wide

Standard sidewall heights shall be 75mm.

3.1.3 Accessories

Standard accessories shall be utilized and shall match the width of the cable tray utilized.

Standard sidewall heights shall be 75mm.

The standard accessories shall be the following:

- 90deg horizontal bends with a radius of 450mm
- Internal and external bends with a radius of 450mm
- Equal Tees with a radius of 450mm
- Equal 4way crossovers with a radius of 450mm

Where any direction change/up/down/left/right/crossovers are to be utilized only standard accessories shall be utilized and no cutting, bending, modification of straights shall be permitted.

3.1.4 Fixing and Fastening

Cable trays shall be vertical wall mounted, horizontal wall mounted, suspended ceiling (roof truss, roof slab etc) mounted as indicated on drawings.

The typical mounting arrangements shall be as follows:

Vertical wall mounted:

P2000 channels shall be vertically fixed to wall via M10 drop-in anchors and bolts.

Cable trays shall then be affixed to P2000 channels via M8.5 slot hold down saddles with M8 hex bolt and M8 spring nuts, cable trays shall have two hold down saddle fixings at each P2000 mounting channel

P2000 mounting channels shall not be spaced at more than 1m centre to centre.

Cables and wires shall be affixed to cable trays via suitable cable ties at spacings not more than 500mm apart and cables shall not be laid over and under each other.

Data, telephone, CCTV, alarm and power cables shall not be laid in the same cable trays.

Horizontal wall mounted:

Standard P1000 cantilever arms shall be utilised for horizontal wall mounting and shall be fixed to wall via M12 drop-in anchors and bolts.

The standoff width shall be determined by the tray to be mounted and shall be 50mm longer than the width of the tray.

Cable trays shall then be affixed to cantilever via M8.5 slot hold down saddles with M8 hex bolt and M8 spring nuts, cable trays shall have two hold down saddle fixings at each P1000 cantilever arm.

Cantilever arms shall not be spaced at more than 1m centre to centre.

Cables and wires shall be affixed to cable trays via suitable cable ties at spacings not more than 500mm apart and cables shall not be laid over and under each other.

Data, telephone, CCTV, alarm and power cables shall not be laid in the same cable trays.

Suspended roof mounted:

P2000 channels shall be horizontally suspended via 2x M10 threaded rod from the roof structure/roof slab and shall be fixed at the P2000 bracket end via 2 x M10 hex nuts with washers.

Where the roof is a concrete slab, the threaded rod shall be fixed via M10 drop-in anchors.

Where the roof structure is steel of wooden trusses etc a suitable threaded rod hanger should be utilized.

The minimum length of the threaded rod shall be 500mm to allow for tray access.

Cable trays shall then be affixed to P2000 channels via M8.5 slot hold down saddles with M8 hex bolt and M8 spring nuts, cable trays shall have two hold down saddle fixings at each P2000 mounting channel.

P2000 mounting channels shall not be spaced at more than 1m centre to centre.

Cables and wires shall be affixed to cable trays via suitable cable ties at spacings not more than 500mm apart and cables shall not be laid over and under each other.

Data, telephone, CCTV, alarm and power cables shall not be laid in the same cable trays.

3.1.5 Earthing (Bonding)

Cable trays shall be bonded to ensure compliance with SANS 10142-1.

Bonding wires shall be a minimum of 2.5mm diameter BCEW and shall be bonded via suitable non-insulated lugs, nuts and bolts.

The bonding conductors shall run the whole length of the cable trays and shall be bonded each 3m section, it shall also be bonded at the main earth bar.

The bonding earth continuity path shall not exceed 0.2Ohms.

Where any steel covers are utilised, these shall also be bonded to the cable tray each 3m section via suitable lugs, nuts and bolts.

3.2 Perforated Metal Cable Trays (Return Flange Heavy Duty - RFHD)

3.2.1 General

All perforated metal cable trays shall be manufactured according to BS EN 61537:2007

All perforated metal cable trays shall be of the heavy duty return flange type.

Heavy Duty return flange Cable tray straights and accessories shall be manufactured from pre-galvanised steel to SANS 3575:2008 / ISO 3575:2005, normally grade Z275.

Standard lengths 3m

Longitudinal Slots: 25 x 7.5mm

Lateral Slots: 20 x11mm

Pitch: 38 x 25mm

Side Rail Height shall be 50mm with one slot.

Pitch (wire aperatures) shall be 50mm x 50mm

Accessory bends radius shall be standard according to width of trays.

3.2.2 Dimensions

The standard return flange heavy duty perforated metal cable tray widths shall be as indicated on the drawings and shall be either one of the following:

- 150mm wide with material thickness 1mm
- 300mm wide with material thickness of 1.2mm
- 600mm wide with material thickness of 1.5mm

Standard sidewall heights shall be 50mm.

3.2.3 Accessories

Standard accessories shall be utilized and shall match the width of the cable tray utilized.

Standard sidewall heights shall be 50mm.

The standard accessories shall be the following:

90deg horizontal bends
- 150mm wide with a radius of 125mm
- 300mm wide with a radius of 150mm
- 600mm wide with a radius of 240mm

Internal and external bends with a radius of 240mm

Equal Tees
- 150mm wide with a radius of 125mm
- 300mm wide with a radius of 150mm
- 600mm wide with a radius of 240mm

Equal 4way crossovers
- 150mm wide with a radius of 125mm
- 300mm wide with a radius of 150mm
- 600mm wide with a radius of 240mm

Where any direction change/up/down/left/right/crossovers are to be utilized only standard accessories shall be utilized and no cutting, bending, modification of straights shall be permitted.

Perforated metal cable trays may be utilised for both power and data/tel. cables when a straight divider is installed.

3.2.4 Fixing and Fastening

Cable trays shall be horizontal wall mounted, suspended ceiling (roof truss, roof slab etc) mounted as indicated on drawings.

The typical mounting arrangements shall be as follows:

Horizontal wall mounted:

Standard P1000 cantilever arms shall be utilised for horizontal wall mounting and shall be fixed to wall via M12 drop-in anchors and bolts.

The standoff width shall be determined by the tray to be mounted and shall be 50mm longer than the width of the tray.

Cable trays shall then be affixed to cantilever via M6 gutter bolts and sq nuts with M6 spring nuts inside the P1000 arm, cable trays shall have two gutter bolt fixings at each P1000 cantilever arm

Cantilever arms shall not be spaced at more than 1m centre to centre.

Cables and wires shall be affixed to cable trays via suitable cable ties at spacings not more than 500mm apart and cables shall not be laid over and under each other.

Data, telephone, CCTV, alarm and power cables shall not be laid in the same cable trays.

Suspended roof mounted:

P2000 channels shall be horizontally suspended via 2x M10 threaded rod from the roof structure/roof slab and shall be fixed at the P2000 bracket end via 2 x M10 hex nuts with washers.

Where the roof is a concrete slab, the threaded rod shall be fixed via M10 drop-in anchors.

Where the roof structure is steel of wooden trusses etc a suitable threaded rod hanger should be utilized.

The minimum length of the threaded rod shall be 500mm to allow for tray access.

Cable trays shall then be affixed to P2000 channels via M6 gutter bolts and sq nuts with M6 spring nuts inside the P2000 channel, cable trays shall have two gutter bolt fixings at each P2000 channel.

P2000 mounting channels shall not be spaced at more than 1m centre to centre.

Cables and wires shall be affixed to cable trays via suitable cable ties at spacings not more than 500mm apart and cables shall not be laid over and under each other.

Data, telephone, CCTV, alarm and power cables shall not be laid in the same cable trays.

Where a divider is used it shall be fixed via four M6 x 12mm gutter bolts and sq nuts.

3.2.5 Earthing (Bonding)

Cable trays shall be bonded to ensure compliance with SANS 10142-1.

Bonding wires shall be a minimum of 2.5mm diameter BCEW and shall be bonded via suitable non-insulated lugs, nuts and bolts.

The bonding conductors shall run the whole length of the cable trays and shall be bonded each 3m section, it shall also be bonded at the main earth bar.

The bonding earth continuity path shall not exceed 0.2Ohms.

Where any steel covers are utilised, these shall also be bonded to the cable tray each 3m section via suitable lugs, nuts and bolts.

3.3 Cable Ladders (Medium Duty- Cl76)

3.3.1 General

All perforated metal cable trays shall be manufactured according to BS EN 61537:2007.

Standard finish HDG - Mild steel to BS 1449-1.2:1991, hot-dip galvanised after manufacture to SANS 121:2001 / ISO 1461:2009.

Material thickness shall be 1.5mm
Standard lengths 3m
Side rail height: 76mm
CL76 Cross rungs
Cross rung spacing: 375mm
Slot size: 20 x 7mm
Slot pitch: 25mm
Accessory bends radius shall be standard 450mm

3.3.2 Dimensions

The standard medium duty perforated cable ladder widths shall be as indicated on the drawings and shall be either one of the following:

- 150mm wide
- 300mm wide
- 600mm wide

Standard sidewall heights shall be 76mm.

3.3.3 Accessories

Standard accessories shall be utilized and shall match the width of the cable tray utilized.

Standard sidewall heights shall be 76mm.

The standard accessories shall be the following:

- 90deg horizontal bends with a radius of 450mm
- Internal and external bends with a radius of 450mm
- Equal Tees with a radius of 450mm
- Equal 4way crossovers with a radius of 450mm

Where any direction change/up/down/left/right/crossovers are to be utilized only standard accessories shall be utilized and no cutting, bending, modification of straights shall be permitted.

3.3.4 Fixing and Fastening

Cable trays shall be horizontal wall mounted, suspended ceiling (roof truss, roof slab etc) mounted as indicated on drawings.

The typical mounting arrangements shall be as follows:

Horizontal wall mounted:

Standard P1000 cantilever arms shall be utilised for horizontal wall mounting and shall be fixed to wall via M12 drop-in anchors and bolts.

The standoff width shall be determined by the tray to be mounted and shall be 50mm longer than the width of the tray.

Cable trays shall then be affixed to cantilever via M6 gutter bolts and sq nuts with M6 spring nuts inside the P1000 arm, cable trays shall have two gutter bolt fixings at each P1000 cantilever arm

Cantilever arms shall not be spaced at more than 1m centre to centre.

Cables and wires shall be affixed to cable trays via suitable cable ties at spacings not more than 500mm apart and cables shall not be laid over and under each other.

Data, telephone, CCTV, alarm and power cables shall not be laid in the same cable trays.

Suspended roof mounted:

P2000 channels shall be horizontally suspended via 2x M10 threaded rod from the roof structure/roof slab and shall be fixed at the P2000 bracket end via 2 x M10 hex nuts with washers

Where the roof is a concrete slab, the threaded rod shall be fixed via M10 drop-in anchors.

Where the roof structure is steel of wooden trusses etc a suitable threaded rod hanger should be utilized.

The minimum length of the threaded rod shall be 500mm to allow for tray access.

Cable trays shall then be affixed to P2000 channels via M6 gutter bolts and sq nuts with M6 spring nuts inside the P2000 channel, cable trays shall have two gutter bolt fixings at each P2000 channel

P2000 mounting channels shall not be spaced at more than 1m centre to centre.

Cables and wires shall be affixed to cable trays via suitable cable clamps as per next section.

Data, telephone, CCTV, alarm and power cables shall not be laid in the same cable trays.

Where a divider is used it shall be fixed via four M6 x 12mm gutter bolts and sq nuts.

3.3.5 Cable Clamps

Cables installed on cable ladders shall be fixed to cable ladder via polypropylene cable clamps supplied complete with M10 304 stainless steel studs, nuts and washers

Cable clamps shall be adjustable and used in the following scenarios as follows:

- 3/4core swa cables: Two brackets namely 50-75mm and 75-100mm dependant.
- 1core swa cables: Two brackets namely 50-75mm and 75-100mm dependant.
- 1core swa cables: Trefoil cable clamps 32-36mm and 53-58mm

Cable clamps shall be fixed to cable ladder via M10 hex nuts through the slots.

3.3.6 Earthing (Bonding)

Cable trays shall be bonded to ensure compliance with SANS 10142-1.
Bonding wires shall be a minimum of 2.5mm diameter BCEW and shall be bonded via suitable non-insulated lugs, nuts and bolts.

The bonding conductors shall run the whole length of the cable trays and shall be bonded each 3m section, it shall also be bonded at the main earth bar.

The bonding earth continuity path shall not exceed 0.2Ohms.

3.4 Wiring Ducting

3.4.1 General

Wiring Ducts and accessories are manufactured from pre-galvanised steel to SANS 3575:2008 / ISO 3575:2005, normally grade Z275.

Wiring Ducting, Standard Splices and Fold-From-Flat Standard and Radiuses Accessories are pre-punched with fixing holes making installation easy and quick.

Pre-punching comes as standard on: P8200 / P8300 / P8000 / P7810 / P9800 / P9810 and P9000. Wiring Duct Straight Covers are supplied in pre-galvanised steel to SANS 3575:2008 / ISO 3575:2005, normally grade Z275

Where requested wiring duct shall be powder coated from the manufacturer.

All wiring ducting shall be supplied with covers.

3.4.2 Dimensions

The standard wiring ducting and accessories:

NO	DESCRIPTION	STANDARD LENGTH	SIZE	MATERIAL THICKNESS	DUCT COVER	TOP OPENING
1	P2000	5m	41.3 x 41.3mm	1mm	P1184	22mm
2	P8000	3m	76 x 76mm	0.8mm	P8184	51mm
3	P9000	3m	120 x 76mm	0.8mm	P9184	102mm

All ducts to be supplied with covers.

3.4.3 Accessories

Standard accessories shall be utilized and shall match the size of the wiring duct utilized.

All accessories shall be fold from flat

The standard accessories shall be the following:
- 90deg horizontal Elbow
- Internal and external Elbows
- Equal Tees
- Equal 4way crossovers
- Where ducts end no open ends shall be allowed and thus all ducts to have end caps

Where any direction change/up/down/left/right/crossovers are to be utilized only standard accessories shall be utilized and no cutting, bending, modification of straights shall be permitted.

3.4.4 Fixing and Fastening

Ducts shall be horizontal wall mounted, suspended ceiling (roof truss, roof slab etc) mounted as indicated on drawings.

The typical mounting arrangements shall be as follows:

Horizontal wall mounted:

Standard P1000 cantilever arms shall be utilised for horizontal wall mounting and shall be fixed to wall via M12 drop-in anchors and bolts.

The standoff width shall be determined by the tray to be mounted and shall be 50mm longer than the width of the tray.

Ducts shall then be affixed to cantilever via M6 gutter bolts and sq nuts with M6 spring nuts inside the P1000 arm.

Cantilever arms shall not be spaced at more than 1m centre to centre.

Data, telephone, CCTV, alarm and power cables shall not be laid in the same cable trays.

Suspended roof mounted:

P2000 channels shall be horizontally suspended via 2x M10 threaded rod from the roof structure/roof slab and shall be fixed at the P2000 bracket end via 2 x M10 hex nuts with washers.

Where the roof is a concrete slab, the threaded rod shall be fixed via M10 drop-in anchors.

Where the roof structure is steel of wooden trusses etc a suitable threaded rod hanger should be utilized.

The minimum length of the threaded rod shall be 500mm to allow for tray access.

Cable trays shall then be affixed to P2000 channels via M6 gutter bolts and sq nuts with M6 spring nuts inside the P2000 channel.

P2000 mounting channels shall not be spaced at more than 1m centre to centre.

Data, telephone, CCTV, alarm and power cables shall not be laid in the same ducts.

3.4.6 Earthing (Bonding)

Duct shall be bonded to ensure compliance with SANS 10142-1.

Bonding wires shall be a minimum of 2.5mm diameter BCEW and shall be bonded via suitable non-insulated lugs, nuts and bolts.

Covers shall be bonded each 3m section to the main duct.

The bonding conductors shall run the whole length of the cable duct and shall be bonded each 3m section, it shall also be bonded at the main earth bar.

The bonding earth continuity path shall not exceed 0.2Ohms.

3.4.7 Marking and Labelling

Where ducting is utilised for different installations namely power, data, telephone, CCTV, etc. this shall clearly be labelled and marked on the ducting.

Ducting shall be labelled bottom and sides each 3m section indicating the functions according to the following:

- “POWER’
- “DATA + TEL”
- “CCTV+ALARM”

The labels shall be at least 20mm high black on white lettering.

3.5 Wiring Conduits

3.5.1 General

Wiring conduit and accessories shall be either galvanized steel conduit (BOSAL) in accordance with the SANS 61386-1 specifications or PVC according to SANS 61386 and SANS 950.

The type of Conduit shall be specified on the drawings.

Galvanised and PVC conduit shall be installed in concrete slabs, under screeds, in ceiling spaces, chased into walls and surface.

Conduit accessories shall match the material of the straight conduit runs.

Where galvanised steel conduit is to be utilized, the accessories shall be plain straight end with locfit accessories and fittings.

Where PVC conduits are utilised, it shall be plain straight end with PVC accessories and fittings.

Where any conduit is cut, it shall be de-burred using a special deburring tool as to ensure no damage to wires.
No bend accessories shall be permitted and straight sections shall be bend with a special tool Namely: Pipe bender(hickey) for steel conduits and spring bender for PVC conduits.

The loop in/loop out system shall be implemented with conduits.

3.5.2 Dimensions

Standard conduit lengths are 4m and standard conduit diameters to be used is 20mm, 25mm, 32mm and 50mm diameter.

No	Conduit dia	Number of 1C gp wires/allowable conductors per conduit.			
		2.5mm	4mm	6mm	10mm
1	20	6	5	4	3
2	25	9	7	6	4
3	32	17	14	10	8

Thus, from the above:

Where lighting circuits are wired with 2.5mm SQ and power circuits are wired with 4/6mm SQ the following applies:

No	Circuit type	Conductor	Conduit	Number of circuits/conduit
1	Lighting	2.5mm SQ	20mm Dia	2
2	Socket and Small power points	4mm SQ	25mm Dia	2
3	Stoves and Larger power points	6mm SQ	25mm Dia	2

Where CAT 5E/CAT 6 DATA cables are to be installed in conduit, 25mm Dia conduit shall be used and no more than 4 cables per conduit shall be installed.

3.5.3 Accessories

Standard accessories shall be utilized and shall match the size and the type of conduit utilized.

All accessories shall be either galvanised steel or PVC to match conduit.

The standard accessories shall be the following:

1-4Way round boxes with side entries

- Round boxes shall be measured as single units in the BOQ and thus the contractor shall allow for 1 to 4-way round boxes when pricing although some instances only 1-ways would be utilised.
- Round boxes shall be of the side entry push in type and not the knock out type, the correct round box shall be used for the application and there may be no open push in entries.
- The round box push in entry dimensions shall be similar as the conduit diameter utilised.
- Round boxes shall be complete with neo rubber lid gasket and cover lids with screws.

1-4Way round boxes with back entries

- Round boxes shall be measured as single units in the BOQ and thus the contractor shall allow for 1 to 4-way round boxes when pricing although some instances only 1-ways would be utilised.
- Round boxes shall be of the side entry push in type and not the knock out type, the correct round box shall be used for the application and there may be no open push in entries.
- The round box push in entry dimensions shall be similar as the conduit diameter utilised.
- Round boxes shall be complete with neo rubber lid gasket and cover lids with screws.

Solid couplings
Couplings shall be of the push in type

Male/Female adaptors
Conduit adaptors shall be either male or female complete with lockrings. Where galvanised conduits are used it shall also be complete with brass bushes.

Saddles
Saddles shall be of the Hospital type complete and fixed via 6mm nail in anchors in masonry and 6mm wood/metal screws in roof trusses. NO STRAP SADDLES TO BE ALLOWED.

Where PVC conduit is used all push in connections (couplers, adaptors, round boxes) shall be glued via PVC BOND.

3.5.4 Fixing and Fastening

Conduits shall be installed as follows:

- Cast in concrete
- Chased/built into masonry wall
- Installed in Drywalling
- Installed in ceiling spaces
- Surface mounted

The typical mounting arrangements shall be as follows:

Cast in Concrete
In order not to delay building operations the Contractor must ensure that all conduits and other electrical equipment which are to be cast in the concrete columns and slabs are installed in good time.

The Contractor shall have a representative in attendance at all times when the casting of concrete takes place.

Draw-boxes, expansion joint boxes and round conduit boxes are to be provided where necessary. Sharp bends of any nature will not be allowed in concrete slabs.

Draw and/or inspection boxes shall be grouped under one common cover plate, and must preferable be installed in passages or male toilets.

All boxes, etc., are to be securely fixed to the shuttering to prevent displacement when concrete is cast. The conduit shall be supported and secured at regular intervals and installed as close as possible to the neutral axis of concrete slabs and/or beams.

Before any concrete slabs are cast, all conduit droppers to switchboards, socket outlets, switches and any other drop shall be neatly spaced and rigidly fixed.

Chased/built into masonry walls
Where conduits are to be chased and installed into plastered masonry walls, this shall be done before plastering.

Chaseworks shall be in plumb and straight lines and shall be deep and wide enough to accommodate number of conduits, no chasework shall be more than 50mm deep to ensure wall structural integrity.

Conduits shall be fixed inside chased channel via chickenmesh strapping over chased area to ensure adherence of plaster.

Where there is facebrick walls, conduit must be built into walls and no chasework shall be allowed.

Installed in drywalling.
Where conduit must be installed in drywalling, this shall be done before both drywall panels are fitted. Outlet boxes and conduit shall be fixed to drywall structural members at intervals not exceeding 1m.

Installed in roof spaces
Where conduits are to be installed in roofspaces, this shall be done before any ceilings are fixed.
Conduits shall be fixed via hospital saddles at spacings of not more than 1m to roof structures.

Conduits shall not sag or criss/cross over each other and where crossings may occur, this shall be neatly done via bending tools.

Surface mounted
Where conduits are to be surface mounted it shall be fixed via hospital saddles fixed to surface with 6mm nail in anchors.

Saddles shall not be spaced more than 1m spacings.

General
Adaptors shall be used at drawboxes/wall boxes/distribution boards etc and the conduits shall be de-burred using the appropriate tool. It shall be fixed via suitable sized male/female adaptors complete with lock nuts and brass bushings.

No conduit runs with more than one 90deg bend shall be allowed without a drawbox at a second direction change, thus conduits shall not change direction more than 90 deg without a drawbox.

No push in bends shall be allowed and conduits straights shall be bend using the appropriate tool (pipe bender, bending spring).

3.5.6 Earthing (Bonding)

Galvanised steel conduit shall be bonded to ensure compliance with SANS 10142-1.

Bonding wires shall be a minimum of 2.5mm diameter BCEW and shall be bonded via suitable non-insulated lugs, nuts and bolts.

Outlet (SSO, Lights etc) earthing conductors may be used as bonding conductors and shall be fixed to conduits or conduit outlet boxes via suitable non-insulated lugs, nuts and bolts.

The bonding earth continuity path shall not exceed 0.2 Ohms.

Where galvanised steel conduits are utilised only in walls for surfix or flat twin and earth, the open ends shall have an earth tag which shall be bonded.

3.5.7 Marking and Labelling

Where Conduits is utilised for different installations namely power, data, telephone, CCTV, etc. this shall clearly be labelled and marked on the ducting.

Conduits shall be labelled each 3m section indicating the functions according to the following:

- "POWER'
- "DATA + TEL"
- "CCTV+ALARM"

The labels shall be at least 20mm high black on white lettering.

3.6 Power Skirting and Power Poles

3.6.1 General

Powerskirting shall be manufactured from pre-galvanised steel to SANS 3575:2008 / ISO 3575:2005, normally grade Z275, powder-coated to SANS 1274:2020 Part 2 - for interior use in non-corrosive environments, on visible surfaces only using a range of aesthetic textured and smooth colours as indicated by the Architect. Colour shall be matt textured white if not indicated.

Powerskirting shall be the N8 steel series single or double compartment complete with covers.

Powerskirting compartment shall be indicated on drawings.

Power poles shall be manufactured or extruded in accordance with DIN EN 755-9 using grade 6063-T6 grade aluminium alloy and then Natural Aluminium (NA) anodized to SANS 1407:2013 (Anodized coatings on Aluminium (for general applications).

All Power Poles and all Outlets shall be supplied with grey plastic covers.

The Power Poles shall include:

- one Ø57mm 4 compartment Natural Aluminium (NA) anodized Pole,
- Four full length Grey PVC Covers,
- One Ceiling Flange Grey ABS,
- Two Ceiling Flange Joiner Clips,
- One Floor Location Pad Grey ABS and
- One Jack Assembly

3.6.2 Dimensions

The powerskirting dimensions shall be as follows:

- Standard lengths: 3m
- Width: 55mm
- Single Compartment Height: 82.5mm
- Double Compartment Height: 165mm
- Thickness of PS and Accessories: 0.8mm

Power Poles standard lengths (heights) shall be as follows:

- 3m
- 4m
- 5m

Power pole heights shall be determined by the ceiling heights.

Power poles shall have a Diameter of 57mm with 4 compartments.

3.6.3 Accessories

Standard accessories shall be utilized and shall match the colour and the type of system utilized.

The standard accessories shall be the following:

- External Elbows 90deg
- Internal Elbows 90deg
- End Caps
- Flat Elbows 90Deg
- Flat Tee

Further to this the outlets utilised for the power skirtings shall be of the Crabtree Diamond range modular outlets.

The outlet cover kits shall compromise of colour matched cover plate, 2 x sez retainer clips and 2 x M3.5 X 10mm raised countersunk slotted screws.

The outlets and cradles shall be supplied separately as required by the specified type and number of outlets.

The type and number of outlets shall be as per the drawings.

Power pole Unimod outlet kits
The unimod kits shall be supplied complete with: one Natural Aluminium anodized 85mm long Unimod Retainer, two Unimod Outlet Kit End Caps Grey ABS, one Unimod Outlet Kit Divider Grey ABS and one Unimod Modular Outlet Cradle PG.

3.6.4 Fixing and Fastening

Powerskirting shall be fixed to walls/surfaces via 6mm Nail in anchors spaced at not more than 1m apart.

Where double compartment power skirting shall be installed, each compartment shall have a nail in anchor thus double.

Conduit entries to powerskirting shall be either surface mounted or chased into the walls (rear entry).

The typical mounting arrangements shall be as follows:

Surface conduit entry
Where conduits are to be surface conduit entry, this shall be by means of suitable sized adaptors complete with locknuts and brass bushes. Suitable holes shall be drilled into the powerskirting for the adaptor sizes. Generally, these conduits shall be 25mm diameter unless otherwise specified.

Rear Entry (chased in conduit)
Where rear entry is indicated on the drawings, there shall be wallboxes chased into the wall of which the quantity shall be according to the drawings. A hole of relevant size shall be cut out of the rear of the powerskirting and the hole shall be lined with a grommet rubber to prevent any cable damages.

Typically, two 4x4 wall boxes next to each other shall be chased into the wall with 4 x 25mm conduits to roofspace. The two 4x4 boxes shall be staggered for a double compartment powerskirting to allow for entry on each compartment.

Powerskirting mounting height shall be indicated on the drawings.

Powerpole mounting shall be according to manufacturer's specifications.

3.6.5 Earthing (Bonding)

Powerskiritng shall be bonded to ensure compliance with SANS 10142-1.

Bonding wires shall be a minimum of 2.5mm diameter BCEW and shall be bonded via suitable non-insulated lugs, nuts and bolts.

Outlet (SSO, Lights etc) earthing conductors may be used as bonding conductors and shall be fixed to powerskirting via suitable non-insulated lugs, nuts and bolts.

The bonding earth continuity path shall not exceed 0.2 Ohms.

3.6.6 Marking and Labelling

Where Conduits is utilised for different installations namely power, data, telephone, CCTV, etc this shall clearly be labelled and marked on the ducting.

Conduits shall be labelled each 3m section indicating the functions according to the following:

- “POWER’
- “DATA + TEL”
- “CCTV+ALARM”

The labels shall be at least 20mm high black on white lettering.

ELSPEC-04-LVLUM:
LOW-VOLTAGE LUMINAIRE AND LIGHTING SPECIFICATIONS

1. INTRODUCTION

This specification relates to the supply, installation, testing of Low voltage lights and luminaires for usage in indoor lighting, outdoor lighting, security lighting and area lighting.

This specification also includes the fixing methods to be utilized.

2. SUPPORTING CLAUSES

2.1 Scope

This standard covers the general requirements for a low voltage lighting and luminaires system.

A low voltage lighting system would typically consist of all or part of the following:
a) Indoor surface mounted luminaires (offices, circulation, high bay, etc);
b) Indoor recessed luminaires (offices, circulation, high bay, etc);
c) Indoor and outdoor bulkhead and area lighting;
d) Security and perimeter lighting;

Specific installations excluded from these specifications are high mast and street light luminaires and installations.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

SANS 475	Luminaires for interior lighting, street lighting and floodlighting – Performance and requirements
SANS 10114-1	Interior lighting part 1: Artificial lighting of interiors
SANS 10114-2	Interior lighting part 2: Emergency lighting
SANS 60598-1	Luminaires part 1: General requirements and tests
SANS 60598-2.1	Luminaires part 2: Particular requirements section 1 – Fixed general-purpose luminaires.
SANS 60598-2.2	Luminaires part 2: Particular requirements section 2 – Recessed luminaires.
SANS 60598-2.3	Luminaires part 2: Particular requirements section 3 – Luminaires for road and street lighting.
SANS 60598-2.5	Luminaires part 2: Particular requirements section 5 – Flood lighting.

SANS 61347-1 to 13	Lamp control gear
SANS 62031	LED modules for general lighting – Safety specifications
SANS 62384	DC or AC supplied electronic control gear for LED modules – Performance requirements.
SANS 62560	Self-ballasted LED lamps for general lighting services with supply voltages > 50V – Safety specification.
SANS 62612	Self-ballasted LED lamps for general lighting services with supply voltages > 50V – Performance requirements
EN 55015	Limits and methods of measurement of radio disturbance of electrical lighting or equipment.
EN 61000-3.2	Electromagnetic compatibility (EMC) limits for harmonic current emissions.
EN 61000-3.3	Electromagnetic compatibility (EMC) limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.
EN 61547	Equipment for general lighting purposes: EMC immunity requirements.
IEC-EN 62471	Photo biological safety of lamps and lamp systems for LEDs
IES LM-79-08	Approved method: Electrical and photometric measurement of solid-state lighting products.
IES LM-80	Approved method: Measuring lumen maintenance of LED light sources.
SANS 1119	Interior luminaires for fluorescent lamps.
SANS 1250	Capacitors for use with fluorescent and other discharge lamp ballasts
SANS 890	Ballasts for fluorescent lamps.
SANS 1464	Safety of luminaires.
SANS 1479	Glow starters for fluorescent lamps.
IEC 400	Lamp holders for tubular fluorescent lamps.
SANS 1041	Tubular fluorescent lamps for general service
SANS VC 8031	Coatings applied by the powder-coating process.
SANS 783	Baked enamels.
SANS 10142	The wiring of Premises

3. LOW VOLTAGE LUMINAIRES REQUIREMENTS

3.1 Interior Luminaires

3.1.1 General

All Light fittings installed for this project is to be of the LED type, unless otherwise stated.

The above mentioned international standard specifications and South-African Bureau of Standards shall apply to the LED luminaire specification:

To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.

If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.

Sample luminaires shall be provided for evaluation and approval by the Electrical Engineer prior to installation and this will form part of the contractors' rates.

Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.

Where luminaires have separate light sources and lamps, these shall be delivered separately.

The luminaires shall be suitable for operation with mid-power LEDs.

Note that no LED tubes are allowed to be used unless stated otherwise.

The luminaire shall be marked with identification labels stating the brand name and model and shall bear the SANS approval mark.

All luminaires shall have a minimum 5-year warranty.

The Contractor shall populate a luminaire order schedule indicating the luminaires and submit to the engineer before orderings for approval by the engineer. The contractor shall only place an order after approval by the engineer

3.1.2 Physical and Environmental Requirements

The luminaires are intended for standard indoor use in buildings.

The luminaires shall be suitable for mounting in or against ceilings as described in the Luminaire schedule drawings.

Luminaires housing and bodies shall be manufactures from either powdercoated cold rolled sheet steel not less than 0,8mm thick, suitably braced or stiffened to prevent distortion or powdercoated die cast LM6 marine grade aluminium.

The luminaire colours shall be indicated by the architect.

Luminaire optics / lenses and diffusers shall be as per luminaire schedule drawings and shall be either of the UV stabilised polycarbonate, PMMA, UV stabilised acrylic or tempered glass as per luminaire schedule drawing.

Luminaire optics / lenses / diffusers shall be fixed via stainless steel screws or clips.
The luminaire must be able to withstand an ambient temperature of 35°C. Storage temperature of this luminaire should be able to handle -40°C < T < 60°C.

The Luminaire operating temperature ranges shall be -30°C < T < 45°C.

The luminaire operating relative humidity shall be 5% to 95%.

To this end internal electrical and mechanical components shall not be allowed to exceed their maximum temperature ratings of 75°C. Test reports from an independent authorised testing facility proving this requirement shall be made available on request.

The noise level emitted from the luminaire shall be kept as low as possible. Drivers/electronic components shall therefore fully comply with the latest edition of SANS 55015.

Suitable knockouts shall be provided in the rear/sides of the luminaire body for wire entry.

All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof. Cadmium plated or stainless-steel materials are preferred.

Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body.

The wiring shall be totally metal enclosed to prevent any possible contact with live components while changing lamps.

The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deteriorations

The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.

An earth terminal, welded to the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug

3.1.3 Electrical Requirements

The luminaires light sources shall be mid powered LEDs. No Led tubes allowed unless otherwise stated in the luminaire schedule.

The Luminaires colour temperature shall be 4000K unless otherwise stated in the luminaire schedule.

The luminaire shall be suitable for operation on a 230V single phase 50Hz mains supply with +-10% voltage fluctuations.

Power factor capacitors shall be supplied to correct the power factor to at least 0.98 of higher.

The driver shall comply with IEC 61347-1 and IEC 61347-2B as applicable and shall be suitable for operation on 230V +-10%, 50Hz single phase system and it must be insured that harmonics filter is provided as per SANS 61000-3-2. The drivers and LED circuitry shall be protected against lighting and power surges. Suitable surge arrestors with a 10kA rating shall be provided for indoor installations and 20kA for outdoor installations.

Colour rendering (Ra) shall be not less than 80 and lumen depreciation of not more than 30% L70 at 50 000 hours @ Tq 25°C.

The luminaires shall be DALI and dimmable options unless otherwise stated in the Luminaire schedule. The design life of the luminaires shall be no less than 100 000 hours.

All luminaires shall be supplied complete with a 3meter cabtyre and 5 Amp plugtop cord unless stated otherwise.

3.1.4 IP and IK Ratings

Interior luminaires shall have the minimum IP ratings as set out in below table unless otherwise stated in the luminaire schedule:

APPLICATION	TYPE	MIN IP RATING
Offices	Ceiling / surface	20
Circulation and reception	Ceiling / surface	20
Ablutions	Ceiling / surface	65
Kitchens, bakeries, butcheries etc.	Ceiling / surface	65
Electrical plant rooms	Ceiling / surface	65
Pumps and mechanical pump rooms	Ceiling / surface	65
Substations	Ceiling / surface	65
Food and beverage works and display areas.	Ceiling / surface	65

3.1.5 Luminaire Mounting

The Contractor is to note that in the case of board and acoustic tile ceilings, i.e. as opposed to concrete slabs, close co-operation with the building contractor is necessary to ensure that as far as possible the luminaires are symmetrically positioned with regard to the ceiling pattern.

The layout of the luminaires as indicated on the drawings must be adhered to as far as possible.

Luminaires installed against concrete/masonry ceilings/walls shall be screwed to the outlet boxes and in addition 2 x 6mm expansion or other approved type fixing bolts (drop-in anchors) are to be provided. The bolts are to be ¾ of the length of the luminaires apart.

Luminaires to be mounted on board ceilings shall be secured by means of four 40mm x No. 10 round head screws and washers. The luminaires shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed ¾ of the length of the fitting apart. The screws shall be fixed to branderings as far as possible

Earth conductors must be drawn in with the circuit wiring and connected to the earthing terminal of all fluorescent luminaires as well as other luminaires exposed to the weather in accordance with the “Wiring Code”.

Where any other mounting is required, this shall be incorporated in the contractor’s rates for luminaire installation.

3.1.6 Photometric Data

The lighting layout designs are based on specific luminaire photometric data and thus the contractor shall submit with his bid the photometric data of each luminaire to verify compliance with the designs. Where this data is not available or not according and in compliance with the designs, the luminaires shall not be accepted by the engineer for installation.

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements, shall be submitted with the contractors bid.

3.2 Prison Cell Luminaire

3.2.1 General

The luminaire is to be used inside prison cells and in the ablution areas of prison cells.

All Light fittings installed for this project is to be of the LED type, unless otherwise stated.

The above mentioned international standard specifications and South-African Bureau of Standards shall apply to the LED luminaire specification:

To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.

If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.

Sample luminaires shall be provided for evaluation and approval by the Electrical Engineer prior to installation and this will form part of the contractors' rates.

Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.

Where luminaires have separate light sources and lamps, these shall be delivered separately.

The luminaires shall be suitable for operation with mid-power LEDs.

Note that no LED tubes are allowed to be used unless stated otherwise.

The luminaire shall be marked with identification labels stating the brand name and model and shall bear the SANS approval mark.

All luminaires shall have a minimum 5-year warranty.

The Contractor shall populate a luminaire order schedule indicating the luminaires and submit to the engineer before orderings for approval by the engineer. The contractor shall only place an order after approval by the engineer

3.2.2 Physical and Environmental Requirements

Due to the location of the luminaire special attention is required to render the luminaire tamper-proof and materials used shall be vandal resistant.

The luminaire shall be of the surface-mounted type. The main body of the luminaire shall be rigid and so designed that it can be firmly fixed flush onto the mounting surface without exposing gaps into which flat

objects can be inserted.

The luminaire shall have no dust-collecting or sharp edges and comers on the accessible side of the luminaire.

The luminaire shape shall be designed so as to prevent the manual gripping of the luminaire to prevent persons from hanging onto the body of the luminaire.

The luminaire must be able to withstand an ambient temperature of 45°C. To this end internal electrical and mechanical components shall not be allowed to exceed their maximum temperature ratings. Test reports from an independent authorised testing facility proving this requirement shall be made available to the Department on request.

The luminaire shall bear the SANS 1464 safety mark.

Due to the sensitive environment in which the luminaire is used, the noise level emitted from the luminaire shall be kept as low as possible. The ballasts shall, therefore, comply fully with the requirements of the latest edition of SANS 890 Part 1.

Nominal dimensions shall be 1 310 x 140 x 120mm or 1610 x 140 x 120mm. The luminaire shall have a rigid high-pressure die-cast aluminium body at least 1mm thick, or, alternatively shall be made from 0,8mm thick cold rolled mild steel. The body shall have a minimum of four holes for mounting flush to the mounting surface by means of expansion bolts. The body shall be suitable to house the main light source with night light applications.

Mounting studs and materials shall be provided with each luminaire, including installation instructions as necessary.

The diffuser shall consist of a one-piece injected moulding of clear ultra-violet-stabilised polycarbonate of high-impact resistance. The light control shall be achieved by internal prisms moulded longitudinally as part of the diffuser. The outer surface of the diffuser shall be completely smooth and shall be shaped to prevent persons from obtaining a firm handgrip on the diffuser.

The diffuser shall be provided with a replaceable neoprene gasket and the diffuser shall be fixed to the luminaire body by means of six tamper-proof stainless-steel bolts with stainless steel washers. The bolt-heads shall preferably be of a flat construction with two pinholes for the insertion of a special tool for fastening or loosening. Sunken hex-heads (for Alien keys) shall preferably not be used. Other tamper-proof proposals may be submitted to the engineer for approval.

The diffuser and body shall be manufactured within close tolerances so that no gaps exist between the body and the diffuser when the diffuser is screwed down.

The control gear tray shall also act as a reflector and shall be manufactured from sheet steel of at least 0,7mm thickness. The gear tray shall be white epoxy powder coated after all cutouts and holes have been prepared on the tray. Alternatively, the gear tray may be made from bright anodised extruded aluminium.

The gear tray shall be mounted to the body by means of identical tamper-proof bolts to those holding the diffuser. The mounting shall, however, be provided with a slide-in facility so that the gear tray can be easily removed without unscrewing the bolts completely. The gear tray shall be completely removable for workshop maintenance and interchangeability.

The gear-tray shall be provided with restraining devices to prevent the tray from falling when the gear-tray is slid out. These restraints shall be unhooked for removal of the tray.

gear-tray shall house the ballast, capacitors and glow-starters in the top section, whilst the lamp holders and lamps must occupy the bottom side of the reflector plate.
The gear tray should be equipped with control gear and circuits to operate the main light source and night

light. Equipping for this option is specified in the detail specification if it is required.

Preparation of all metal surfaces for the painting or epoxy powder coating thereof shall be done in accordance with SANS VC8031.

The luminaire must be able to withstand an ambient temperature of 35°C. Storage temperature of this luminaire should be able to handle -40°C < T < 60°C.

The Luminaire operating temperature ranges shall be -30°C < T < 45°C.
The luminaire operating relative humidity shall be 5% to 95%

To this end internal electrical and mechanical components shall not be allowed to exceed their maximum temperature ratings of 75°C. Test reports from an independent authorised testing facility proving this requirement shall be made available on request.

The noise level emitted from the luminaire shall be kept as low as possible. Drivers/electronic components shall therefore fully comply with the latest edition of SANS 55015.

Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body.

The wiring shall be totally metal enclosed to prevent any possible contact with live components while changing lamps.

The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deteriorations

The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.

An earth terminal, welded to the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug

3.2.3 Electrical Requirements

The luminaires light sources shall be mid powered LEDs. No Led tubes allowed unless otherwise stated in the luminaire schedule.

The Luminaires colour temperature shall be 4000K unless otherwise stated in the luminaire schedule.

The luminaire shall be suitable for operation on a 230V single phase 50Hz mains supply with +-10% voltage fluctuations.

Power factor capacitors shall be supplied to correct the power factor to at least 0.98 of higher.

The driver shall comply with IEC 61347-1 and IEC 61347-2B as applicable and shall be suitable for operation on 230V +-10%, 50Hz single phase system and it must be insured that harmonics filter is provided as per SANS 61000-3-2. The drivers and LED circuitry shall be protected against lighting and power surges. Suitable surge arrestors with a 10kA rating shall be provided for indoor installations and 20kA for outdoor installations.

Colour rendering (Ra) shall be not less than 80 and lumen depreciation of not more than 30% L70 at 50 000 hours @ Tq 25°C.

The luminaires shall be DALI and dimmable options unless otherwise stated in the Luminaire schedule.

The design life of the luminaires shall be no less than 100 000 hours.

For ease of maintenance, it is imperative that the gear-tray should be completely removable with ease, including the disconnection of the electrical supply internally. Removal of the diffuser and gear tray must only be possible by means of a special unscrewing tool.

The connection between the gear tray equipment and the incoming mains shall preferably be via a suitable sturdy plug and socket for easy disconnection.

3.2.4 IP and IK Ratings

The luminaire shall have an ingress protection rating of IP66 and this shall be substantiated by a certificate of the South African National Standards.

3.2.5 Luminaire Mounting

The Contractor is to note that in the case of board and acoustic tile ceilings, i.e. as opposed to concrete slabs, close co-operation with the building contractor is necessary to ensure that as far as possible the luminaires are symmetrically positioned with regard to the ceiling pattern.

The layout of the luminaires as indicated on the drawings must be adhered to as far as possible.

Luminaires installed against concrete/masonry ceilings/walls shall be screwed to the outlet boxes and in addition 2 x 6mm expansion or other approved type fixing bolts (drop-in anchors) are to be provided. The bolts are to be ¾ of the length of the luminaires apart.

Luminaires to be mounted on board ceilings shall be secured by means of four 40mm x No. 10 round head screws and washers. The luminaires shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed ¾ of the length of the fitting apart. The screws shall be fixed to branderings as far as possible.

Earth conductors must be drawn in with the circuit wiring and connected to the earthing terminal of all fluorescent luminaires as well as other luminaires exposed to the weather in accordance with the “Wiring Code”.

Where any other mounting is required, this shall be incorporated in the contractor’s rates for luminaire installation.

3.2.6 Photometric Data

The lighting layout designs are based on specific luminaire photometric data and thus the contractor shall submit with his bid the photometric data of each luminaire to verify compliance with the designs. Where this data is not available or not according and in compliance with the designs, the luminaires shall not be accepted by the engineer for installation.

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements, shall be submitted with the contractors bid.

3.3 Exterior Luminaires

3.3.1 General

All Light fittings installed for this project is to be of the LED type, unless otherwise stated.

The above mentioned international standard specifications and South-African Bureau of Standards shall

apply to the LED luminaire specification:

To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.

If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.

Sample luminaires shall be provided for evaluation and approval by the Electrical Engineer prior to installation and this will form part of the contractors' rates.

Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.

Where luminaires have separate light sources and lamps, these shall be delivered separately.

The luminaires shall be suitable for operation with mid-power LEDs.

Note that no LED tubes are allowed to be used unless stated otherwise.

The luminaire shall be marked with identification labels stating the brand name and model and shall bear the SANS approval mark.

All luminaires shall have a minimum 5-year warranty.

The Contractor shall populate a luminaire order schedule indicating the luminaires and submit to the engineer before orderings for approval by the engineer. The contractor shall only place an order after approval by the engineer

3.3.2 Physical and Environmental Requirements

The luminaires are intended for exterior and outdoor use and thus

Outdoor luminaires shall be split into three categories namely: Bulkhead, Post top luminaires and Flood light luminaires

Bulkhead luminaires shall be suitable for mounting against concrete and masonry.

Post top luminaires shall be suitable for mounting on poles with a 76MM diameter bottom entry spigot entry and secured by stainless steel grub screws.

Floodlight luminaires shall be suitable for mounting on pole top brackets, walls, masonry etc via adjustable stainless steel stirrup mount as per detail drawings and luminaire schedule.

Luminaires housing and bodies shall be manufactured from powdercoated die cast LM6 marine grade aluminium. The luminaire powdercoating colours shall be indicated by the architect.

Luminaire optics / lenses and diffusers shall be as per luminaire schedule drawings and shall be either of the UV stabilised polycarbonate, PMMA, UV stabilised acrylic or tempered glass as per luminaire schedule drawing.

Luminaire optics / lenses / diffusers shall be fixed via stainless steel screws or clips.

The luminaire must be able to withstand an ambient temperature of 35°C. Storage temperature of this luminaire should be able to handle -40°C < T < 60°C.

The Luminaire operating temperature ranges shall be -30°C < T < 45°C.

The luminaire operating relative humidity shall be 5% to 95%

To this end internal electrical and mechanical components shall not be allowed to exceed their maximum temperature ratings of 75°C. Test reports from an independent authorised testing facility proving this requirement shall be made available on request.

The noise level emitted from the luminaire shall be kept as low as possible. Drivers/electronic components shall therefore fully comply with the latest edition of SANS 55015.

Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body.

The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deteriorations.

The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.

An earth terminal, welded to the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

3.3.3 Electrical Requirements

The luminaires light sources shall be mid powered LEDs.

The Luminaires colour temperature shall be 4000K unless otherwise stated in the luminaire schedule

The luminaire shall be suitable for operation on a 230V single phase 50Hz mains supply with +-10% voltage fluctuations.

Power factor capacitors shall be supplied to correct the power factor to at least 0.98 of higher.

The driver shall comply with IEC 61347-1 and IEC 61347-2B as applicable and shall be suitable for operation on 230V +-10%, 50Hz single phase system and it must be insured that harmonics filter is provided as per SANS 61000-3-2. The drivers and LED circuitry shall be protected against lighting and power surges. Suitable surge arrestors with a 10kA rating shall be provided for indoor installations and 20kA for outdoor installations.

Colour rendering (Ra) shall be not less than 80 and lumen depreciation of not more than 30% L70 at 50 000 hours @ Tq 25°C.

The luminaires shall be DALI and dimmable options unless otherwise stated in the Luminaire schedule.

The design life of the luminaires shall be no less than 100 000 hours.

3.3.4 IP and IK Ratings

Exterior Bulkhead, post top and Floodlight luminaires shall have the minimum IP ratings of IP66.

Further to this the luminaires shall have an IK rating of minimum IK 08.

3.3.5 Luminaire Mounting

Bulkhead luminaires installed against concrete/masonry walls shall be screwed to the outlet boxes and in addition 2 x 6mm expansion or other approved type fixing bolts (drop-in anchors) are to be provided. The bolts are to be ¾ of the length of the luminaires apart.

Post top luminaires shall be mounted via bottom entry 76mm dia spigot mount fixed via stainless steel allen head grub screws.

Floodlight luminaires shall be complete with adjustable stainless steel stirrup mounting brackets with a minimum of three mounting holes. Floodlight luminaires installed against concrete/masonry walls shall be fixed via 2 x 10mm expansion or other approved type fixing bolts (drop-in anchors).

Where floodlights are to be pole mounted this shall be done via a pole mounted bracket and the floodlight stirrups shall be mounted on the pole mount bracket complete with 10mm stainless steel hex bolts with nuts and washers.

Where any other mounting is required, this shall be incorporated in the contractor's rates for luminaire installation.

3.3.6 Photometric Data

The lighting layout designs are based on specific luminaire photometric data and thus the contractor shall submit with his bid the photometric data of each luminaire to verify compliance with the designs. Where this data is not available or not according and in compliance with the designs, the luminaires shall not be accepted by the engineer for installation.

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements, shall be submitted with the contractors bid.

4. AREA LIGHTING GRP POLES

The pole shall be constructed by the filament winding process to achieve optimum results for strength and rigidity. The filament winding process shall be continuously applied with uniform tension onto a rotating mandrel and shall result in a minimum mass glass to resin ratio of 70:30. The surface shall be seamless, smooth and tapered.

The material of the finishing coat shall be a gel coat that shall comply with the requirements of SANS 1749 and shall be applied to a uniform thickness of between 250 and 500 microns. It shall provide a weatherproof, UV resistant, flame resistant and impact strong surface in the colour specified.

A standard pole supporting a luminaire with a wind surface of 0.20m² shall not have a pole top deflection of more than 5% of its height above ground when subjected to a basic wind pressure of 500 Pa. A safety factor of 2.5 times the total maximum windload shall be applicable.

The pole shall be manufactured in accordance with SANS 1749 under the ISO 9002 quality system.

The access opening cut-out shall be covered by an access door cover manufactured from glass filled nylon impregnated in the same colour as that of the surface coat. It shall be secured to the pole by two stainless steel Allen head captive screws into M4 brass inserts embedded in the pole.

A cable entry with a minimum diameter of 34mm shall be provided at a minimum depth of 400mm below the ground surface.

A hot dipped galvanised glandplate, suitable for gland no. 0 or 1, complete with terminal block and DIN rail for a miniature circuitbreaker, shall be provided and shall be mounted to a bolt provided in the access opening.

Poles for direct embedment in the ground shall be provided with a 300x300x1.6mm hot dipped galvanised baseplate complete with 2 x hot dipped galvanised steel hookbolts and nuts. Base mounted poles shall have a hot dipped galvanised flange plate that can be bolted to a foundation which shall be designed to withstand the forces the pole will experience in service.

RELEVANT POLE DATA AND OTHER FACTORS		**CORRESPONDING CALCULATED KEY VALUES**		
Total length of pole **m**	Height of pole above ground **m**	Diameter of pole at ground level **mm**	Load to be applied in pole-top deflection test **N**	Maximum permitted deflection in pole-top deflection test **mm**
2.6	2.0	110	135.4	100
3.1	2.5	120	143.4	125
3.6	3.0	128	152.0	150
4.1	3.5	135	161.0	175
4.6	4.0	146	171.6	200
5.2	4.5	155	182.3	225
5.7	5.0	164	193.6	250
6.3	5.5	173	205.4	275
6.9	6.0	170	213.7	300
7.4	6.5	178	225.9	325
8.0	7.0	186	238.6	350
8.6	7.5	194	251.8	375
9.2	8.0	202	265.5	400
9.8	8.5	210	279.7	425
10.4	9.0	218	294.3	450
11.0	9.5	226	309.4	475
11.6	10.0	237	326.8	500
13.4	11.5	290	463.4	575
14.0	12.0	300	504.0	600

NOTES:
1. Relevant pole data is based on a shape factor of 0.7 and a calculated wind pressure of 500.14 Pa.
2. Corresponding calculated key values are based on a luminaire surface area of 0.2 m^2 with a shape factor of 1.

ELSPEC-05-LVSPP:
SMALL POWER POINTS AND WIRING

1. INTRODUCTION

This specification relates to the supply, installation, testing of small power points and wiring installations

2. SUPPORTING CLAUSES

2.1 Scope

This standard covers the general requirements for small power points and wiring.

Small power points and wiring would typically consist of all or part of the following:
a) Light switches
b) Switched socket outlets
c) Photovoltaic relays (Day/night switches)
d) Power clusters
e) Occupancy sensors
f) Isolators and equipment connections

This specification is not limited to above.

2.2 Normative/Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

SANS 1507-2	Fixed extruded insulation 300/500 V to 600/1 000 V
SANS 1574-3	Flexible, PVC or rubber insulated
SANS 1574-5	≤ 600/1 000 V
	Conductors ≤ 185 mm2
SANS 1574, SANS 60227-5	Flexible cords
	Conductors ≤ 4 mm2
SANS 1574-3	Fixed, flexible, PVC or rubber insulated ≤
SANS 1574-5	600/1 000 V
SANS 529	Single core; Cu; ≤ 300 V
	Rated temperature ≤ 250 °C

SANS 1213	Excluding – entirely non-metallic – for flameproof use
SANS 60947-3	≤ 1 000 V AC or 1 500 V DC Disconnectors (non-trip)
SANS 1411-1	Earth wire Bare copper
SANS 62103	Electrical and electronic equipment for use in installations
SANS 60529	Enclosures IP ratings
SANS 61238-1	Ferrules and lugs Ferrules and lugs for copper and aluminium conductors
SANS 1012	Light dimmers for incandescent lamps
SANS 60669-2-1 and VC 8003	– electromechanical 250 V – electronic – maximum of 3 kW
SANS 1085	Outlet boxes
SANS 164-0, SANS 164-1, SANS 164-2, SANS 164-3, SANS 164-4, SANS 164-5, SANS 164-6 and SANS 60884-1	Socket-outlets
SANS 60309-1 and SANS 60309-2	Socket-outlets (industrial type)
SANS 337	Stove coupler
SANS 61643-11	Surge arresters for low-voltage systems
SANS 60669-1	Switches (manually operated)
SANS 60669-2-1	Switches (photoelectric)
SANS 1777 SANS 60947-3	Switches and switch disconnectors (non-trip)
SANS 60669-2-1	Timer switches
SANS 60730-2-7 SANS 60947-6-1	Transfer switches
SANS 61558-1	Transformers (isolating) Test
SANS 61558-2-2	Control

SANS 61558-2-4	Separating (double-wound)
SANS 61558-2-5	Shaver units
SANS 61558-2-6	Safety isolating
SANS 61558-2-15	Medical locations
SANS 61347-2-2	Electronic convertors (for lamps)
SANS 10142-1	Wiring of premises

3. SMALL POWER POINTS AND WIRING REQUIREMENTS

3.1 General

All small power points, switches, isolators, isolators, occupancy sensors, equipment connections etc utilised in the wiring of premises shall conform to above normative standards.

The contractor shall submit the proposed equipment schedules from the manufacturer to the Engineer for approval before any procurement or order is placed.

Only Contractors registered at the department of Labour as an installation electrician or three phase electrician or master electrician may carry out any works on site and there shall be full time supervision on site by the registered person.

The IP ratings of different installations shall be adhered to, to ensure correct equipment ratings.

The installation shall be done according to SANS 10142-1.

Wiring to be carried out in conduit as far as possible and where any deviance is suggested this shall be approved by the engineer.

The following documentation shall be submitted to the engineer for approval before commencement with any work on site:

- Department of Labour registration as an electrical contractor
- Registered persons wiremen's license
- COIDA certification
- Organogram of site personnel
- Anticipated programme of works.
- Proposed equipment schedules.

This specification is only applicable to low voltage installations and the wiring thereof.

3.2 Low Voltage Wiring

All low voltage wiring shall be manufactured according to SANS 1507-2 and the copper conductors shall be high conductivity annealed stranded conductors to SANS 1411-1.

LV wiring shall be insulated with PVC unless otherwise as per SANS 10142-1.

The wiring voltage shall be 600/1000V and the wiring coils shall be standard 100m rolls.

Wiring sizes to be utilized as follows:

NO	PROTECTION CB(A)	WIRE SIZE (Sq mm)	MAX DISTANCE TO POINT OF CONSUMPTION
1	10	2.5	66m
2	20	4	52m
3	30	6	53m
4	40	6	39m
5	50	10	52m
6	60	16	68m

Where these distances to point of consumption is exceeded the contractor shall upsize these conductors according to SANS 10142-1 to not exceed the allowable 5% voltage drop.

Each circuit shall be wired with a separate live, neutral and earth conductors.

The type of LV system earthing philosophy shall be TN-C-S and all earth and neutral conductors within the premises shall be separated.

Earthing conductors shall be at least the same size (Sq mm) as the live and neutral conductors.

The wiring system shall consist of the loop in loop out system and no junction boxes will be allowed where these are not accessible for maintenance and checks.

No joints in wiring circuits will be allowed and only terminations at point of consumptions shall be allowed.

The colour coding shall be as per SANS 10142-1 and generally these colours shall be:

- Live conductors: Red
- Neutral conductors: Black
- Earth conductors: BCEW or Insulated Green/Yellow

No open wiring shall be allowed and wiring shall only be done in conduits and enclosed wiring ducting.

The number of circuits allowed to be installed in a conduit shall be as per below table and according to SANS 10142-1:

No	Conduit dia	Number of 1C GP wires/allowable conductors per conduit.			
		2.5mm	4mm	6mm	10mm
1	20	6	5	4	3
2	25	9	7	6	4
3	32	17	14	10	8

The following table indicates the general wiring of lighting and socket outlets and the conduit utilised and the number of circuits allowed per conduit:

No	Circuit type	Conductor	Conduit	Number of circuits/conduits
1	Lighting	2.5mm SQ	20mm Dia	2
2	Socket and Small power points	4mm SQ	25mm Dia	2
3	Stoves and Larger power points	6mm SQ	25mm Dia	2

The contractor shall before any equipment is connected at points of consumptions and before any terminations is done at luminaires and electronic equipment, test the insulation resistance of all LV wiring according to SANS 10142-1 with a “megger” type approved instrument.

Where any termination is carried out at luminaires, socket outlets or isolators etc, the terminations shall be carried out according to manufacturer’s specifications and shall be terminated with the appropriate sized insulated lugs / bootlace ferrules.

A maximum of three conductors may be connected to any one terminal provided that the terminal has the correct rating.

3.3 Socket Outlets

Socket outlets shall conform to SANS 164-0, SANS 164-1, SANS 164-2, SANS 164-3, SANS 164-4, SANS 164-5, SANS 164-6 and SANS 60884-1.

Wall mounted socket outlets shall be of the steel cover type (crabtree classic range)

Socket outlets shall be colour coded as follows:

NO	POWER	APPLICATION	COVER COLOUR	SWITCH COLOUR
1	normal	normal	white	white
2	normal	dedicated	white	white
3	emergency	normal	white	red
4	emergency	dedicated	red	red
5	ups	normal	white	blue
6	ups	dedicated	blue	blue

Where socket outlets are to be powerskirting, cluster wall/floor boxes and power poles, these shall be modular type outlets (crabtree diamond range).

Socket outlet ratings shall have a current rating of 16A

Socket outlet mounting heights shall be indicated on the drawings.

The Socket outlets arrangements shall be as per the drawings and Socket outlet schedules.

Where socket outlets are to be mounted outdoors these shall be mounted in a weatherproof enclosure.

3.4 Light Switches

Light switches shall comply to SANS 60669

Light switches shall be of the steel cover type (crabtree classic range)

Light switches arrangements shall be as per drawings.

Light switch current ratings shall be 20A

Light switches for outdoor weartherproof / vapour proof applications shall be the rotary type Matelec 16A IP54 type unless otherwise stated.

Day/night switches shall be of the HDAD square Matelec type with adjustable lux settings shall have a IP rating of 65 and a Current rating of 15A.

Dimmer switches shall be of the rotary LED 500w dimmer types unless otherwise specified.

3.5 Occupancy Sensors

Occupancy sensors shall be of the PIR surface or recessed mounted type with a motion detection range of 360deg with 10m radius for Motion and 6m radius for occupancy.

The unit shall have the switching capacity of 300w LED, 600W fluorescent and 2000W Incandescent.

The unit shall be time and lux adjustable and be similar to the Matelec/Major Tech.

3.6 Isolators

All Isolators shall comply to SANS 60947-3.

Isolators shall be of the steel cover type (crabtree classic range).

2 Pole 60A isolators shall be utilized on single phase connections.

3 Pole 60A isolators shall be utilized on three phase connections.

Where isolators are located indoors these shall be surface/wall mounted on an extension 4x4 box or recessed 4x4 wall box.

Where Isolators are located outdoors locations these shall be mounted in a PSO2-stealth IP66 weatherproof outlet box.

3.7 Equipment Connections

Equipment connections shall be done in accordance with SANS 10142-1 and below are some specifications but not limited to:

Single Phase Aircons (9000 to 30000btu)
The power to Air-condition outdoor units shall be via a 60A 2P weatherproof isolator mounted in a PSO2 stealth IP66 box. Connection shall be done via 2meter 20mm diameter flexible galvanised conduit complete with adaptors and bushes. 2-meter 4mmSQ GP wire Red, Black and BCEW (L,N,E) from isolator to equipment connections.

Indoor unit power shall be supplied from the outdoor unit terminations via 4mmSQ GP wire Red, Black and BCEW (L,N,E) installed in conduit or wiring ducting.

Three Phase Aircons (36000 to 60000 btu)
The power to Air-condition outdoor units shall be via a 60A 3P weatherproof isolator mounted in a PSO2 stealth IP66 box. Connection shall be done via 2meter 20mm diameter flexible galvanised conduit complete with adaptors and bushes. 2-meter 4mmSQ GP wire Red, Yellow, Blue, Black and BCEW (L1,L2,L3,N,E) from isolator to equipment connections.

Indoor unit power shall be supplied from the outdoor unit terminations via 4mmSQ GP wire Red, Yellow, Blue, Black and BCEW (L1,L2,L3,N,E) installed in conduit or wiring ducting

Single Phase Geysers
The power to the geyser units shall be via a 60A 2P weatherproof isolator mounted in a PSO2 stealth IP66 box. Connection shall be done via 2meter 20mm diameter flexible galvanised conduit complete with adaptors and bushes. 2-meter 4mmSQ GP wire Red, Black and BCEW(L,N,E) from isolator to equipment connections.

Hot and cold-water piping shall be bonded via 4mmSQ conductor to the earthing terminal inside the isolator.

Single Phase Hand Driers
The power to the hand drier units shall be via a 60A 2P weatherproof isolator mounted in a PSO2 stealth IP66 box. Connection shall be done with 2-meter 4mmSQ GP wire Red, Black and BCEW (L,N,E) from isolator to equipment connections.

Single Phase Gate motors and garage door openers
The power to the geyser units shall be via a 60A 2P weatherproof isolator mounted in a PSO2 stealth IP66 box. Connection shall be done via 2meter 20mm diameter flexible galvanised conduit complete with adaptors and bushes. 2-meter 4mmSQ GP wire Red, Black and BCEW (L,N,E) from isolator to equipment connections.

3.8 Labelling

All switches, socket outlets, isolators etc shall be identified with a unique instrument label.

The labels shall indicate the circuit number and from which DB it is fed.

The labels shall be clearly visible and be black lettering on white background at least 6mm in height.

The complete installation shall be labelled according to SANS 10142-1.

4. DOCUMENTATION

4.1 Drawings and Design Documentation

All drawings, information, and documentation shall be in the English language, Drawings for acceptance shall be provided on A3 paper copies.

Three copies shall be provided for all equipment supplied.

Manual formats shall be A4 size on the filing side which shall be vertical with 20 mm margin for filing.

The manuals shall include all technical product certificates and manuals of the installed equipment

5. TESTING AND COMMISSIONING

The contractor shall test the whole of the installation according to SANS regulations and shall indicate to the Engineer timeously when this testing is scheduled. The Testing and certification shall be in the presence of

the Engineer.

The Contractor shall complete the COC and issue the full COC for the whole of the installation. Each DB section shall have its own COC.

Additional test reports shall be attached in the format issued by the Engineer. A comprehensive photo reports shall be attached to the COC's. Practical completion and handover certificates as accepted by the client shall also be attached to the COC's.

The contractor shall supply all equipment necessary to fully test the installation for compliance and shall arrange for any additional test equipment that may be required by the Engineer.

ELSPEC-06-LVMOT:
ELECTRICAL MOTORS SPECIFICATIONS

1. INTRODUCTION

This specification relates to the supply, installation, testing of Low voltage electrical motors in pumpstations, fans, industrial installations.

2. SUPPORTING CLAUSES

2.1 Scope

This standard covers the general requirements for Low voltage electrical motors in pumpstations, fans, industrial installations.

A low voltage motor system would typically consist of all or part of the following:
a) Motor Materials
b) Motor ratings and performances
c) Motor frame types
d) Motor Efficiency
e) Motor IP ratings
f) Motor terminal arrangements

2.2 Normative/Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

SANS 1804-1	Induction motors Part 1: IEC requirements
SANS 1804-2	Induction motors Part 2: LV 3-phase standard motors
SANS 60034-1	Rotating electrical machines - Rating and performance
SANS 60034-2-1	Standard methods for determining losses & efficiency from tests
SANS 60034-30	Efficiency classes of single-speed, three-phase, cage-induction motors (IE-code)
SANS 60034-5	Rotating electrical machines Part 5: Degrees of protection Provided by the integral design of rotating electrical machines (IP code) – Classification
SANS 60034-14	Rotating electrical machines Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher. Measurement, evaluation and limits of vibration severity
SANS 60034-7	Rotating electrical machines Part 7: Classification types of construction, mounting arrangements, terminal box position
SANS 60034-6	Rotating electrical machines Part 6: Methods of cooling

3. GENERAL

All low voltage motors shall be manufactured according to normative standards.

This specification covers low voltage (up to and including 1 000 V), 3-phase, slip ring and squirrel cage induction motors up to 450 kW and at a frequency of 50 Hertz.

Motors must be 4 pole 400V type and suitable for DOL;Star/Delta; Soft starting and Variable speed drive operation, unless approved otherwise by the engineer.

Motors are to be supplied complete with a suitable cable box for feeder cables, terminal boxes, nuts, locknuts, intermediate disconnecting leads, cable lugs, etc.

Mounting bolts and geared half-couplings must be included in the motor's price.

Preferred motors:
a) Actom motors to be used throughout where possible, unless approved otherwise by the engineer.
b) Motors in Pump stations to be horizontal mount, unless approved otherwise by the engineer.
c) Motors at Boreholes to be vertical mount, unless approved otherwise by the engineer.

4. MOTORS TYPE CONSTRUCTION

Motor to be used shall be of the TEFC (totally enclosed fan cooled) Cast Iron type.

Motors shall be rated at 400V 50hZ.

All materials must be new and of the quality class most suitable for the purpose specified.

All parts must be capable of withstanding variations of temperature arising under working conditions without distortion, deterioration or setting up of undue strain in any part.

Quality control must be in accordance with ISO 9001.

Motors of the same rating must be identical, fully interchangeable and from the same motor manufacturer.

All similar parts are to be made accurately to dimensions and must be interchange-able with each other, so that a spare part or any part of another similar motor can be used satisfactorily in the relevant position on a motor without recourse to additional machining or filing.

5. MOTOR RATINGS

Motors shall be premium efficiency motors with an efficiency rating of IE3 to IEC 60034–30, IEC 60034–2–1.

Motors must have continuous maximum ratings not less than the following:
- 50 kW or under, not less than 25 % in excess of the maximum likely to be drawn by the load within the operating range.
- Over 50 kW and up to 100 kW, not less than 15 % in excess of the maximum likely to be drawn by the load within the operating range.
- Over 100 kW, not less than 10 % in excess of the maximum likely to be drawn by the load within the operating range unless otherwise specified.
- Where operating at other than continuous running duty is required, (i.e. short time or intermittent periods, as for valve actuators, hoists etc.), motors must have appropriate ratings in respect of output, duty and starting class.
- All motors will be capable of continuous operation over the range of temperatures from - 10° C to + 45°C with a 24-hour continuous maximum ambient of 35° C at the specified altitude.
- All motors will be suitable for operation at any voltage between ± 10 % of the nominal value and ± 2 % of nominal frequency at the altitude specified.

Motors shall be 4-Pole motors unless otherwise stated.

Standard motor ratings shall be as per table on next page:

STANDARD MOTOR RATINGS (IE3) (4 Pole)

Output	Frame Size	Type	Speed	Pole	Current at 400 V	Current at 525 V	FLT	Efficiency			Power Factor			D.O.L		BDT	LRT (s)		Rotor Inertia	Motor Mass
kW		LS6	r/min		A	A	Nm	(%)	(%)	(%)				Starting	pu	p.u.	Cold	Hot	kg.m²	kg
								4/4	3/4	1/2	4/4	3/4	1/2	Torque	Current					
0.37	71	073	1330	4	0.95	0.72	2.7	77.4	76.5	74.0	0.73	0.71	0.63	2.1	6.0	2.2	26	12	0.0010	16
0.55	80	080	1390	4	1.31	1.00	3.8	81.0	79.5	78.0	0.75	0.72	0.65	2.3	7.3	2.3	24	8	0.0016	17
0.75	80	083	1390	4	1.75	1.33	5.2	82.6	82.2	80.5	0.75	0.72	0.65	2.3	7.3	2.3	23	8	0.0020	18.5
1.1	90S	090	1440	4	2.47	1.88	7.3	84.7	84.7	83.1	0.76	0.72	0.65	2.3	6.8	2.3	18	10	0.0030	24
1.5	90L	093	1440	4	3.28	2.50	9.9	85.7	86.1	84.3	0.77	0.73	0.66	2.3	7.0	2.3	13	7	0.0040	29.5
2.2	100L	101	1440	4	4.50	3.43	14.6	87.2	87.0	86.5	0.81	0.78	0.71	2.3	7.5	2.3	16	9	0.0077	39.5
3	100L	102	1440	4	5.99	4.57	19.9	88.1	88.1	87.1	0.82	0.78	0.72	2.3	7.5	2.3	18	11	0.0093	43.5
4	112M	112	1440	4	7.92	6.03	26.5	88.9	89.0	88.5	0.82	0.77	0.72	2.3	7.5	2.3	18	6	0.0171	52
5.5	132S	130	1460	4	10.8	8.21	36.0	89.9	89.8	88.9	0.82	0.78	0.74	2.3	7.5	2.3	25	10	0.0339	66
7.5	132M	133	1465	4	14.6	11.1	48.9	90.7	90.9	90.3	0.82	0.78	0.74	2.3	7.5	2.3	21	9	0.0448	78
9.2	132M	135	1465	4	17.9	13.6	60.0	90.7	90.9	90.3	0.82	0.78	0.74	2.3	7.5	2.3	21	9	0.0556	95
11	160M	163	1475	4	20.4	15.5	71.2	91.7	91.8	90.9	0.85	0.81	0.72	2.0	7.5	2.3	19	6	0.0900	122
15	160L	166	1475	4	27.2	20.8	97.1	92.4	92.6	92.0	0.86	0.82	0.73	2.0	7.5	2.3	17	6	0.0180	140
18.5	180M	183	1470	4	33.4	25.4	120	93.0	92.8	91.7	0.86	0.84	0.78	2.0	7.8	2.1	19	7	0.0148	188
22	180L	186	1470	4	39.6	30.2	143	93.3	93.0	92.0	0.86	0.84	0.78	2.0	7.8	2.1	18	6	0.0182	193
30	200L	207	1475	4	53.7	40.9	194	93.8	93.7	92.7	0.86	0.82	0.77	2.0	7.3	2.3	25	11	0.321	295
37	225S	220	1480	4	65.9	50.2	239	94.2	94.0	93.4	0.86	0.82	0.78	2.2	7.9	2.3	18	9	0.473	308
45	225M	223	1480	4	79.9	60.9	290	94.5	94.3	93.9	0.86	0.82	0.78	2.2	7.9	2.3	25	12	0.554	337
55	250S	253	1490	4	97.4	74.2	352	94.8	94.5	93.7	0.86	0.84	0.76	2.2	7.4	2.3	21	10	0.751	410
75	250M	255	1495	4	132	101	479	95.2	94.8	94.1	0.86	0.84	0.76	2.0	7.4	2.3	22	10	0.91	430
90	280S	283	1480	4	155	118	581	95.5	95.3	94.4	0.88	0.85	0.78	2.0	7.5	2.3	26	12	2.32	652
110	280M	285	1480	4	189	144	710	95.7	95.5	94.5	0.88	0.85	0.78	2.0	7.5	2.2	25	12	2.83	720
132	315S	310	1480	4	225	170	852	95.9	95.7	94.9	0.89	0.87	0.83	2.1	7.6	2.2	25	13	2.58	1055
160	315M	311	1480	4	270	205	1032	96.0	95.8	95.1	0.89	0.87	0.83	2.1	7.6	2.2	24	13	2.96	1155
185	315L	312	1480	4	315	240	1194	96.0	95.9	95.4	0.89	0.87	0.83	2.1	7.6	2.2	24	12	3.21	1200
200	315L	313	1480	4	335	255	1290	96.0	95.9	95.4	0.90	0.87	0.83	2.1	7.6	2.2	25	13	3.46	1230
225	315LX	314	1485	4	385	295	1447	96.2	96.2	95.0	0.88	0.87	0.85	2	7.1	2.2	24	11	6.4	1597
250	315LX	315	1485	4	430	325	1608	96.2	96.2	95.0	0.88	0.87	0.85	2	7.1	2.2	25	11	6.9	1601

6. IP RATINGS

The motors shall have a degree of protection of IP 66.

7. INSULATION CLASS

All motors shall have a Class H insulation rating with a class B temperature rise rating

8. BEARING ARRANGEMENTS

Motors with ratings up to and including 9.2kW shall have sealed bearings and motors with ratings from 11-250kW shall have re-greaseable bearings

Bearing must be plain, ball or roller type, as appropriate unless otherwise specified.

Vertical shafts, must have approved thrust and guide bearings. Grease-lubricated bearings must be provided.

The grease must be **ENGEN GENLEX 42 MT** and where applicable oil must be **ENGEN TURBINE 46**.

When the motor shaft is not located axially by its own bearings, it must be permanently marked to indicate its normal running position and the extent of float in either direction.

Ball, or roller bearings must be loaded conservatively, in order that the grease may be renewed at intervals of not less than one year, and they must be equipped with grease nipples or cups.

Care must be taken that bearings are sealed properly, in order to prevent ingress of bearing lubricant into windings and cores. For purpose of maintenance, end-shield bearings are preferred. A minimum bearing life of 40 000 hours is required. Unless otherwise approved in writing, motor bearings must be designed to allow the motor to run indefinitely, when uncoupled from the driven machine.

Where necessary, to prevent damage by any shaft currents, which may be produced, the bearings and their lubricating and cooling systems must be insulated from the bedplate or frame.

9. TERMINAL BOXES

The terminal box for the supply cables must be suitable for the cables specified and must be oversized. It must have a removable cover and gland plate. The degree of protection must not be less that IP 66.

Cable outlets must be capable of pointing to any of four directions at 90-degree intervals.

All terminals must be properly and permanently marked for easy identification. Terminal boxes must be on the top/right hand side if viewed from the drive end unless otherwise specified.

10. NAME PLATES FOR MOTORS

In addition to the information required by standards, the following need to be identified on the nameplates.

- Year of manufacture.
- The order number.
- Total mass of motor in kg.
- Diagram indicating the number, type and positions of temperature detectors.
- Bearing types and sizes.
- Bearing grease interval.

11. TEMPERATURE DETECTORS

The motors shall be supplied with bearing RTD's.

The motors shall be supplied with Winding RTD's.

12. MOUNTING

The motors must be mounted as required by the driven equipment supplied.

Each motor must be mounted on a common base-plate with the equipment driven.

When uncoupled from the load, it must be possible to lift the motor clear without withdrawing the rotor and with the minimum amount of dismantling.

13. ROTATION

The normal rotation of the motors must be co-ordinated by the contractor with the supplier of the driven equipment. All AC motors must be capable of having their direction of rotation reversed, merely by interchanging the supply leads. AC motors fitted with unidirectional fans, and therefore not capable of being easily reversed, must be supplied with a double- ended shaft and the holding-down boltholes must be symmetrical about both centre lines. This will permit the motor to be rotated through 180 degrees and coupled to the load, giving an opposite drive. A suitable cover must be provided for the unused bare shaft extension.

The above arrangement also requires that two motor terminal boxes are provided diametrically opposite each other. The correct direction of rotation of a unidirectional motor must be indicated in a permanent manner on the frame.

14. BALANCE AND CRITICAL SPEED

Motors and couplings must be accurately and efficiently balanced statically, and dynamically, so that there will be no unbalanced end-thrust, when either new or worn, and to eliminate noise and vibration when running.

Where end-thrust arises, adequate longwearing thrust bearings must be provided. Dynamic balancing must be done by the removal of parent metal, in a manner, which does not affect the structural strength of the rotating element.

The use of solder, or similar deposits for balancing, will not be accepted. The operating speed of rotating elements must be below and as far removed as is possible from the critical resonant speeds thereof.

Vibration of all rotating equipment during operation must be to the satisfaction of the Engineer. Strict attention must be paid to this aspect of the installation and certificates must be provided.

Notwithstanding the acceptance of the vibration limits during the works test, Sedibeng Water reserves the right to call for a vibration test on the installed equipment, if he considers it necessary and the contractor must be responsible for reducing the vibrations to within the specified peaks and provide certificates.

15. INSPECTION OF MANUFACTURED EQUIPMENT

The Engineers, reserves the right to inspect the motors or associated parts at any stage of manufacture.

The Contractor must ascertain when inspection is required and the contractor must then give the Engineers not less than seven days' notice of when such inspection may be undertaken.

16. GUARANTEE AND MAINTENANCE

The complete installation must be fully guaranteed for a period of twelve months from the date of commissioning. A complete full maintenance service must be provided during this period. The Tenderer must indicate with in tender what duties have been included and the time intervals between services. Should the Tenderer fail to provide this information; Sedibeng Water will lay down the duties as well as time intervals with which the contractor must comply.

Four copies of all test certificates, showing the results of all tests performed, will be supplied at a date not later than the delivery date of the motors.

17. DRAWINGS AND INFORMATION FOR APPROVAL

The following drawings and information must be submitted for approval by the Engineer before manufacture commences:

- Dimensioned outline and required foundation drawings of the motors. (Shaft diameter, shaft height and motor mass to be clearly shown).
- Cross-sectional dimensioned drawings of the cable boxes. Detailed drawings of the motor base plate showing full constructional details with dimensions.
- Motor specifications indicating ratings, efficiencies, etc

18. TEST IN THE FACTORY

Type Tests

One motor of every type, 50 kW and larger, must be tested for temperature rise, efficiency and pullout torque. Type test certificates on identical motors will be acceptable in lieu of these tests for motors smaller than 50 kW. Should type test certificates for motors smaller than 50 kW not be available then the first motor of each size manufactured must be tested.

The measurement of the temperature rise of the stator windings of the motors must be by the increase in resistance method unless otherwise specified.

In addition to the type tests specified in SABS 948 the following must be done:

- Vibration Test: The amplitude of vibration (peak to peak) is to be measured in microns.
- Efficiency Test: The efficiency must be measured for full load and rated duty load.
- Temperature detector readings must be taken at intervals of the test.

Test Certificates

Four copies of all test certificates, showing the results of all tests performed, must be supplied at a date not later than the delivery date of the motors.

19. ERECTION AND COMMISSIONING

Erection

Where possible, motors must be erected by the motor supplier. Care must be taken to ensure that adequate tolerance margins are made available to ensure interchange ability with replacement motors. Tenderer must indicate with the tender who will erect the motors

A minimum of 10 mm of packers must be provided under the motor frame of motor bedplate to allow for adjustment in height.

Before holding-down bolts are grouted in, the motor must be lined up and the bolts must be properly centred in the hole of the bedplate.

The contractor must satisfy himself that the motors are properly installed, aligned and sufficiently protected and must check the settings of all motor protection gear before any motor is switched on.

The Engineer must be notified at least 7 days in advance of any commissioning or testing to enable him to be present

The contractor who supplies the motors must ensure that the overloads protecting the motors are suitable rated to protect the motor or that the protection relays, where applicable, are correctly set.

Bearing Inspection

The Engineer must inspect motors with ball/roller bearings. The grease must be examined to ensure that it is not hard. No roughness must be felt when the shaft is rotated by hand and the motor must run without undue noise or vibration. A complete set of spare anti-friction bearings must be provided for each motor and delivered at the same time as the motor. Should the bearings fail or exhibit symptoms or brine ling during the guarantee period, the contractor, free of charge, without delay, must change them.

Alignment

After erection, the alignment of the geared half-coupling between the motor and the driven machine must be measured. In the case of a pedestal bearing motor, the air gap clearance between the rotor and the stator must also be measured. A record must be kept of these figures and they must be submitted to the Engineer for approval.

A horizontal sleeve bearing or limited end-float roller bearing motor must be run uncoupled from its load to ensure that it rotates at the axial position indicated on the shaft and that the rotor is free to move to either side of this position. Particular attention must be paid to ensure that the free running position and the rotor end-float are in agreement with the axial movement of the geared coupling

Insulation Resistance

Before energising any of the motors, for the purpose of commissioning, the contractor must measure the insulation resistance of each motor between phases and casing with a 500 Volt “Megger” instrument, which values must be recorded and forwarded to Sedibeng Water for information. If any of the readings for a particular motor are lower than 1,5 megohms, that motor must not be energised until it has been dried out by the contractor by a method to Sedibeng Water’s prior approval.

The method adopted for drying-out must be by applying heat, preferably by circulating current through the windings or, alternatively, by means of space heaters located in and around the machine.

Insulation resistance measurements and temperature readings must be taken regularly every hour until the motor attains an even temperature and thereafter every hour for the duration of the dry out period. The characteristic dry-out curve of insulation resistance versus temperature must be plotted. Dry-out will be considered complete four hours after the resistance readings have started to rise from the steady minimum value, provided that the winding temperatures remain steady during this period.
The contractor must provide all equipment and the personnel required for the drying-out operation. The onus remains on the contractor to satisfy him that a motor is dry before it is connected to the supply. Any motor, which fails as a result of being commissioned in a damp condition, must be repaired free of charge by the contractor.

20. STANDARD REQUIREMENTS

Supply	:	400 Volts; 3 Phase; 50 Hz
Output Rating	:	To suit pump requirements as per specification
Speed	:	1450 rpm unless otherwise approved
Type of Motor	:	LS premium Efficiency TEFC Cast Iron 3Phase Induction motor
Frame size	:	To suit pump
Enclosure	:	IP66
Mounting	:	Foot/Flange
Shaft Axis	:	According to application
Insulation	:	Class h
Harmonic Levels	:	Less than 5 %
Duty-Class	:	Continuous
Bearings	:	Ball
Cable Entry Location	:	Bottom
Cable and Gland	:	To be submitted to successful tenderer on request
Drive Details	:	Direct (pulley and V-belts)
Method of Starting	:	VSD
Colour	:	Blue

ELSPEC-07-LVCI:
CONTROL INSTRUMENTATION

1. INTRODUCTION

This specification relates to the supply, installation, testing of MCC field control instrumentation equipment.

2. SUPPORTING CLAUSES

2.1 Scope

This standard covers the general requirements for MCC field control instrumentation equipment

Field control instrumentation would typically consist of all or part of the following:
a) Pressure switches and sensors
b) Level switches and sensors
c) Flow switches and sensors
d) d)Temperature switches and sensor
e) Instrumentation wiring

This specification is not limited to above.

2.2 Normative/Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

SANS 10108	The classification of hazardous locations and the selection of apparatus for use in such locations
SANS 10142	Standard Regulations for Wiring of Premises.
SANS 60529	Degrees of protection provided by enclosures (IP Code)
SANS 60730-2-15 & -2-18	Automatic electrical controls for household and similar use
SANS 60947-5	Low-voltage switchgear and controlgear Part 5: Control circuit devices and switching elements
SANS 61000	Electromagnetic compatibility (EMC)
SANS 61643-1	Low-voltage surge protective devices Part 1: Surge protective devices connected to low-voltage power distribution systems - Requirements and tests
BS 1646	Symbolic representation for process measurement control functions and instrumentation
BS 5863	Analogue Signals for Process Control Systems
BS 6739	Code of Practice for Instrumentation in Process Control Systems:

	Installation Design and Practice
BS 7405	Guide to the selection of an application of flowmeters
BS EN 837	Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
BS EN 1092	Flanges and bolting for pipes, valves and fittings.
BS EN 12449	Copper and copper alloys. Seamless, round tubes for general purposes
BS EN 50288	Multi-element metallic cables used in analogue and digital communication and control. Generic specification
BS EN 60534	Industrial-process control valves. Dimensions. Face-to-face dimensions for rotary control valves except butterfly valves
BS EN 60770	Transmitters for use in industrial-process control systems. Methods for performance evaluation
BS EN 61010	Safety requirements for electrical equipment for measurement, control and laboratory use. Safety requirements for hand-held probe assemblies for electrical measurement and test
BS EN ISO 5167	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full. Orifice plates, nozzles, and venturi tubes inserted in circular cross-section conduits running full
BS EN ISO 6817	Measurement of conductive liquid flow in closed conduits. Method using electromagnetic flowmeters
BS EN ISO 9906	Rotodynamic pumps. Hydraulic performance acceptance tests
SANS 61131	Programmable Controllers.

3. CONTROL INSTRUMENTATION REQUIREMENTS

3.1 General

3.1.1 Overview of Requirements

All instruments shall be suitable for operation on a single phase, 50 Hz alternating supply, and environmental conditions as per project description and general information.

The instrument enclosure shall house the instrument monitor, power supplies and the required EMI/RFI surge suppressors. A local isolator shall be provided in the instrument enclosure to isolate the instrument.

All instruments shall be equipped with a local indicator, indicating the process variable being measured.

All instruments shall be equipped to generate an isolated 4-20 mA output proportional to the process variable being measured or a digital contact signal.

Brackets, supports or any other load bearing devices shall be protected against corrosion related to climatic weather conditions, and/or the location of installation with respect to the process environment.

Wherever possible, the instruments shall be located so that they are protected from damage by passing or falling objects.

All outgoing and incoming signal lines (excluding transducer signal lines) shall be free floating, i.e. ungrounded at the instrument. All these signals will be centrally grounded at the main control room or field processing unit.

All instruments supplied shall have a proven track record in Southern Africa under similar operating conditions.

The equipment shall be designed and installed to operate continuously at the specified rating for 24 hours per day, 7 days per week at the operating conditions specified. Unless otherwise specified, the equipment shall have a design life of 15 years with only routine maintenance required.

The provision of all hardware and software integrated in a Manufacturer's package control system for the purpose of interfacing to the overall control system is the responsibility of the Contractor. All associated hardware and software required to complete the interface shall be documented in the Contractor's preliminary design documentation for review by the Engineer.

Wherever possible the electrical, instrumentation and control system components shall be preassembled/pre-mounted and pre-wired to junction boxes prior to being transported to site. These pre-assembled components shall be completely calibrated and tested prior to shipping

Wherever practicable all control circuits and instruments shall be designed so as to be fail safe in the event of power, equipment or wiring failure

All instrument monitors shall be mounted in a weatherproof enclosure offering a protection of IP 65. The enclosure shall be padlockable and shall be equipped with a shatterproof-armour plated glass insert so that the local indicator can be read without opening the enclosure.

Unless otherwise specified the Contractor shall assume that the supplied equipment shall be installed outdoors and exposed to an environment of direct sunlight, rain, dusty atmosphere and salt laden air. And that the supplied equipment will be subjected to spillage of process liquids and splashing from high pressure wash-down water and in sections of the process plant, to corrosive liquids.

Non-metallic covers shall be UV stabilised long life type.

A list of all proposed instrumentation and control equipment shall be provided to the Engineer for review prior to any associated procurement or construction.

If non-standard control equipment is approved by the Engineer the Contractor will be responsible for the integration of this non-standard hardware in the overall control system. This is not limited to the supply of all hardware and developing the software to establish communication between the relevant PLC's.

3.1.2 Programming of Equipment

The Contractor is responsible for the control system software development for all controllers provided in their scope of supply.

Contractor control system development shall include:

a) PLC programming to control equipment and process within their scope of supply;
b) The configuration of the controller to facilitate monitoring and control of the Manufacturer's package from the control system;
c) Operator interfaces required to monitor and control the equipment and process.

All Human Machine Interfaces (HMI's) shall be integrated to the control system. Based on the complexity of their packages control and monitoring requirements, Contractors shall provide a suitable operator interface for equipment within their scope of supply.

Contractors shall provide samples of their packages HMI to the Engineer for review and authorisation prior to complete system development.

3.1.3 Labelling

All electrical equipment and instruments shall be identified with a unique instrument / equipment tag number

All instruments, transmitters, control valves and pushbutton stations shall have a nameplate fitted to the instrument stand or adjacent structure.

Equipment shall be labelled clearly and visibly using black lettering on white background traffolyte labels fixed by at least two (2) stainless steel screws. Lettering size shall be not less 6mm high.

3.1.4 Instrument Power Supplies

Instrument power supply shall be 24 VDC for all loop powered instruments and where possible 24 VDC for all non-loop powered instruments.

Only where 24 VDC is not an option, and where approval from the Engineer has been received, shall 230 VAC be used for non-loop powered instruments. All four-wire devices and analysers, however, shall be powered using 230 VAC.

3.1.5 Lightning and Surge Protection

All instruments shall be protected against lightning and other EMI/RFI in the following way:

a) The power supply to the instrument shall be protected at the instrument by means of line surge voltage protection unit.
b) The instrument shall be protected against surges on all outgoing and incoming signal lines.

In addition to the above, all outgoing and incoming signal lines shall be protected by means of a plug-in fuse with light indicator.

Surge protection devices shall be provided at both ends of the 4-20 mA signal cables and digital data lines. Each device shall be securely bonded to the earthing system.

Surge protection devices are not required if the signal loop:

- Does not extend outside of the switchboard or
- Does not extend outside the confines of a building

3.2 Pressure Switches and Sensors

3.2.1 Pressure Element Materials

The wetted parts of process pressure measuring instruments shall be made of Type 316 stainless steel unless dictated otherwise by the nature of the process. Alternative materials are acceptable on instrument measuring pneumatic instrument signals.

Suppressed range or elevated range instruments:

a) Suppressed range or elevated range pressure measurement instruments shall be furnished where necessary to provide additional measuring sensitivity for control purposes.
b) Each installation with an instrument having an elevated or a suppressed zero shall have a pressure gauge that can indicate actual pressure during startup and shutdown.

3.2.2 Pressure Gauges

The arc covered by the graduations on the pressure gauge dial shall not be less than 270 degrees.

All pressure gauges shall be equipped with a blow-out facility to prevent personnel injury in the event of element

rupture.

All pressure gauges shall be furnished with full scale pressure ranges which include zero pressure reading.

3.2.3 Mechanical Pressure Gauges

Analogue mechanical or bourdon tube pressure gauges shall be of the bottom entry type and shall have a face of at least 60 mm in diameter with clear, readable markings and indicators.

The indicated range on the gauge shall span 120% of the operational pressure range specified for the relevant equipment. Accuracy shall be within 3% of the full-scale deflection value. An adjustable indicator shall be set to indicate the maximum operational system pressure clearly.

It shall be possible to isolate the pressure gauge from the pipe pressure by means of a valve or a gauge cock, which shall be supplied and installed by the contractor and shall be included in the tendered rate for the equipment.

A gauge protector shall be fitted where a gauge has to indicate pressures in corrosive media or liquids that could easily clog the pressure ports. It is a requirement that gauge protectors be fitted where sludge is the working medium.

Pressure gauges fitted to hydraulic pipe lines shall be glycerine-filled for damping purposes, and gauges fitted to pneumatic or gas pipelines shall be vacuum damped.

3.2.4 Pressure Gauge Signals

All pressure gauges shall have factory fitted relays and have an output of 4-20mA Analog. The relay contacts shall be rated for 230V AC and 24V DC.

The relay must be activated via adjustable dials on the Pressure gauge to operate at adjustable pressures.

The output signals / contact shall be utilised for MCC control wiring.

3.3 Flow Switches and Sensors

3.3.1 General Requirements

All flow measurements expressed as ratios or that are cascaded with other process variable shall be linearised.

All flow meter runs shall have connections for static pressure and fluid temperature measurement. These connections shall be located at least 8 pipe diameters downstream of the primary measuring device.

Flow element shall be sized so that:
a) Normal flow rate falls at approximately 70% of maximum scale range.
b) Minimum flow is not less than 30% of maximum scale range.

The calculations for flow elements shall be done at the following standard reference conditions:
a) Flow liquids - 101,325 kPA abs @ 20° C.
b) For gas and vapours - 101,325 kPA abs @ 0° C.

3.3.2 Electromagnetic Flow Meters

3.3.2.1 General

The instrument shall be of a type suitable for application in raw sewage and activated sludge and borehole water. It shall have high stability properties and shall require negligible maintenance over extended periods.

3.3.2.2 Operating Principle and Construction Requirements

The electromagnetic flow detector shall consist of a length of smooth bore pipe having an equal internal diameter to that of the pipeline into which it is to be installed. This pipe insert shall be non-magnetic and lined throughout its bore with an electric insulant. A magnetic field shall be generated across this pipe insert and the two diametrically opposing electrodes shall detect the voltage generated when liquid flows through the field. This generated voltage shall be amplified by a remotely mounted amplifier and converted to an electric signal suitable for receiving instruments such as indicators, recorders, integrators and controllers.

All electromagnetic flow meters shall consist of a separate detector head and amplifier. The detector head shall be of a robust construction and shall suffer no harmful effects if submerged, i.e. protection of enclosure to be IP68. The detector liner shall be of hard-wearing ebonite rubber suitable for sewage water applications and shall extend over the flange faces. The detector head electrodes and earthing discs (to be supplied with the instrument) shall be made of stainless-steel grade 316 or better.

The electrodes shall be automatically cleaned. Any build-up of fats and other debris on the electrodes shall not influence the operation of the instrument. In the selection of the instrument due cognisance shall be taken of the potential fatty nature of sewage water.

The amplifier shall be mounted in the previously described instrument enclosure, together with the previously specified auxiliaries such as surge suppressors, etc. The amplifier shall be equipped with a digital rate of flow indicator, preferably of the LCD type, a non-resettable flow totaliser, totalising in cubic metres, a galvanically isolated 4-20 mA output linear to flow and an isolated pulsed output for remote flow totalising.

The instrument shall have a variable span facility, with automatic zero control and a signal hold facility. The instrument shall preferably operate on a pulsed DC field or other means to reduce power consumed and prevent electrode polarisation and zero drift.

The magnetic flow meter shall be capable of withstanding the test pressure experienced during mains testing without impairing operating performance

3.3.2.3 Installation Requirements

Where electromagnetic instruments are required, a removable pipe section of adequate length will be provided by the piping Contractor. This pipe section will be flanged on one side and will be supplied with a coupling on the other side. The Contractor will be required to shorten the pipe insert to accommodate this flow meter head. Before ordering the detector head, the Contractor shall ascertain the flange details of the pipe supplied so that the detector flanges and pipework flanges match.

The lining of the flow meter head shall not be used as a gasket. Suitable gaskets shall be provided and installed between the flow meter head, earthing rings and adjacent pipe work.

A suitable local earth shall be provided by means of 1,8 m copper earthing electrodes.

Sufficient electrodes shall be provided to obtain an earth resistance of less than 1 ohm.

The instrument enclosure shall be pedestal mounted adjacent to the flow chamber 1 200 mm above natural ground level.

The instrument installation shall include all interconnections and sundry requirements between sensor and control/amplifier unit.

Where magnetic flow meters are installed then dual earth rings with earthing straps shall be installed at either end of the meter flange face. The earthing straps shall be attached to the process pipe work and shall provide earthing continuity.

3.3.2.4 Accuracy

The accuracy of the instrument shall be guaranteed to be equal or better than:

- ± 0,5% of measured flow in the flow range 50 - 100%
- ± 0,1% of full scale for flows in all other ranges.

The repeatability of the instrument shall be better than 0,1% of full-scale deflection and the linearity of the instrument shall be better than 0,05% of full-scale deflection.

3.3.2.5 Maintenance

The instrument shall be maintenance free.

3.3.3 Paddle Type Flow Switch

The electromechanical flow switch is designed for the detection of interrupted flow (“no flow”) of water and other non-corrosive liquids. The flow switch signal is used for operational controls that prevent system failure in the absence of cooling water flow.

The cost-effective flow switch is enclosed by a plastic case. The ingress protection of IP30 protects it from unwanted ingress of foreign bodies.

The model FSM-6100 is equipped with UL-listed microswitches and protective bellows to ensure high durability with continuous operation and a long service life. The range of flow ranges, with pipe sizes from 25 ... 150 mm [1 ... 6 in], enables use for flow measurement in a variety of applications with non-critical media.

The switch shall have a service life of > 500,000 cycles.

The paddle shall be stainless steel 316 and bellows from phosphor bronze. The paddle shall be adjustable for different pipe diameters

The switch shall have a single pole double throw switch with shall be settable to different flow ranges. The switch shall have a rating of 15A AC/DC with a max operating pressure of 16 bar.

The paddle switch shall be able to operate in different pipe bores ranging from 25mm,32mm,50mm, 65mm, 80mm, 100mm, 125mm, 150mm.

The switch shall have a thread size of 1" NPT, male per ASME B1.20.1 / 1" BSPT, male per ISO 7.

3.4 Level Switches and Sensors

3.4.1 Ultrasonic Level Sensors

3.4.1.1 General

All ultrasonic Level Sensor shall be microprocessor based, non-contact level sensors and be able to be programmed to read level accurately in an irregularly shaped container/sump etc.

3.4.1.2 Operating Principle

A burst of ultrasonic pulses is transmitted from a transducer, which is not in contact with the medium. These pulses are reflected of the top surface of the medium and received by the same transducer. The time delay between the transmitted and received signal is proportional to the level between the transmitter/receiver, which is fixed, and the medium, which is variable, hence the level can be calculated.

To compensate for the temperature dependence of the ultrasonic signal, the air temperature shall be measured at the transducer and shall be taken into consideration when the level difference is calculated between transmitter and medium.

3.4.1.3 Constructional Requirements

The ultrasonic transducer shall include a built-in temperature sensor and shall have a minimum enclosure rating of IP 65. The transducer shall be corrosion protected as well as immune against UV radiation.

The level calculation shall be temperature compensated.

A galvanically isolated 4-20 mA output and pulse, PNP, or relay output, linear to level shall be provided for remote indication and processing.

The control unit shall be supplied complete with battery backup to prevent against loss of setup data in the event of a power failure.

Installation requirements:

- The ultrasonic transducer shall be supplied complete with mounting bracket and frame. The mounting frame shall be rigid and made from stainless steel. The transducer shall be mounted in such a way that it is free from all handrails, walkways, etc. Passing traffic and the operation of other machines in the vicinity of the transducer shall have no influence on the transducer.
- The Contractor shall conform to the manufacturer's recommended instructions for the positioning and mounting requirements for the installation of the level sensor.
- The installation shall include for all required interconnections and sundries between the sensor and control unit.

3.4.1.4 Accuracy

The accuracy of the level measurement shall be better than 0,25% of full scale.

3.5 Temperature Switches and Sensors

Temperature meters

General
The instruments shall be suitable for measuring temperature in containers and pipes. The temperature probes shall be suitable for use in hazardous areas (methane gas environment).

Operating principle
The temperature probes shall be of the RTD type complete with a suitable temperature transmitter.

Construction
The temperature transmitter shall be of the basic four wire type, with a separate 230 VAC supply and a galvanically isolated 4-20 mA output signal linearly proportional to the measured temperature. The temperature transmitter shall be equipped with a digital local temperature indicator.

Installation
Where temperature is to be measured in large containers, e.g. digesters, thermometer pockets will be provided by others. Where the temperature is to be measured in a pipe, a suitable thermowell shall be installed in
the pipe to accommodate the temperature probe.

Accuracy
The accuracy of the temperature measurement shall be better than 1% of full-scale deflection.

Thermocouples

Thermocouples shall be:

a) Chromel-alumel (ISA Type K) for temperatures between -70°C and + 900°C.
b) Platinum / 10% rhodium platinum (ISA Type S) for temperatures in excess of 900°C.

All thermocouples shall be made from premium grade thermocouple wire.

Only thermocouples which are not grounded to the sheath shall be used.

Only duplex or triplex type thermocouples shall be used.

Thermocouple terminal heads shall provide the degree of protection against dust and moisture of IP 65.

The heads shall be made of aluminium alloy.

Resistance temperature detectors

Resistance temperature detectors (RTD) shall be used in applications where thermocouple performance can be influenced by electrical fields.

The choice between the use of thermocouples or RTF shall be based on the suitability for the application.

The choice for using RTD elements (100 W @ 0E C) shall be limited to temperatures of -175° C to +475°C. A duplex RTD platinum element shall have sealed windings within high purity alumina insulation with three leads per winding. The element shall be enclosed in a Type 316 stainless steel tube 6,3 mm OD.

Temperature elements

Duplex temperature elements shall be used for controlling purposes. One temperature element shall be used for the controller input measurement. If the process requires a continuous recording, the second element shall be used for recording purposes. Two instruments shall not be connected to the same temperature element.

Temperature signal transmitters

The temperature signal to console mounted temperature instruments may be converted to the standard analogue signal specified for electronic transmitters. The following shall apply when temperature transmitters are used:

- Cold junction compensation shall be done at the transmitter.
- Radio frequency interference (R.F.I) protection shall be provided.
- The output-signal shall be linear with respect to temperature.
- Line resistant shall not affect signal accuracy.
- The direction in which the transducer output must fail on element failure shall be specified.

Local temperature indicators

All local temperature indicators shall be adjustable angle, bimetallic actuated, 130 mm diameter dial thermometers with 6,3 mm OD stems. These shall not be installed more than 4500 mm above grade or a platform. Installations above this height limit shall use remote reading gas or liquid filled thermal system thermometers with a 115 mm diameter indicator installed 1700 mm above grade or on a platform.

4. FIELD WIRING FOR SWITCHES AND SENSORS

4.1 General Requirements

All wiring on instrument systems in hazardous areas shall meet the requirements of SANS 10108.

Shielded cable shall be used for all instrument signals of 90 V or less.

Shield and/or shield drain wires for individual pairs and inner overall shields of multi-pair cables shall have continuity from the sensing element to the control room or local panel. The shield on individual pairs shall be carried as an additional wire, isolated from earth with sleeving, wired through separate terminals, and

connected to the high-quality earth at the control room or panel only. The outer overall shield of multi-pair cables shall be connected to safety earth at the source end only.

Instrument wiring in control rooms shall generally consist of PVC insulated cables installed in trunking or tray, or bunched in control panels.

Field cables shall generally be one continuous run from service to destination but where junction boxes are required, they shall enter and exit by the bottom gland plate.

4.2 Wiring from Instrument to Junction Box

All field mounted instruments shall be provided with single pair or triple cable installed on rigid supports providing protection against mechanical damage.

All wiring shall meet the electrical area classification requirements of the plant in which it is installed.

No splices shall be made in single pair or triple cables.

Stranded wires shall be connected to terminals with insulated pressure type lugs and each wire shall be marked at both ends with yellow fluorescent label material to indicate the terminal numbers.

4.3 Junction Boxes

Field mounted junction boxes shall be provided for the termination of the single pair (or triple) cables and connection to multi-pair cables.

Only one multi-pair cable shall be allowed per junction box.

Junction boxes for outdoor use in non-hazardous areas, or for intrinsically safe systems in hazardous areas, shall be impact and corrosion resistant polyester boxes with terminal blocks and shall have hinged covers. All hinges and cover fasteners shall be corrosion resistant.

Explosion proof junction boxes shall have explosion proof combined breather and drain fittings at the bottom.

All cable runs shall enter junction boxes at the bottom or at the side within 200 mm from the bottom.

Cables between any junction box and control room shall be armoured multicore cables and can be routed above or below ground.

Each junction box shall be numbered and identified with a permanent nameplate.

Separate junction boxes and home run cables shall be provided for each voltage level and signal function.

Terminal blocks shall be sectional (barrier), two screw type for use with pre-insulated tip terminals, or screwless terminal blocks with cage clamp springs for all types of conductors used without terminal lugs.

Minimum spacing in junction boxes shall be 150 mm from terminal block to the side of the box and 150 mm between terminal block centrelines.

All junction points shall be permanently identified, both on the wire and on the terminal block. All terminals within a junction box shall be numbered consecutively. All field cables shall be tagged with the field instrument tag number and shall carry this number continuously to the control room.

All junction boxes shall have sufficient terminal blocks to terminate all cable pairs or triples including shield wire and spares.

4.4 Cable Trays

Instrument cables where practicable shall be routed on separate trays from electrical power cables. Particular consideration shall be given to the requirement of specialist cables involving limits on resistance, capacitance and inductance, intrinsically safe electronic circuits and thermocouples.

The Contractor shall generally use existing cable trays, trenches or ducts showing particular consideration for cable types and their segregational requirements.

Vertically oriented cable trays are preferred to minimise fire hazards due to the accumulation of combustible dirt.

Cable trays containing 230 VAC power cables and cable racks containing instrument signal cables and thermocouple cable crossing each other, shall be separated by 100 mm.

4.5 Cable Runs

Cabling between the field mounted junction boxes and the control rooms shall be multi-pair cables in overhead cable tray. Instrument leads and thermocouple leads shall not be run in the same multi-pair cable.

Instrument and thermocouple cables shall be isolated from power wiring according to the following directive:

In cable racks 230 VAC power cables shall be spaced 100 mm from instrument signal cables and thermocouple cables. In cases where 100 mm spacing cannot be achieved, a metal barrier fixed to the cable rack shall be installed between the 230 VAC power cables and instrument signal/thermocouple cables.

If it is required to join two cables on very long runs (more than 1000 m) the cables shall be brought to a connection box and connected through terminal blocks.

Multi-pair cables for instruments and thermocouples may be installed in the same tray or duct. Intrinsically safe cables may be installed in the same trays with other instrument and thermocouple cables.

When selecting a new multi-core cable on a project, one with the least standard number of cores possible shall be used. However, if the number of cores to be used exceeds 80% of the capacity of the cable, then the next larger standard size shall be selected.

4.6 Interconnections

All materials required to interconnect or install instrument or electrical devices located on the package unit shall be supplied as part of the package (e.g. thermowells for thermocouples).

All interconnections between items supplied in the package unit (electrical, pneumatic, etc.) shall be supplied and installed by the Contractor.

All devices shall be pre-wired to a junction box, pre-piped, etc., except where shipping constraints necessitate dismantling of the unit, in which case interconnecting cables, pipe, tubing, etc., shall be clearly tagged for re-connection at the site.

Erection and assembly, and testing instructions shall be provided for and shall accompany any disassembled instrumentation or electrical equipment.

4.7 Instrument Signal Levels

Control voltage shall be 24 VDC for field device circuits and programmable controller inputs and outputs.

Signals to all programmable controller inputs shall be from isolated, voltage-free contacts capable of reliably switching 2A at 24VDC.

The Contractor shall supply analogue instruments whenever possible with 4-20mA signals.

All relay contacts shall be capable of reliably switching 2A at 230VAC and 24VDC. Contacts shall be self-cleaning (wiping) action or be hermetically sealed. Where interposing relays are used the relay coil shall be rated for continuous operation.

Preference shall be given to loop-powered instruments wherever possible.

Four-wire instruments shall provide isolated signals where possible or shall incorporate a signal-isolating device.

Control system analogue inputs and outputs shall be isolated milliamp signals unless otherwise specified or agreed. Voltage inputs or outputs are generally not acceptable.

Any transducers required for signal conditioning and measuring devices with analogue outputs shall be smart loop powered devices with 4-20 mA outputs.

Low level (mV) signals shall be converted to 4-20 mA signals as close to the source as possible for field transmission (e.g. thermocouple).

Intelligent instruments (e.g. analysers) may communicate directly to a PLC utilising a communication bus protocol.

5. DOCUMENTATION

5.1 Drawings and Design Documentation

All drawings, information, and documentation shall be in the English language, Drawings for acceptance shall be provided on A3 paper copies.

Three Operation Manuals, three Maintenance Manuals and three Certification copies shall be provided for all equipment supplied.

Manual formats shall be A4 size on the filing side which shall be vertical with 20 mm margin for filing.

5.2 Operating Manual

The operating manuals shall include at least the following:

a) Manufacturer's name, address, telephone number and telefax numbers.
b) A full technical specification of the equipment.
c) Full description and details of design capacity and design criteria for each item of equipment and each product.
d) Detailed description of the function of all operator controls.
e) Detailed description of all alarms, indications and protective devices.
f) Detailed description of all adjustments.
g) Operating instructions. These shall cover the different modes of operation and startup/ shut-down procedures.
h) Relevant reduced drawings - general arrangements, assemblies, electrical schematics and parts lists.
i) Procedures in case of a fault.

5.3 Maintenance Manual

The manual shall include at least the following:

a) Technical description of all components (Instrument Specification Sheets).
b) Maintenance instructions for all components and including repair, overhaul, change-out and installation procedures.
c) Recommended inspections and frequency thereof.
d) Schedules for running and shutdown maintenance.

e) Spare parts information incorporating cross-section/"exploded" view drawings/ illustrations with parts references/descriptions which provide clear reference to the Manufacturers part number and original manufacturer's name and part number when applicable.
f) All Process Equipment alarm and control parameters e.g. trip amp settings, control set points and control action values etc.

5.4 Certification

The testing results and certification shall include at least the following:
a) Suppliers' acknowledgement of purchase order
b) Certification copies e.g. hazardous area classification
c) Pre-installation check sheets
d) Loop testing sheets
e) Acceptance certificate
f) Calibration test certificates
g) All "as built" design documentation

The Contractor shall guarantee that all products shall be suitable for the intended application and shall be capable of the duties specified.

The period for which the contractor shall maintain the works in a perfect state of repair, order and condition shall be 12 months from the issue of the total plant taking-over certificate.

6. TESTING AND COMMISSIONING

6.1 General Requirements for Testing

Manufacturers that supply field instruments shall factory test and pre-assemble, fit accessories, tag, configure, calibrate and shop function test (including 24-hour burn in) instruments prior to delivery.

The Contractor shall be responsible for the commissioning of all services and equipment supplied and installed under the Contract. He shall provide proof of conformance and Manufacturer's performance guarantees for the relevant equipment.

All work, activities, instrument serial numbers, adjustments, commissioning results, names of personnel, dates, times etc. shall be scheduled in an approved format throughout the duration of the works. The Contractor shall ensure that any system which he intends to operate is in a safe and ready condition.

The Engineer reserves the right to witness all or part of the works factory acceptance tests. At least 48 hours' notice shall be given to the Engineer of any test. The accuracy of the test instruments and methods shall be demonstrated to the Engineer when required. The Contractor shall make available to the Engineer, copies of the relevant test sheets, prior to witnessing.

Any damage to plant or equipment during commissioning by the tests shall be rectified by the Contractor.

Any defects cause by poor workmanship, materials and performance maladjustments or other irregularities which become apparent during the testing and commissioning operations shall be rectified by the Contractor at his expense and the tests shall be repeated at the Contractor's expense to the satisfaction of the Engineer.

The Contractor shall ensure that all necessary spares are available on-site during commissioning.

Four copies of final test results shall be issued to the Engineer in an appropriate and approved format

Instrument data sheets are to be 'as built' and material plus test (pressure, leak, hazardous area) certificates and calibration sheets are to be provided for each instrument in accordance with the data sheets.

The equipment shall be tested and commissioned together with the relevant pipework and other equipment such as pumps or compressors.

Prior to shipment the following shall be confirmed:

a) Standard manufacturer calibration and alignment tests of all instruments have been completed.
b) A parameter printout for electronic instrumentation is attached to the instrument calibration sheet.

Key non-standard set-up parameters shall be noted on the instrument data sheet. A calibration sticker shall be placed on all shop tested and calibrated instruments. The Contractor shall be responsible for all instrument calibration on site if the instrument requires adjustment or further calibration.

All cables shall be insulation and continuity tested before being connected at either end.

Wherever possible instrumentation once installed shall be fully checked and tested in service and test sheets completed.

After completion of installation, the Contractor shall provide evidence of the satisfactory operation of all equipment before the site acceptance certification be validated.

6.2 Visual Checks

The Contractor shall carry out the following visual inspections to ensure that: -

a) Terminals, cables, tubes, piping instruments and equipment have been identified and labelled.
b) Painting and protection against corrosion is complete.
c) Correct materials have been used.
d) Reticulation piping and equipment is adequately supported and accessible.
e) Installations are in accordance with the contract documents.
f) All connections are taped and tight.
g) All air supplies to instruments are on and pressure regulators are set correctly.
h) Impulse lines and air supply lines are leak tested. All pipe and tubing runs shall be pressure tested using air at 700 kPa and tested for leaks.
i) Particular attention is to be paid to the inspection of earthing to ensure that all equipment manufacturers' requirements are met.
j) Air lines are to be blown out with dry, filtered air before being connected to field devices
k) All cables tied in cable tray or installed in approved conduit.

6.3 Functional Tests

Functional testing shall be conducted to confirm all equipment operates as per the Control Philosophy and the Test Sheets. The Contractor will provide a Test Sheet for every loop. This sheet will show the tag number, instrument range, process signal spans, alarm settings, etc. for the instruments.

By performing functional tests, the Contractor will show and record that all instrumentation when signalled, or excited performs the dynamical functions for which it was designed, and that all complete loops and all interconnections are correct.

The Contractor shall ensure that all field instruments and all control room instruments, or SCADA display belonging in the same loop, are functionally tested at the same time to prove the whole loop is correct.

6.4 Field Instruments

For transmitting instruments, a simulated process input of 0, 25, 50, 75 and 100% both rising and falling shall be injected into the transmitter.

The transmitter shall be powered by the respective instrument power. The reading shall be noted for each input, and checked on the control System SCADA displays.

If a local indicator (4-20 mA) is in series with the transmitter, its reading shall also be recorded for each input. The transmitter and local indicator shall be adjusted, if necessary, until the output is within specification.

For receiving instruments, signals of 4 mA, 8 mA, 12 mA, 16 mA and 20 mA both rising and falling shall be injected via the control system. The output of the receiving instrument shall be adjusted if necessary until it is

within specification.

Permission must be obtained prior to testing final elements. The final element shall be stroked open to closed and the position noted for 0, 50 and 100% signals. If main instrument air is used for these tests, it shall be turned off after the test is completed.

For switching instruments, a simulated process input or mechanical actuation shall be applied and the alarm initiated. The switch shall be adjusted if necessary, so that it operates at the correct setting, e.g.
a) Pressure switch: apply pressure equal to the setpoint.
b) Flow switch: apply liquid flow equal to the setpoint.
c) Level transmitter with alarm contact: raise the level to the setpoint

Switching valves shall be stroked open to close by energising and de-energising the respective solenoid valve. The results shall be recorded on the test sheet. Permission shall be obtained prior to testing switching valves.

For temperature signals the cable shall be disconnected and a resistance or mV signal shall be injected direct to the cable. All temperature sensors shall be checked for open or short circuit.

For magnetic type level gauges, the float in the tube shall be moved up and down. The indication shall be checked for all possible positions.

All in line pressure instruments shall be subjected to non-destructive testing to the applicable piping code or vessel specification, including the following as a minimum in the absence of any other guide:
a) Pressure tests to 1.5 times the system design pressure at design temperature.
b) Radiographic testing of welds to detect all flaws (by a qualified operator).

In line instruments and control valves must be replaced by spools while process lines are cleaned and tested.

Thermocouple inputs shall be tested for correct burn out / open circuit response and indication. Unless otherwise specified, temperature transmitters shall be configured for upscale burnout.

6.5 Control Components

Where the package has no integral control system or control panel there shall be a complete test of all instrumentation from the point of interface (e.g. junction box for external connection).

All control valves shall be stroked without the positioner fitted to confirm bench set range and after the positioner is fitted to test the action of analogue and digital feedback signals.

Control valves and actuators are to be stroked over their entire range and feedback checks performed at 0, 25, 50, 75 and 100% of travel. Hysteresis checks are to be performed to ensure that process control requirements are met.

Function generators are to be used to test all inputs at the field end of input cables. i.e. mV, mA etc. At least three input signals shall be used. These are 0%, 50% and 100% of range.

Control loops shall be tested to confirm control action and to ensure that the dynamic response is suitable for the process being controlled.

All sequence logic is to be tested to ensure correct operation of the process and to ensure that a malfunction at any time in the sequence shall not leave plant, equipment or personnel exposed to unsafe conditions.

All devices shall be tested to ensure that indications and alarms function correctly.

ALL DB'S AND MCC'S SHALL BE FULLY TESTED ACCORDING TO SANS 10142-1 AND THE ELECTRICAL CONTRACTOR SHALL ISSUE A COC TO THE CLIENT FOR EACH DB, MCC

ELECTRICAL INSTALLATION DETAILS

1. GENERAL SITE AND OPERATING CONDITIONS

The site is located in Wesselsbron, Free State Province, South Africa.

The altitude is: ±1309m

Min temperature: -5 deg C

Max temperature: 43 deg C

The equipment must be able to operate in the above-mentioned conditions.

2. GSM COMMANDER COMMS PANEL

Digital Inputs:	2 x onboard Opto-isolated. Inputs draw 10-30mA, depending on the voltage. Can accept DC signals of any type, including: • Dry Contacts • Open Collector (NPN) • Open Collector (PNP) • DC Voltage (6-18V)
Digital Outputs:	2 x SPDT Relays
Rating:	8Amp DC (10-48v) OR 4Amp AC (110-400v) (non-inductive loads)
Current Consumption:	60mA at Idle (no inputs or outputs active)
Power Supply:	10-24V DC via DC Jack or Screw Terminal
Operating Temperature:	-10 to +60 deg C
Storage Temperature:	-20 to +85 deg C
Dimensions:	148 x 86 x 28mm
Number of statements:	64
GPRS:	Yes
Batt/Power monitor:	Yes
Extendable:	Yes

The comms panels shall be equipped with one GSM commander Standard complete with 2 x 5 input/5 output expansion modules.

The unit shall be installed in the panel complete with GSM antenna, switching power supply and 7Ah battery.

Further to this the panel shall be equipped with termination blocks for the connection of signal input wiring from the pump control MCC, the electric fence energizer and the pepper spray alarm panel.

The output of the GSM Commander shall activate relays to energize led indictor lights mounted on the panel door.

The below table indicates the input and outputs:

DI1	SUMP HIGH LEVEL	DO1	INDICATOR LED HIGH LEVEL
DI2	SUMP LOW LEVEL	DO2	INDICATOR LED LOW LEVEL
DI3	PUMP1 TRIP	DO3	INDICATOR LED PUMP1 TRIP
DI4	PUMP1 RUN	DO4	INDICATORLED PUMP1 RUN
DI5	PUMP2 TRIP	DO5	INDICATOR LED PUMP2 TRIP
DI6	PUMP2 RUN	DO6	INDICATOR LED PUMP2 RUN
DI7	ELECTRIC FENCE ALARM	DO7	INDICATOR ELECTRIC FENCE ON
DI8	PEPPER SPRAY ALARM	DO8	INDICATOR PEPPER SPRAY ALARM ON
DI9	PEPPER SPRAY ALARM ACTIVATED	DO9	PEPPER SPAY ALARM ACTIVATE
DI10	ELECTRICAL FENCE ACTIVATED	DO10	ELECTRIC FENCE ACTIVATE
DI11		DO11	
DI12		DO12	

The panel shall furthermore have the following LED indicator lights:

- Sump high level-RED
- Sump low level-AMBER
- Pump 1 run-GREEN
- Pump 1 trip-RED
- Pump 2 run-GREEN
- Pump 2 trip-RED
- Electric Fence Alarm-RED
- Pepper Spray Alarm-RED
- Electric Fence Armed-GREEN
- Pepper Spray Armed-GREEN

The GSM Commander shall communicate with the MIMIC panel mounted elsewhere to indicate the above inputs.

The panel shall have separate power and comms compartments:

The following equipment to be housed in the power compartment:
- 63A 1P+N 6kA earth leakage overload
- 20A 1P 6kA MCB-power supply feed
- Din Rail mounted Switched 230Vac/14Vdc power supply 30W
- 1 x 10A DC fuses with fuse bays-DC Supply fuse
- Panel mount power on indicator LED pilot lights 230V with 3 x 5A fuses with fuse bays.

The following equipment to be housed in the comms compartment:
- GSM Commander with 2 x 5IN/5OUT expansion modules
- Backup 7ah battery 12V
- 10A DPDT 12Vdc coil plug in relays x10
- 24-way digital input terminals
- 24-way digital output terminals
- Earthing terminals.
- 12V panel mount indicator led pilot lights

3. GSM COMMANDER MIMIC PANEL

Digital Inputs:	2 x onboard Opto-isolated. Inputs draw 10-30mA, depending on the voltage. Can accept DC signals of any type, including: • Dry Contacts • Open Collector (NPN) • Open Collector (PNP) • DC Voltage (6-18V)
Digital Outputs:	2 x SPDT Relays
Rating:	8Amp DC (10-48v) OR 4Amp AC (110-400v) (non-inductive loads)
Current Consumption:	60mA at Idle (no inputs or outputs active)
Power Supply:	10-24V DC via DC Jack or Screw Terminal
Operating Temperature:	-10 to +60 deg C
Storage Temperature:	-20 to +85 deg C
Dimensions:	148 x 86 x 28mm
Number of statements:	64
GPRS:	Yes
Batt/Power monitor:	Yes
Extendable:	Yes

The mimic panels shall be equipped with one GSM commander Standard complete with 4 x 5 input/5 output expansion modules.

The unit shall be installed in the panel complete with GSM antenna, switching power supply and 7Ah battery.

Further to this the panel shall be equipped with termination blocks for the connection of signal input wiring from the pump control MCC, the electric fence energizer and the pepper spray alarm panel.

The output of the GSM Commander shall activate relays to energize led indictor lights mounted on the panel door.

The below table indicates the input and outputs:

DI1		DO1	INDICATOR LED HIGH LEVEL PS A
DI2		DO2	INDICATOR LED LOW LEVEL PS A
DI3		DO3	INDICATOR LED PUMPS TRIP PS A
DI4		DO4	INDICATORLED PUMPS RUN PSA
DI5		DO5	INDICATOR LED HIGH LEVEL PS B
DI6		DO6	INDICATOR LED LOW LEVEL PS B
DI7		DO7	INDICATOR LED PUMPS TRIP PS B
DI8		DO8	INDICATORLED PUMPS RUN PS B
DI9		DO9	INDICATOR LED HIGH LEVEL PS C
DI10		DO10	INDICATOR LED LOW LEVEL PS C
DI11		DO11	INDICATOR LED PUMPS TRIP PS C
DI12		DO12	INDICATORLED PUMPS RUN PS C
DI13		DO13	INDICATOR LED HIGH LEVEL PS D
DI14		DO14	INDICATOR LED LOW LEVEL PS D
DI15		DO15	INDICATOR LED PUMPS TRIP PS D
		DO 16	INDICATORLED PUMPS RUN PS D
		DO 17	PS A ALARM/FENCE ALARM
		DO 18	PS B ALARM/FENCE ALARM
		DO 19	PS C ALARM/FENCE ALARM
		DO 20	PS D ALARM/FENCE ALARM
		DO 21	
		DO 22	

The panel shall furthermore have the following LED indicator lights:

- PS A high level-RED
- PS A low level-RED
- PS A pumps trip-RED
- PS A pumps run-GREEN
- PS B high level-RED
- PS B low level-RED
- PS B pumps trip-RED
- PS B pumps run-GREEN
- PS C high level-RED
- PS C low level-RED
- PS C pumps trip-RED
- PS C pumps run-GREEN
- PS D high level-RED
- PS D low level-RED
- PS D pumps trip-RED
- PS D pumps run-GREEN
- PS A alarm/fence alarm-RED
- PS B alarm/fence alarm-RED
- PS C alarm/fence alarm-RED
- PS D alarm/fence alarm-RED

The panel shall have separate power and comms compartments:

The following equipment to be housed in the power compartment:
- 63A 1P+N 6kA earth leakage overload
- 20A 1P 6kA MCB-power supply feed
- Din Rail mounted Switched 230Vac/14Vdc power supply 30W
- 1 x 10A DC fuses with fuse bays-DC Supply fuse
- Panel mount power on indicator LED pilot lights 230V with 3 x 5A fuses with fuse bays.

The following equipment to be housed in the comms compartment
- GSM Commander with 4 x 5IN/5OUT expansion modules
- Backup 7ah battery 12V
- 10A DPDT 12Vdc coil plug in relays x10
- 24-way digital input terminals
- 24-way digital output terminals
- Earthing terminals.
- 12V panel mount indicator led pilot lights

4. ELECTRICAL FENCE

The security electric fencing shall be of the 6 wire 0.6 meter high piggyback type complete as described below and to conform to sans specifications. 6 Strand piggyback electrical fence with 6 strands 2,24 high strain galvanised wires, 3m intermediate piggyback system installed on top of the existing concrete palisade fence, complete with mounting plates(piggyback) corner strains, intermediate insulators, tensioner insulators, gate contacts, earth spikes spaced as per SANS, danger boards, indicator on light, etc to be in working order complete with earthloops mounted between each intermediate pole between all live and earth wires.

Security fence electrifiers

The electrifiers shall conform to the following:
- The electrical fence energizers shall be of the JVA Z14 Fence energizer with backup battery, plug in power supply, sherlotronics 1CH receiver and 2 remotes (to be handed over to client) alarm indication surface mounted strobe light and siren.
- Mounted in an outdoor weatherproof wall mounted steel cabinet manufactured from 1,6mm 3CR12 stainless steel complete with doors with metal-t hinges, padlockable lever lock handles, equipment rails, terminations plates, name plate holders on face plate, busbars, non removeable laminated legend card and prepare for and including all internal wiring for the equipment-cabinet to be approved by engineer.
- Complete cabinet with energizer.

Environmental

Free air operating temperature:	0ºc to +50 ºc
Storage temperature:	-10 ºc to +75 ºc
Lightning protection:	protection on data and supply lines

Configuration

Configuration:	2 to 12 wire loops
Length of wire:	ability of at least 40 km

Software configuration

Modes:	alarm mode: passive monitoring
Non-lethal:	9.5kV peak 1 Hz pulse rate 6A into 500 ohms 8 Joules/sec maximum energy output SABS IEC 1011 specifications

Alarm functions
Multiple ground alarm
Single ground alarm
Power failure alarm (mains) external input
Break alarm (loop open)
Short circuit alarm
System alarm
Audible alarm

Measurement accuracy
Non-lethal and alarm mode

Multiple ground:	<80 metres of origin or 0.25% of wire length
Single ground:	<70 metres or 0.25% of wire length
CTC (correction table calculation):	<30 metres of origin

Measurement method
HT interrupted for measurement
Instantaneous detection in alarm mode

Alarm indication

Ground:	lcd
Open:	lcd
Short:	lcd
System:	lcd
Mains:	lcd
HT voltage:	line and return voltage

Communication
RS 232/485
1200 bd – 19200 bd
Master slave configured

I/O
Relay contacts for switching of external equipment

5. PEPPER SPRAY ALARM

Surface mounted Skunk pepper spray master alarm panel with battery backup, 2 x PIR sensors, door magnet, sound bomb, receiver and 2 x remotes, power supply and led surface mounted indicator light outside building. Unit complete with wiring to siren and Led indicator light, spare pepper spray canister etc to be in working order

6. GENERAL TESTING AND COMMISSIONING

The full system shall be tested and commissioned by the specialist installer contractor and they shall issue a COC covering the complete system.

All manuals shall be handed to the engineer and a handover documentation set shall be compiled by the contractor indicating all test carried out and COC and manuals.

NALA LOCAL MUNICIPALITY

CONTRACT NO.

NLM/TS/004/2025-26

THE REFURBISHMENT OF SEWER PUMP STATION AND ERADICATION OF 250 BUCKETS IN EXT. 12 & 13 IN WESSELSBRON

SECTION C3.5

OCCUPATIONAL HEALTH & SAFETY SPECIFICATION AND BASELINE RISK ASSESSMENT

NALA LOCAL MUNICIPALITY

CONTRACT NO.

NLM/TS/004/2025-26

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SECTION C3.5

OCCUPATIONAL HEALTH & SAFETY SPECIFICATION AND BASELINE RISK ASSESSMENT

C3.5.1 HEALTH AND SAFETY SPECIFICATIONS

Project Location:

The project is located in Wesselsbron, Free State Province, South Africa.

Project Description:

Refurbishment of the Golf Course Sewer Pump Station and the Eradication of 250 Buckets in Ext. 12 and 13 of Monyakeng.

Project Scope:

The scope of work for the project entails the manufacture, supply, delivery, installation, and commissioning of various equipment and components, including:

- Screw Pumps: The installation of screw pumps ensures efficient sewage conveyance, preventing clogs and ensuring smooth wastewater flow, ultimately reducing operational disruptions.
- Inlet Works - Mechanical Screen: Including a mechanical screen in the inlet works is essential to protect downstream equipment, improve system efficiency, and minimize maintenance costs by preventing the entry of large debris.
- Compactor: The compactor's role in waste volume reduction offers a sustainable and economical solution for waste management, reducing disposal expenses and promoting environmental responsibility.
- Degritter: Integrating a degritter is critical for grit removal, safeguarding infrastructure integrity, and minimizing operational downtime due to equipment wear and tear.
- Pista Trap Paddler: The Pista Trap Paddler enhances water quality by facilitating the sedimentation of solids, contributing to efficient treatment and the production of clearer water.
- Sluice Gates: Sluice gates are vital for flow control, ensuring system reliability by preventing overflows during heavy rainfall, reducing the risk of environmental contamination and

infrastructure damage.

- Hand Screen: Including a hand screen is essential for the effective removal of fine debris and small particles from wastewater, preventing blockages, equipment damage, and operational disruptions while maintaining system efficiency.
- Waste Removal Equipment:
  - Supply new waste bins.
  - Deliver the waste bins to the project site.
- Pumps and Pipe Work:
  - Supply two new STX CORNELL pumps.
  - Provide the necessary pipe work.
  - Deliver the pumps and pipework to the project site.
  - Install the pumps and associated pipe work.
  - Commission the pumps and pipe work for efficient operation.
- Repair and electrification of a concrete palisade fence consisting of the following:
  - Concrete palisade fence.
  - Electrical fence.
  - Construction of ablution facilities and tool shed.
  - Replacement of Stolen electrical transformers.
  - Upgrading of the current steel doors to prevent birds access and security improvements.
- Civil Works:
  - Repair channel walls.
  - Seal all channel corners using Sika products.
  - Repair and grout sluice gate slides.
  - Replacement of Pista paddler
  - Supply and install a 160 NB PVC suction pipe to redirect suction from the final effluent sump.
  - New hand railing in the pump station.
  - Supply and install HDG RS 40 25x4.5 grating.
  - Test the rising main line from the pump station to the wastewater treatment works, including all fittings, valves, and testing equipment.
  - Inspect and repair water-retaining concrete structures, including sealing cracks and applying an approved ABE sealer to the sump.

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Baseline Hazard Identification and Risk Assessment Register

1. Sewer Project

2. Methodology

3. HIRA

Configuration Management			
Prepared By:	**Bennie Maritz & L. Mkabela**		
Issue Date:	**18 May 2025**	**Project:**	**SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON**

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

2. Methodology

Seriousness rating	Description
1	No injury or illness
2	First-aid treatment case, medical treatment case and temporary discomfort case
3	Medical mitigation case; occupational disease with non-permanent effect
4	Lost Time Injury. Occupational disease with permanent consequence e.g. hearing loss
5	Fatality (as a result of incident or occupational disease e.g. asbestosis)
6	Multiple fatalities or multiple permanent occupational diseases

Plot consequence & likelihood in risk matrix to determine risk priority level

Seriousness	A	B	C	D	E
6	III	II	I	I	I
5	III	II	II	I	I
4	IV	III	II	I	I
3	IV	III	II	II	I
2	IV	IV	III	II	II
1	IV	IV	III	III	III

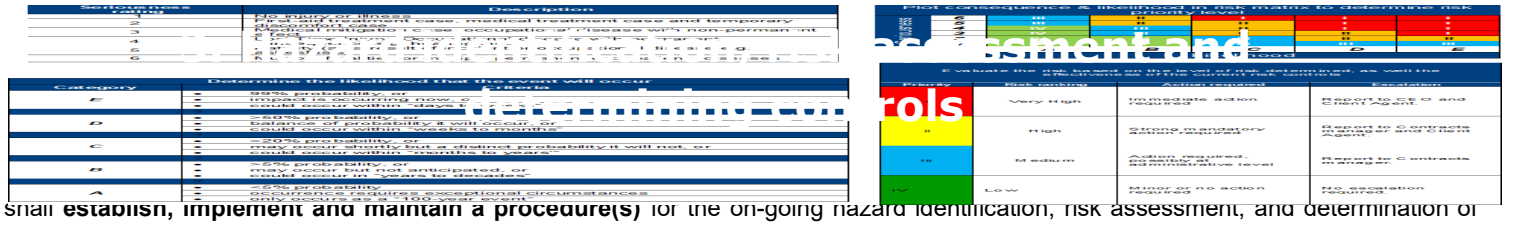
Likelihood

Determine the likelihood that the event will occur	
Category	**Criteria**
E	• 99% probability, or • impact is occurring now, or • could occur within "days to weeks"
	?
D	• >50% probability, or • balance of probability it will occur, or • could occur within "weeks to months"
	?
C	• >20% probability, or • may occur shortly but a distinct probability it will not, or • could occur within "months to years'"
	?
B	• >5% probability, or • may occur but not anticipated, or • could occur in "years to decades"
	?
A	• <5% probability • occurrence requires exceptional circumstances • only occurs as a "100-year event"

Evaluate the risk based on the level of risk determined, as well the effectiveness of the current risk controls

Priority	Risk ranking	Action required	Escalation
i	Very High	Immediate action required	Report to CEO and Client Agent.
ii	High	Strong mandatory action required	Report to Contracts manager and Client Agent.
iii	Medium	Action required, possibly at administrative level	Report to Contracts manager.
iV	Low	Minor or no action required	No escalation required.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2



The organization shall **establish, implement and maintain a procedure(s)** for the on-going hazard identification, risk assessment, and determination of **necessary controls**. The procedure(s) for hazard identification and risk assessment shall consider:

a) routine and non-routine activities.
b) activities of all people having access to the workplace (including contractors and visitors);
c) human behaviour, capabilities and other human factors.
d) identified hazards originating outside the workplace capable of adversely affecting the health and safety of people under the control of the organization within the workplace.
e) hazards created in the vicinity of the workplace by work-related activities under the control of the organization.
f) infrastructure, equipment and materials at the workplace, whether provided by the organization or others.
g) changes or proposed changes in the organization, its activities, or materials.
h) modifications to the OH&S management system, including temporary changes, and their impacts on operations, processes, and activities.
i) any applicable legal obligations relating to risk assessment and implementation of necessary controls.
j) the design of work areas, processes, installations, machinery/equipment, operating procedures and work organization, including their adaptation to human capabilities.

The organization's methodology for hazard identification and risk assessment shall:

a) be defined with respect to its scope, nature and timing to ensure it is proactive rather than reactive; and
b) provide for the identification, prioritization and documentation of risks, and the application of controls, as appropriate.

For the management of change, the organization shall identify the OH&S hazards and OH&S risks associated with changes in the organization, the OH&S management system, or its activities, prior to the introduction of such changes.

When determining controls, or considering changes to existing controls, consideration shall be given to reducing the risks according to the following hierarchy:

Before construction starts, the Baseline Risk Assessment is a theoretical assessment to highlight the foreseen hazards, but this is not intended to be seen as an absolute 100% hazard that may occur.

The Principal Contractor or their appointed Contractor should take this and whatever hazards that may be presented, due to the unique process which get used to execute the specific construction activity.

This Baseline Risk Assessment provides recommendations regarding the control measures; it is however the Principal Contractor duties to ensure that detailed control measures are addressed in applicable site-specific Risk Assessment by the Principal Contractor or their appointed Contractor. The risk rating is deliberately rated high because there are no controls in this and without the required controls the possibility of the potential risk is very high, as indicated.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Designation	Name	Signature	Date
Appointed Client Health & Safety Consultant	Bennie Maritz		18 May 2025
Health and Safety Agent Pr.CHSM	L. Mkabela		18 May 2025

HEALTH AND SAFETY BASELINE RISK ASSESSMENT – SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON

No	Hazard	Description of impact	Potential Risk/s	Control Measures	Pictorial (Where applicable)	Existing Controls (Environmental)	H-S-E Identification	Risk Rating			Legal Reference
1	Site location.	The site is located within residential areas.	Injuries, fatalities and damage to property due to work stoppages and community unrests.	- Prior engagement with local community structures and authorities. - Effective security measures.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
2	Civil Works: - Repair channel walls. - Seal all channel corners using Sika products. - Repair and grout sluice gate slides. - Replacement of Pista paddler - Supply and install a 160 NB PVC suction pipe to redirect suction from the final effluent sump. - New hand railing in the pump station. - Supply and install HDG RS 40 25x4.5 grating. - Test the rising main line from the pump station to the wastewater treatment works, including all fittings, valves, and testing equipment. - Inspect and repair water-retaining concrete structures, including sealing cracks and applying an approved ABE sealer to the sump	- Portable electrical equipment, - Lifting Tackle - Hazardous Chemical Substances - Concrete work - Welding - Gas Cutting - Drilling - General Installation work	Injuries, fatalities and damage to equipment and property, NIHL Hepatitis B, Falling Objects, Heights	- Suitable earthmoving equipment. - Trained, licensed, competent and medical fit drivers and operators. - Competent supervision. - Valid checklists.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

HEALTH AND SAFETY BASELINE RISK ASSESSMENT – SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON											
No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
3	Delivery and off-loading of sewerage plant equipment - Screw Pumps, Mechanical Screens, compactor, Degritter, Pista Trap Paddler and hand screen.	- Delivery trucks. - Mechanical lifting equipment.	Injuries, fatalities and damage to equipment and property due to falling objects and collisions.	- Suitable lifting equipment. - Trained, licensed, competent and fit medical drivers and operators. - Trained and competent banksmen. - Certified lifting equipment, - Competent supervision. - Valid checklists and registers.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
4	Pump and Pipe Works. - 3 new pumps and pipe work	- Delivery trucks. - Mechanical lifting equipment. - Falling objects. - Manual lifting activities.	- Injuries, fatalities and damage to equipment and property due to falling objects and collisions. - Musculoskeletal disorders such as muscle strains and low back injuries due to repetitive work.	- Competent supervision. - Trained, licensed and competent operators. - Trained and competent banksmen. - Certified lifting equipment, - Valid checklists and registers. - Ergonomics risk assessment.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
5	Preparing the foundation of Clearview fencing, Concrete Palisade	- Excavation work. - Earthmoving activities. - Earthmoving equipment.	Injuries, fatalities and damage to equipment and property due to collisions.	- Suitable earthmoving equipment. - Trained, licensed, competent and medical fit drivers and operators. - Competent banksman. - Competent supervision. - Valid checklists.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E		Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

HEALTH AND SAFETY BASELINE RISK ASSESSMENT – SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON											
No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
6	Laying the foundation for new ablution facilities and tool shed.	- Ready-mix trucks. - Concrete placing. - Vibrating equipment. - Reinforcing bars.	- Injuries, fatalities and damage to equipment and property due to collisions. - Injuries resulting from contact with sharp objects. - Musculoskeletal disorders such as muscle strains and low back injuries due to repetitive work. - Eye injuries due to foreign objects.	- Trained, licensed, competent and medical fit drivers and operators. - Competent banksman. - Competent supervision. - Rest breaks. - Ergonomics risk assessment. - Full PPE.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
7	Lifting and assembling sewer plant components.	- Mechanical lifting equipment. - Lifting, positioning and assembling and assembling of plant components. - Falling objects. - Manual handling activities. - Industrial tools.	- Injuries, fatalities and damage to equipment and property due to falling objects and collisions. - Musculoskeletal disorders such as muscle strains and low back injuries due to repetitive work.	- Competent supervision. - Trained, licenced, competent and medical fit operators. - Trained and competent banksmen. - Certified lifting equipment, - Valid checklists and registers. - Ergonomics risk assessment.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

HEALTH AND SAFETY BASELINE RISK ASSESSMENT – SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON											
No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
8	Scaffolding and Temporary works.	- Mechanical lifting equipment. - Industrial tools. - Falling objects. - Manual handling activities. - Securing of plant.	- Injuries, fatalities and damage to equipment and property due to falling objects and collisions. - Musculoskeletal disorders such as muscle strains and low back injuries due to repetitive work.	- Competent supervision. - Trained, licensed and competent operators. - Trained and competent banksmen. - Certified lifting equipment. - Valid checklists and registers. - Ergonomics risk assessment.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
9	Installation of temporary feeding line.	- Lifting and laying down of pipe segments. - Positioning of pipes, - Pipe connection activities etc.	- Injuries, fatalities and damage to equipment and property due to falling objects and collisions. - Back injuries and musculoskeletal disorders.	- Competent supervision. - Trained, licensed and competent operators. - Trained and competent banksmen. - Certified lifting equipment, - Valid checklists and registers. - Full compliance with manufacturer's specifications. - Ergonomics risk assessment.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

HEALTH AND SAFETY BASELINE RISK ASSESSMENT – SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON

No	Hazard	Description of impact	Potential Risk/s	Control Measures	Pictorial (Where applicable)	Existing Controls (Environmental)	H-S-E Identification	Risk Rating			Legal Reference
10	Installation of temporary discharge line.	- Lifting and laying down of pipe segments. - Positioning of pipes - Pipe connection activities etc.	- Injuries, fatalities and damage to equipment and property due to falling objects and collisions. - Back injuries and musculoskeletal disorders.	- Competent supervision. - Trained, licensed and competent operators. - Trained and competent banksmen. - Certified lifting equipment, - Valid checklists and registers. - Full compliance with manufacturer's specifications. - Ergonomics risk assessment.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
11	Electrical installations.	- Lifting and fixing electrical components. - Installation of electrical wires. - Fixing of electrical components. - Electrical connections. - Confined spaces.	Contact with live electrical wires or connections resulting in: - Electrical shocks. - Electrical burns. - Electrocution.	- Competent supervision. - Certificated, competent and accredited electrician. - Full PPE. - Ergonomics risk assessment. - Lock-out procedure. - Air monitoring using appropriate air - monitoring device with a valid calibration record.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
12	Unintentional activation of plant equipment, machinery or equipment parts.	- Contact with rotating parts.	- Injuries and / fatalities due to contact with rotating parts.	- Lock-out procedure. - Full PPE. - Competent supervision.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

HEALTH AND SAFETY BASELINE RISK ASSESSMENT – SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON

No	Hazard	Description of impact	Potential Risk/s	Control Measures	Pictorial (Where applicable)	Existing Controls (Environmental)	H-S-E Identification	Risk Rating			Legal Reference
13	Refurbishment of the screening equipment and grit removal. - new hand screens	- Refurbishment of screening equipment - Removal of solid materials from the wastewater system. - Grit removal. - Confined spaces.	- Water contamination is causing diseases. - Damage to equipment due to falling objects. - Falling objects landing on workers causing injuries and / fatalities. - Eye injuries due to foreign particles penetrating the eyes of workers. - Skin dermatitis due to contact with solids.	- Competent supervision. - Trained, licensed and competent operators. - Trained and competent banksmen. - Certified lifting equipment, - Valid checklists and registers. - Full compliance with manufacturer's specifications. - Ergonomics risk assessment. - Air monitoring using an appropriate air monitoring device with a valid calibration record.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
14	Repair Channel walls, seal channel corners, grout work.	- Repair of center walls. - Repair of corners. - Confined spaces. - Replacement of Pista Paddler - Unintentional activation of machinery or equipment parts. - Solids.	Diseases due to: - Bacterial infections. - Pathogens. - Fungus; - Parasites. - Viruses. - Skin infections. - Dead micro-organisms. - Worms. - Respiratory problems / suffocation because of work performed in an - oxygen deficient atmosphere.	- Competent supervision. - Avoid direct contact with organic material. - Placing the pump inside the tank while there is still some water. - Full PPE. - Full compliance with manufacturer's specifications.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

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No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
15	Cleaning and removal of sewer/waste from working surfaces/areas and supply new waste bins.	- Sewer/waste - Solids.	Diseases due to: - Organic matter. - Dead micro-organisms. - Exposure to toxic vapours and gases. - Respiratory problems / suffocation because of work performed in an oxygen deficient atmosphere.	- Competent supervision. - Avoid direct contact with organic material. - Placing the pump inside the tank while there is still some water. - Full PPE. - Full compliance with manufacturer's specifications. - Emergency evacuation procedure.	As far as possible have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
16	Installation of CCTV cameras.	- Removal and replacement of old fence. - Installation of new cameras. - Heights - Electricity.	- Respiratory problems / suffocation because of work performed in an oxygen deficient atmosphere.	- Competent supervision. - Avoid direct contact with organic material. - Placing the pump inside the tank while there is still some water. - Full PPE. - Full compliance with manufacturer's specifications. - Emergency evacuation procedure.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

HEALTH AND SAFETY BASELINE RISK ASSESSMENT – SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON

No	Hazard	Description of impact	Potential Risk/s	Control Measures	Pictorial (Where applicable)	Existing Controls (Environmental)	H-S-E Identification	Risk Rating			Legal Reference
17	Installation Compactor.	- Bacteria. - Viruses - Archaea - Fungi - Protists and other microbes. - Confined spaces. - Lifing Activities	Diseases such as: - Cholera - Dysentery - Typhoid - Respiratory problems / suffocation due to chemical inhalation. - Respiratory problems / suffocation because of work performed in an - oxygen deficient atmosphere.	- Competent supervision. - Avoid direct contact with organic material. - Placing the pump inside the tank while there is still some water. - Full PPE. - Full compliance with manufacturer's specifications. - Emergency evacuation procedure. - Legal Compliant Lifting Equipment - Medically fit employees	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
18	Modification of inlet. .	- Removal of old equipment. - Installation of new mechanical Screens	Diseases due to: - Organic matter. - Dead micro-organisms. - Exposure to toxic vapours and gases. - Respiratory problems / suffocation because of work performed in an oxygen deficient atmosphere.	- Competent supervision. - Avoid direct contact with organic material. - Placing the pump inside the tank while there is still some water. - Full PPE. - Full compliance with manufacturer's specifications. - Emergency evacuation procedure. - Legal Compliant Lifting Equipment - Medically fit employees	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

HEALTH AND SAFETY BASELINE RISK ASSESSMENT – SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON											
No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
19	Installation of screw pumps, Degritter, Pista Paddler and Sluice Gates.	- Decomposing sewage sludge. - Sewer - Lifting activities	Diseases due to: - Organic matter. - Dead micro-organisms. - Exposure to toxic vapours and gases. - Respiratory problems / suffocation because of work performed in an oxygen deficient atmosphere. - Musculoskeletal disorders such as muscle strains and low back injuries - due to repetitive work.	- Competent supervision. - Full PPE. - Full adherence to the biogas flow meter measurement readings. - Emergency evacuation procedure. - Legal Compliant Lifting Equipment - Medically fit employees	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
20	Security upgrades – Steel doors	- Vandalization of infrastructure. - Armed robberies. - Theft of equipment.	- Damage to network systems resulting in spills. - Waste water spills due to theft of equipment or vandalization of infrastructure. - Injuries and fatalities due to lack of security measures for plant operators / workers.	- Supervisory control. - Reinforced steel doors. - Competent and registered security personnel with relevant grading requirements. - Secure and reliable control systems. - Data acquisition systems such as SCADA. - Installation of CCTV cameras. - Upgrading of existing equipment. - Compliance with national and global water treatment standards. - Risk assessment.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

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No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
21	Installation of transformers	- Falling objects. - Working on heights. - . Connecting the Transformers to the power supply.	- Employees falling to lower levels or the ground sustaining injuries or losing their lives. - Falling objects resulting in injuries, fatalities and damage to property. - Contact with live electrical wires or connections resulting in: - Electrical shocks. - Electrical burns. - Electrocution.	- Accredited solar system contractor. Competent supervision. - Certificated, competent and accredited electrician. - Full PPE. - Ergonomics risk assessment. - Lock-out procedure. - Working at heights risk assessment. - Medical, physical and psychological fit workers. - Suitable fall protection equipment. - Valid checklists and registers. - Full PPE	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
22	Working at heights.	- Performing work from a fall risk position. - Falling objects. - Drop-off edges, openings etc.	- Employees falling to lower levels or the ground sustaining injuries or losing their lives. - Falling objects resulting in injuries, fatalities and damage to property.	- Working at heights risk assessment. - Medical, physical and psychological fit workers. - Suitable fall protection equipment. - Valid checklists and registers. - Full PPE.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

HEALTH AND SAFETY BASELINE RISK ASSESSMENT – SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON											
No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
23	Earthmoving activities.	- Excavation work. - Trenching. - Loading and hauling. - Stockpiling. - Back filling and compaction work. - Earthmoving equipment.	- Workers and community members may be run over by construction equipment resulting in injuries and fatalities. - Damage to property due to collisions. - Noise induced hearing loss due to excessive noise levels. - Respiratory problems due to chemical inhalation. - Loss of vision as a result of foreign particles etc.	- Competent supervision. - Trained, licenced and competent drivers and operators. - Full PPE. - Issuing of notices to the community. - Traffic control measures. - Traffic management plan.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
24	Construction equipment.	- Haul roads. - Falling objects	- Workers and community members may be run over by construction equipment resulting in injuries and fatalities. - Damage to property due to collisions. - Noise induced hearing loss due to excessive noise levels. - Respiratory problems due to chemical inhalation. - Loss of vision because of foreign particles etc.	- Competent supervision. - Trained, licenced and competent drivers and operators. - Full PPE. - Issuing of notices to the community. - Traffic control measures. - Traffic management plan.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

HEALTH AND SAFETY BASELINE RISK ASSESSMENT – SEWER PUMP STATION AND THE ERADICATION OF 250 BUCKETS IN EXT. 12 AND 13 - WESSELSBRON											
No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
25	Water environments.	- Intense rain. - Large water volumes. - Water flow velocity, - Local and impacting flash floods.	- Drowning cases. - Construction equipment engulfed by / swept away by heavy water flows.	- Competent supervision. - Full PPE. - Compliance with weather alerts.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
28	Confined spaces	- Performing work between structures.	- Heat stroke / stress cases. - Injuries, fatalities, - Claustrophobia cases. - Suffocation etc. resulting from restricted access / egress, restricted movement, oxygen deficient atmosphere, toxic gases and vapours - etc.	- Competent supervision. - Full PPE. - Air monitoring devices. - Compliance with weather alerts. - Heat stress and cold stress risk assessment.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
26	Dangerous goods	- Transportation. - Handling and storage of dangerous goods.	- Explosions. - Dermatitis is due to contact with chemicals. - Breathing problems resulting from chemical inhalation. - Stomach irritation / diarrhea due to chemical ingestion. - Eye irritation due to liquid splashes.	- Suitable training in dangerous goods. - Trained, licensed and competent drivers and operators. - Suitable vehicle branded with applicable warning signage. - Firefighting equipment. - Valid PDP. - Tremcard.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

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No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
27	Grinding	- Grinding sparks. - Rotating parts. - Flying objects.	- Eye irritations / loss of sight resulting from flying objects. - Respiratory problems due to chemical inhalation and injuries due to rotating parts.	- Trained and competent artisan/s. - Full PPE. - Firefighting equipment. - Valid checklists and registers.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
28	Welding	- Welding flames, welding gases, metals, hot spatters.	- Arc eyes because of gazing directly at the welding activities, burns from hot spatters, breathing problems because of chemical inhalation.	- Trained and competent artisan/s. - Full PPE. - Firefighting equipment. - Valid checklists and registers.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
29	Flame cutting	- Acetylene, metals, and toxic gases.	- Injuries, fatalities and damage to property due to cylinder explosion and breathing complications because of chemical inhalation.	- Trained and competent artisan/s. - Full PPE. - Firefighting equipment. - Valid checklists and registers.	As far as possible have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
30	Reinforcing	- Reinforcing bars.	- Lacerations due to contact with sharp edges and nip points.	- Trained and competent skilled workers. - Full PPE. - Valid checklists and registers.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

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No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
31	Concrete	- Concrete batching, concrete placing, concrete prefabs, concrete patch and repair work concrete breaking, cement dust, fly ash, chemicals, concrete splashes, noise, vibration, dust, flying objects.	- Dermatitis due to contact with chemicals, breathing complications resulting from chemical inhalation and stomach irritation / diarrhea due to chemical ingestion. - Impact injuries / fatalities from striking support structures, falls, trips, slips and due to falling objects.	- Trained and competent skilled workers. - Full PPE. - Valid checklists and registers.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
32	Carpentry work.	- Woodworking equipment, rotating parts, wood dust.	- Injuries due to contact with sharp objects and rotating parts. Breathing complications resulting from dust inhalation.	- Trained and competent skilled workers. - Full PPE. - Valid checklists and registers.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
33	Mechanical repairs and Installation - sewerage plant equipment - Screw Pumps, Mechanical Screens, compactor, Degritter, Pista Trap Paddler.	- Industrial machinery, mechanical and hydraulic lifting devices, hazardous chemicals substances.	Injuries because of contact with heavy objects. Burns resulting from hot objects. Dermatitis due to contact with chemicals, breathing complications resulting from chemical inhalation and stomach irritation / diarrhoea due to - chemical ingestion.	- Trained and competent skilled workers. - Full PPE. - Valid checklists and registers.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

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No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
34	Radio-active material	- Density, soil and moisture gauges.	- Exposure to ionizing radiation resulting in radiation cases with a great potential of death.	- Trained and competent skilled workers. - Full PPE. - Valid checklists and registers.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
35	File Approval as per OHS Requirements and Client Specification	- Work commencing prior to file being available and approved. - No valid registration with COID. - Expired Documentation (e.g. competencies, equipment load test, medicals, work permits) - Documentation not available or approved asper required -Client Spec and OHS act.	- Site stoppages due to legal noncompliance	Recommendations: - No Work Commencement until approval has been signed off. - Client Health and Safety Specification. - Baseline Risk Assessment Site Conditions evaluation	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards. CR 3
36	Legal Appointments and Competency	- Employees appointed not in possession of required or valid competencies as per the Client Spec and OHS Act. - Appointment not as per legal requirements. - Lack of experience for appointed position.	- Site stoppages due to legal noncompliance	- Recommendation - No Work Commencement until approval has been signed off. - Client Health and Safety Specification. - Baseline Risk Assessment	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

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No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
37	Required legal documentation asper OHS act	- Documentation not Site Specific. - Policies and Procedure not in place and approved.	- Site stoppages due to legal noncompliance	- Recommendations - No Work Commencement until approval has been signed off. - Client Health and Safety Specification. - Baseline Risk Assessment Training Needs analysis to be conducted by Contractor. - Communication of required documentation	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
38	Risk Identification	- Method of works not site specific - Risk identification not in place or conducted - Risk identification not site specific - Risk controls not sufficient - Risk Assessor not competent - Continues Risk evaluation not conducted	- Site stoppages due to legal noncompliance	- Recommendations - No Work Commencement until approval has been signed off. - Client Health and Safety Specification. - Baseline Risk Assessment - Method Statement of Tasks Site conditions Evaluation	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

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No	**Hazard**	**Description of impact**	**Potential Risk/s**	**Control Measures**	**Pictorial (Where applicable)**	**Existing Controls (Environmental)**	**H-S-E Identification**	**Risk Rating**			**Legal Reference**
39	Induction & Medical certificate of fitness/Vaccination	- Employees entering the site are not being inducted. - Visitors entering site are not being inducted /signing visitors' induction form. - Visitors are not being provided with the necessary personal protective equipment. - Induction being conducted on employees without them being in possession of a valid medical certificate of fitness in the form of an Annexure 3. The medical must be conducted by a registered Occupational Health Practitioner. - Construction vehicles and mobile plant operators entering the site without being inducted. - Driver of delivery vehicles not made aware of the specific site conditions. - Employees being inducted without valid work permits / certified ID Copies.	Site stoppages due to legal noncompliance	- Recommendation: - Site induction can only be done with an employee if the required up to date medical is presented at the induction. - Medical fitness certificates must be validated by the principal contractor to ensure adherence to the minimum requirements and validity of the document. - All employees that may encounter sewer to be vaccinated for Hepatitis B - Each person's ID or valid work permit must be inspected before induction can be allowed on site for the individual.	As far as possible have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.

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40	List of employees and Contractors	- Number of employees on site not listed on employee lifts. - Number of contractors on site not listed on contractor list. - Employee and contractor lists are not updated as required.	- Site stoppages due to legal noncompliance - No record of injured employees.	- Recommendation: - Keep all employees working on site on an employee register. - Keep all contractors on site on an updated contractor list. Enter new employees and contractors into the - lift as soon as they have received the site induction.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
41	Notification of Construction	- Contractor not submitting application to the DOL as required by legal requirement. - Permit application	- Site stoppages due to legal noncompliance	- Recommendation: - Contractor to provide the DOL with the required Notification as legislated. - Notification to contain the minimum required information and to be submitted as legislated to prevent work stoppages from DOL.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	Occupational Health and Safety Act and Regulations (85 of 1993) and incorporated safety standards.
42	Top structures and house connections	- Concrete placing, concrete prefabs, cement dust, fly ash, chemicals, concrete splashes, noise, vibration, dust, flying objects.	- Dermatitis due to contact with chemicals, breathing complications resulting from chemical inhalation and stomach irritation / diarrhea due to chemical ingestion. - Impact injuries / fatalities from striking support structures, falls, trips, slips and due to falling objects.	- Trained and competent skilled workers. - Full PPE. - Valid checklists and registers.	As far as possible, have a picture which can be of benefit for illiterate readers when the detailed risk assessment is done.	N/A	H&S	6	E	6E	

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2