Electrical Specification

Construction of the Bulk Water Supply at Blyde Canyon Nature Reserve

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1. STANDARD SPECIFICATIONS, ACTS, REGULATIONS, AND BY-LAWS

Wherever any reference is made to the South African National Standard (SANS) and the British Standard specification (BS) in either of the General Specification (Section 1), Project Specification (Section 2), and Quality Specifications for schools this reference shall be deemed to read "SANS or equivalent standard" and "BS or equivalent standard" respectively.

The following shall apply to this contract:

(a) GP_E5_1: Standard Quality Specifications – General Electrical Installations

(b) GP_E5_2: Quality Specification – Electrical Material and Equipment

(c) GP_E6_1 Rev1: Standard Quality Specification for General Electrical Installations (Schools)

(d) GP_E6_2 Rev1: Standard Quality Specification for Electrical Material & Equipment (Schools)

(e) GP_E1_2: Standard Quality Specification for Intercommunication Systems

(f) GP_E1_7: Standard Quality Specification for Public Address Systems

(g) GP_E2_2: Standard Quality Specification for Access Control Systems

(h) GP_E2_7: Standard Quality Specification for Intruder Alarm Systems

(i) GP_E2_C: Standard Quality Specification for Automatic Fire Alarm Systems

(j) GP_E4_2: Standard Quality Specification for Standby Diesel Alternator Sets

(k) GP_E4_7: Standard Quality Specification for Uninterruptible Power Supply Systems

(l) GP_E4_C: Standard Quality Specification for Solar Power Systems

(m) SANS 10142: The Wiring of Premises.

(n) SANS 204: Energy Efficiency in Buildings

(o) SANS 10114-1: Interior lighting Part 1: Artificial interior lighting.

(p) SANS 10114-2: Emergency Lighting

(q) SANS 10389-1: Exterior Lighting Part 1 – Artificial Lighting of exterior areas for work and safety

(r) SANS 10098-1: Public Lighting Part 1 - The Lighting of Public Thoroughfares

(s) SANS 10098-2: Public Lighting Part 1 - The Lighting of Certain Specific Areas of Streets and Highways.

(t) SANS 10292: Earthing of Low Voltage Distribution Systems.

(u) SANS 10313: Protection of structures against lightning

(v) SANS 10400: The Application of the National Building Regulations

(w) Act 85 of 1993: Occupational Health and Safety Ac

2. NOTICE AND FEES

The contractor shall make all arrangements, give all required notices, and pay all necessary fees, including any inspection fees, due to the local Supply Authority relating to the connection, alteration, or upgrade of the electricity supply to the premises.

The actual net amounts paid will be refunded to the contractor upon receipt of proof of payment.

Provisional amounts to cover these costs are allowed for in the Bill of Quantities and an allowance is made for the tenderers to price for attendance, profit, and all incidental costs relating to this requirement.

3. CONDUIT AND CONDUIT ACCESSORIES

The indoor installation may be in black enamelled conduit or PVC conduit. All conduits shall be concealed in the building work where possible. Black enamelled conduit shall be screwed or plain end.

Should for some reason it not be possible to conceal conduit in the building work requiring the conduit to be surface mounted, only steel conduit may be used, secured neatly in vertical and horizontal positions using galvanized steel spacer saddles.

Steel conduit exposed to damp or weather conditions shall be galvanized to SANS 121.

Galvanized draw wires must be provided in all conduits provided for other services.

- All steel conduit joints in concrete slabs and all running joints must be painted.
- No chasing by hammer and chisel will be accepted. Slots for conduits must be cut by using power-cutting disk tools where necessary.
- Bushes on metal conduit shall be of brass only.
- All outlet box cover plates must be metal and steel outlet boxes must be hot-dipped galvanized to SANS 121.
- Where cavity walls or face brick walls are encountered deep back-to-back (one end closed) wall boxes must be used.
- Blank cover plates on round outlet boxes must be fixed with flathead brass screws and a gasket to seal the box.
- Blank cover plates on 100 x 100 mm outlet boxes must be fixed with two countersunk chrome screws.
- Where outlet boxes or draw boxes are mounted on finished surfaces the electrical contractor shall take care that such outlets are mounted symmetrically. It will not be sufficient to scale the position of any outlet of the drawings. No extra payment will be allowed where the outlets are not mounted symmetrically and must be changed. Unless other methods of installation are specified for certain circuits, the installation shall be in conduit throughout. No open wiring in roof spaces or elsewhere will be permitted.
- Non-metallic conduit or conduit boxes shall not support luminaries and other fittings. These fittings shall be secured to the surrounding structure in a way that is acceptable to the Employer's Agent.
- Surface-mounted conduit shall be supported and fixed with saddles with a maximum spacing of 1,5 m, even in roof spaces. (Refer to SANS 10142-1).
- The contractor shall supply and install all additional supporting timbers required.

It shall be possible to rewire the completed installation in the future without undue difficulty.

Non-metallic conduit and fittings shall not be used under the following conditions:

a) Outside a building (unless protected or sheltered under eaves).

b) For mechanical load bearing.

c) Where it may be subjected to temperatures below -10°C or above 70°C for prolonged periods.

d) As primary electrical insulation.

e) In areas where it may be subject to mechanical damage.

f) For applications other than those for which it is designed

Painting of Conduits

The exposed conduit may be painted with normal oil or PVA paints, but care must be taken to ensure that the paint used does not contain any component that will soften or have any other detrimental effect on the materials from which the conduit and fittings are manufactured.

Connecting of Conduit to Metal Equipment/Components

When any part of a non-metallic conduit system has to be connected to metal equipment or components (e.g. switchboard, surface socket-outlet or switch box, existing metallic conduit system, etc.) fittings and couplings manufactured specifically for this purpose must be used. Non-metallic conduit must not be threaded to fit metallic connectors.

Bends

The technique applied in bending conduit shall result in a smoothly bent conduit without conduit surface ripple, cracking, or flattening of the conduit. Suitable bending tools shall be applied to achieve this where manual methods are inadequate. Bends shall comply with SANS 10142-1. Conduits shall be secured immediately following bending.

Adhesive Joints

All adhesive joints must be made in a clean dry area. The surfaces of all components to be bonded must be dry and clean. The technique applied in jointing conduit shall ensure that a mechanically sound and watertight joint with an insertion depth equal

to half the length of the coupling is achieved and that no excess jointing adhesive is squeezed into the conduit or accessory.

NOTE: Solvent adhesives containing highly volatile liquids and their containers should not be left open.

Cutting of Conduit

A fine-tooth hacksaw shall be used to cut the conduit to the required length. Each cut end shall be square and free from swarf, burrs, and loose material. When determining the length of conduit to be cut, allowance must be made for the length of couplings or accessories attached to the conduit. Incorrect determination will cause bulging of the conduit or insufficient joint length.

4. CONDUIT IN ROOF SPACES

In roof spaces, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit shall be secured at intervals not exceeding 1,5 m using saddles fixed to the roof timbers using screws or acceptable clout nails.

In the case of repairs and renovations, conduit runs from a distribution board shall, where possible, terminate in fabricated sheet steel draw boxes installed directly above or near the boards.

5. WIRING

Except where otherwise specified in Section 2 of the specification or indicated on the drawings, wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted.

No wiring shall be drawn into the conduit until the conduit installation has been completed and all conduit ends provided with bushes. All conduit is to be clear of moisture and debris before wiring is commenced.

The wiring of the installation shall be carried out by the latest edition of the Wiring Code (SANS 10142). It is a specific requirement of this contract that earth conductors be provided and drawn into the conduit with the main conductors to all points, including all lighting points throughout the installation, irrespective of the type of conduit used.

Wiring for lighting circuits is to be carried out with a 2.5 mm² conductor and a 2,5 mm² earth conductor.

For socket outlet circuits the wiring shall comprise 4 mm² and a 2,5 mm² earth conductor. In certain instances, as will be directed in Section 2 of this specification or shown on the drawings, the sizes of the conductors may have to be increased for specified circuits.

Sizes of conductors to be drawn into conduits in all other instances, such as feeders to distribution boards, power points, etc, shall be as specified elsewhere in this specification or indicated on the drawings. Sizes of conductors not specified must be following the Wiring Code.

The stipulations concerning the installation of earth conductors to a certain maximum length for a given size of the conductor as set out in the "Wiring Code" are to be strictly applied.

The loop-in system shall be followed throughout, and no joints of any description will be permitted. The wiring shall be done in PVC insulated 300/500V grade cable to SANS 1507.

Where cable ends connect to switches, fittings, etc. the end strands must be neatly and tightly twisted together and firmly secured. Cutting away wire strands of any cable will not be allowed.

Insulated heat-resistant wiring shall be used to connect totally enclosed luminaires and other fittings where excessive temperatures are likely to occur.

6. SWITCHES *AND SOCKET OUTLETS*

All light switches shall be installed with the center line at 1,4 m above the finished floor level and all socket outlets with the center line at 300mm above the finished floor level or, where applicable, between a worktop window sill in such manner that it is either totally within or totally above any tiled area, unless a specific mounting height is indicated on the drawings or specified in the Project Specification (Section 2).

Screws longer than 30mm to affix a light switch or switch socket cradles to the draw box will not be accepted.

7. DISTRIBUTION BOARDS

General

All boards shall be by the types as specified, be constructed according to the detail or type drawings, and must be approved by the Employer's Agent before installation.

In all instances where provision is to be made on boards for the Supply Authority's main switch and/or metering equipment, the contractor must ensure that all requirements of the authorities concerned in this respect are met.

Two spare 25mm dia. and three spare 20mm dia conduits must be supplied from all distribution boards to roof spaces.

Three sets of factory drawings on all distribution boards must be submitted for approval before the manufacture of the distribution boards commences.

The Employer's Agent must be notified at least two weeks in advance of the completion of the distribution boards so that an inspection may be carried out.

Installation

All distribution boards shall be supplied and installed in the positions shown on the drawings.

All distribution boards must be flush mounted unless otherwise indicated and are to be installed with the top of the board 2,0 m above the finished floor level.

The distribution boards must be placed in such a way that they can be built into the walls where applicable. Special provision must be made that the distribution board tray is not damaged or distorted while being built in.

Where boards must be installed in walls of single brick width an expanded mesh shall be affixed to the rear of the board tray to provide support to plaster. All distribution boards must be installed level.

Where a sleeve to provide cable entry into a flush board is required, the distribution board tray shall be set back into the wall to permit the sleeve to terminate below the tray for its full diameter. Face brick facets shall in such instances be used to conceal the sleeve. Slots in the wall with a cover plate will not be permitted unless specifically approved by the Employer's Agent.

Earth conductors must be fastened with screws and/or lugs to earth bars.

Labelling

Circuit breakers that do not feed any load must be marked "SPARE" on the distribution boards. Labels indicating the source of supply and the size of the supply cable must be provided on each distribution board.

Where switchboards are positioned behind doors of the building structure i.e. built-in cupboards, a suitable approved electrical danger sign as well as the applicable distribution board designation label must be supplied and fitted in a suitable position on the outside top section of one of the entrance doors at each such location.

8. EARTHING OF INSTALLATION

The type of main earth provided must be as required by the Supply Authority, in addition to any requirements indicated by the Employer's Agent, who may require additional earthing to achieve desired results.

Earth rods or trench earths will be required as specified or directed by the Employer's Agent. Installations shall be effectively earthed following the Wiring Code.

All hot and cold water and waste pipes are to be effectively bonded using 12,5 mm x 1,6 mm solid or perforated copper tape (not wire), clamped using brass bolts and nuts. The tape is to be fixed to walls using rounded brass screws at intervals not exceeding 150 mm.

Provision must be made for the conduit to be installed in the wall for all earthing requirements. Main earth copper tapes/wires must be installed in these conduits. Where provision was not made as stipulated above, 20 mm diameter galvanized steel conduit must be installed from below ground level to 3 m above ground level. This conduit must be securely fixed to the walls. Corrugated iron roofs and guttering must be effectively earthed with copper tape and brass bolts with nuts at intervals not exceeding 2m. Self-tapping screws are not acceptable as a means of securing earth conductors.

Connection from the main earth bar on the main board must be made at the cold water main, the incoming service earth conductor, if any, and the local earth electrode using 12,5 mm x 1,60 mm solid or perforated copper tape or 16 mm² stranded (not solid) bare copper wire or such conductor as the Employer's Agent may direct.

9. LIGHTNING PROTECTION

The buildings shall be protected against lighting by way of a 40mm x 4mm aluminium strip secured to the roof tiles along the ridges. Fixing shall be done in such a manner that no tile is penetrated or cracked, using M7 concrete anchors at every second tile edge.

The aluminium strip shall be installed perfectly straight without weaving or twisting.

At the roof edges the strip shall be bonded to a down conductor consisting of 10mm² bare copper earth wire contained in a 20dia PVC conduit, running from a point close to the roof edge to the earth pegs below.

A 100 x 100mm draw box with a cover shall be provided 300mm above floor level and another above ceiling level to facilitate installation.

Bonding shall be using M8 stainless steel bolts washers and nuts

TECHNICAL SPECIFICATIONS

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1. INTRODUCTION

This project scope covers the supply and installation of the Blyde Canyon Reserve Water Supply's electrical installation to suit SANS' standards of the electrical system.

2. SCOPE *OF WORK*

The specification covers the supply, installation, testing, commissioning, and handing over in working condition and maintenance during the guarantee period of the general electrical installation of the school. The scope of this includes new electrical installations necessary for the proper functioning of the Reserve Water Supply. The contractor is to provide all the items required to provide a **COMPLETE** installation as indicated below under the **Summary of the work.**

Essence of the contract

Installation Electrician

Employ an installation electrician to plan control and supervise the day-to-day construction work activities on site with the associated responsibility. The installation electrician must also do full-time quality control for the contractor on the site and sign the final compliance documentation for the project.

Enclosed is a copy of the 'Installation Electrician' certificates, addressing his telephone number with the tender. Failure to provide this document disqualifies the tender.

3. REGISTRATION AS ELECTRICAL CONTRACTOR

The contractor must provide the following documents with the tender submission:

(a) CIDB Grading of 3EB

(b) Installation Electrician certificate.

(c) Electrical contractor's license.

(d) Registration certificates and latest receipts of payment to the Workman's Compensation as required by the Workman's Compensation Act of 1941, as amended.

The contractor must enclose certified copies of the above documents (a) (b) and (c), with the tender submission. Failure to provide these documents disqualifies the tender.

4. CABLE *SUPPORT SYSTEM*

- The contractor is to provide the following cable support systems, as indicated on the drawings and in the standard specifications:
- All associated fittings, accessories, and fixtures are to be factory-manufactured and NOT to be manufactured on-site by the contractor. All makeshift fittings will be rejected.
- Wire all contacts and monitoring facilities to a terminal block at the back of the panel.
- Should the isolator panel not be able to accommodate the equipment required for the current energy measurement, the contractor should consider the use of a summation transformer to provide an indication of these measurements on the main incomer. The engineer must approve the designs of all equipment to be provided before the commencement of the actual work.
- Wire all contacts and monitoring facilities to a terminal block at the back of the panel.

5. WIRING SCHEDULES

Item	Description	Cable Size	Earth Wire
1	Lighting	2.5mm^2 PVC conductor GP wire	2.5mm^2 PVC insulated earth conductor
2	Plugs	4.0 mm^2 PVC conductor GP wire	4.0mm2 PVC insulated earth conductor

6. LIGHTING SCHEDULE

TYPE		DESCRIPTION
Type A		1 165mm long surface mounted light fitting c/w 46W, LED, 7000-8000 lumens, IP65, 4 000K, UV stabilized polycarbonate diffuser, electronic control gear, and a 5year warranty.
Type B		Surface-mounted high-pressure die-cast aluminum powdercoated body with injection-molded, UV stabilized highimpact, non-discoloring acrylic diffuser, the diffuser shall be held to the body by four captive stainless steel Allen's head screws c/w 20W LED, 2000-3000 lumens, IP65, electronic control gear, and a 5-year warranty.

7. DISTRIBUTION *BOARD PROPERTIES*

- Type: Surfaced wall-mounted
- Doors: Cupboard fitted with doors, lockable
- Front panel: Hinged front panel (face plate) with pad lockable swing handles
- Colour: Orange

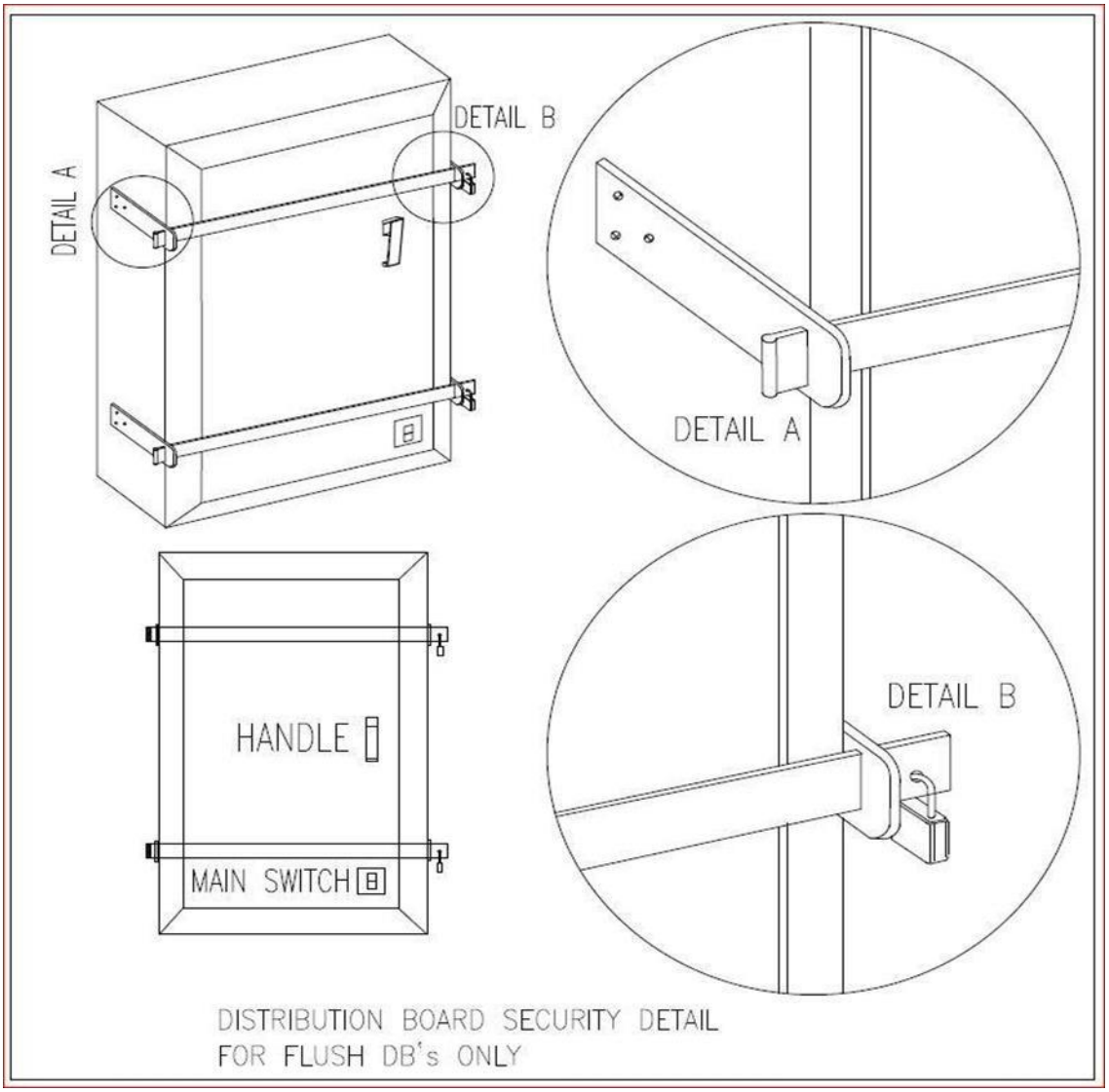
Distribution board doors must have a neat and professionally manufactured cut-out, with reinforced and properly finished edges, so that the main isolator of the distribution board can be switched without opening the door in case of emergency. Distribution boards must be lockable, and padlocks must be supplied with the distribution board. A drawing showing the design of the locking mechanisms and cut-out forms part of the single-line drawings of the project.

Two spare/additional 25mm dia. and three spare/additional 20mm diameter conduits must be installed to all distribution boards and are to be terminated onto a suitably sized galvanized draw box with a cover plate installed within the open ceiling roof space.

The main circuit breaker in the generator room distribution board and the administration building main distribution board must be adjustable to trip at lower currents than the maximum rating.

All main distribution boards and sub-distribution boards are to be fitted with a digital display kilowatt-hour meter with data storage and retention (with battery backup). Both kilowatt-hours and maximum demand must be measured for the main incoming supply and the generator supply. Phase and neutral currents must also be measured. Provide battery backed up data storage and retention.

Install surge arrestors for the main incoming supply and in all distribution boards that complies with SANS 10142-1:2017, Edition 2.



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WET SERVICES SPECIFICATION

For

Construction of the Blyde Canyon Nature Reserve Water Supply

Blyde Canyon, Mpumalanga

Client: Mpumalanga Tourism and Parks Agency

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1. CONDITIONS OF TENDER

1.1 PRIORITY OF DOCUMENTS

This Tender package consists of multiple documents. All discrepancies shall be brought to the attention of the responsible Engineer in writing and a minimum of one week prior to Tender close.

In cases of discrepancies the document hierarchy shall be as below;

1.15.1: Drawings
1.15.2: Technical Specification
1.15.3: Bills of Quantities

1.2 INSPECTION OF SITE

The Tenderer shall inspect and examine the site and its surroundings and shall satisfy himself before submitting his Tender as to the nature of the Site, the quantities and nature of the work and materials necessary for the completion of the Works and the means of access to the Site, the accommodation he may require and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer.

1.3 DECLARATION OF SUB-CONTRACTORS

The Tenderer shall state in an accompanying letter the name of the sub-contractors he proposes to employ to assist him to complete the Works and the proposed extent of the sub-contractor's responsibilities.

All terms and conditions of this agreement and specification shall be binding on the Tenderer and any sub-contractor utilized by the Tenderer.

1.4 ORDERING OF MATERIALS

The Bills of Quantities must not be used for the ordering of materials. Any ordering of materials based on these Bills of Quantities is at the sole risk of the Contractor.

1.5 DRAWINGS

The contractor is required to inspect all drawings and must familiarize himself with all the requirements needed to fulfil this contract. No claims will be entertained as a result of the non-compliance with the above. Should drawings or parts of drawings be unclear, the Tenderer must seek an explanation from the engineer to clarify the matter.

1.6 CONTRACT PERIOD AND PENALTIES

The contract period shall be advised. The period shall consist of;

- Tender return: ……
- Tender award: ……
- Date of completion: ……

The contractor shall be responsible for the following;

1.20.1. Compliance with Tender formalities
1.20.2. One (1) week site work execution, commissioning and balancing from date of completion
1.20.3. Twelve (12) months free maintenance period: start on completion & acceptance of site work execution.

A penalty of R…… per day shall be paid for each calendar day the works remain incomplete following the periods indicated here. The calculation of days shall include public holidays, and weekends.

1.7 MATERIALS OFF-SITE AND SERVICES

Notwithstanding the options given in the principal agreement or form of contract an application for payment for materials stored off-site and payment for services off-site will only be considered upon receipt of an approved guarantee from an approved bank or financial institution for the full value thereof and shall be made at the discretion of the Employer and or his agent.

1.8 SITE SECURITY

The contractor is to provide his own security arrangements to safeguard his own property and unfixed materials on site.

1.9 PRICING OF THESE GENERAL NOTES

The Contractor may allow in his pricing, or where provided for in the Preliminaries, for all additional costs arising out of requirements of the notes set out in Section 1 as no claims for additional costs in this respect will be considered.

1.10 SUFFICIENCY OF TENDER

The Tenderer shall be deemed to have satisfied himself before submitting his offer as to the correctness and sufficiency thereof for the Works and of the rates and prices he has stated in the Schedules which rates and prices shall cover all his obligations under the Contracts and all matters and things necessary for the proper completion of the Works.

1.11 RATES AND PRICES

The rates and prices inserted in the Contract Documentation shall be deemed to include, but shall not be limited to the following:

1.25.1. Materials, workmanship and utilization of plant and equipment,
1.25.2. Transport, unloading, storing and hoisting to all levels of all materials,

1.25.3. Temporary works,
1.25.4. Cutting and waste,
1.25.5. Overhead charges and profit,
1.25.6. Stoppage for inspection purposes by the Principal Agent or Engineer,
1.25.7. Overtime working necessary to complete the Works within the time for completion.
1.25.8. Documentation and record keeping required to handover and maintain the project.
1.25.9. 12 months free maintenance in accordance with the Tender documentation

Value Added Tax (VAT) shall not be included with the rates and prices, but shall be shown separately on the Form of Tender.

1.12 OCCUPATIONAL HEALTH AND SAFETY ACT

Tenderers shall note, and make provision for, the execution of the contract works in strict compliance with the relevant clauses of the Occupational Health and Safety Act, Act 85 of 1993 as amended, including any special clauses or requirements as may be stipulated in main contractor's Health and Safety Agreement pertaining to contractors and contract works.

All works involving pressurized fluids and or gasses shall be executed in accordance with the Pressure Equipment Regulations (2009). Special note shall be made of the requirement for registration and training of personnel working with and handling pressurized refrigerant gasses.

The Construction Regulations (2003) shall apply to this project and provision shall be made for these within the Tenderers allowances.

Prior to commencement of work the Tenderer will be required to undergo Safety, Health and Environmental (SHE) training from the Employer. A work permit will not be issued to work on the Employer's premises until this has been approved by the SHE department.

STANDARD SPECIFICATION

1.13 DEFINITIONS & ABBREVIATIONS

Definitions of terms used in these documents shall mean:

"Approved" / "Satisfactory" / "Accepted":	As approved, satisfactory, and accepted by the Employer or his agent.
"Balancing":	Work adjustments and checks necessary to proportion the flow within the distribution system, sub-mains, branches and terminals of a system in accordance with specified quantities and to achieve specified performance.
"Contractor" "Tenderer":	The contractor or Tenderer is the party, persons or company successful in their bid return as part of this contract.
"Commissioning":	Work necessary to place the installation and work covered by this specification into normal operating conditions to the satisfaction of the Employer or his agent.
"Indicated": "Shown" or "Noted"	As indicated, shown or noted on drawings and/or specifications
"Install":	To erect, mount, fix and connect complete with all related accessories to enable the desired function.
"Provided":	To supply, install, connect up and commission into regular and safe operation of particular item referred to.
"Testing":	Work and checks necessary to determine quantitative performance of equipment installation and workmanship.
"SANS":	South African National Standards

1.14 RELEVANT NORMS AND STATUTORY REQUIREMENTS

The soil and waste drainage and the internal water services system shall be designed and installed in accordance with the following standards

2.2.1. SANS 10400: The Application of the National Building Regulations.
2.2.2. SANS 10252: Water supply and drainage for buildings (Part 1 & 2).
2.2.3. The Occupational Health & Safety Act, Act No. 85 of 1993, as amended.
2.2.4. SANS 460: Plumbing Code of Practice (2003)
2.2.5. SANS 62: Steel Pipes (2013)
2.2.6. SANS 719: Electric Welded Low Carbon Steel Pipes for Aqueous Fluids (1971)
2.2.7. SANS 1200: Standardised Specification for Civil Engineering Construction (1983)
2.2.8. SABS 558: Covers and Frames (1973)

1.15 WET SERVICES

2.3.1. All wet services will be designed and installed with the objective to economize the installation and maintenance costs, while still providing an appropriate level of comfort to the occupants.

2.3.2. All materials, plant or equipment will be installed with appropriate access for ease of operation, maintenance and replacement. Local products with SANS approval will have preference.

1.16 CONTRACT MANAGEMENT AND CONTROL

1.16.1 Resources

The Tenderer shall make available suitably competent, experienced and capable resources for the timely execution of the works in accordance with the project specification.

Attendance at meetings shall be provided as requested by the Engineer, Principle Contractor and Employer.

Upper level management attendance shall be provided at regular site, contract, commercial and engineering meetings.

The Tenderer is to submit an organogram of supervisory staff (with names) that will be involved on the project, showing the time in a month that each individual will be committing to the project against the project program (i.e. a resourced program).

The Tenderer is to submit CV's of his key staff indicating relevant experience.

All resources on site shall be certified via appropriate organisations demonstrating competence in their ability to perform the tasks required.

1.16.2 Program and completion

The Tenderer shall provide a resourced program of the works, in accordance with the directives herein and in compliance with the form of contract.

This program shall be provided within one week of appointment and shall clearly indicate all interdependencies related to works by others.

The Tenderer shall ensure their program of works is co-ordinated with others and satisfies the requirements of the main contractor and the principle building contract.

The program of works shall be updated bi-monthly to indicate progress on site and remediate any potential delays.

The Contractor shall submit a detailed works program and anticipated cash flow estimate of his/her Tender.

Suitable time shall be allocated to perform commissioning, validation and hand-over to the approval of the engineer. Particular attention must be made to the required completion dates and penalties as described within the contract conditions.

1.16.3 Lead time guarantee

The contractor shall submit with the Tender return a guarantee that all equipment and corresponding supply (lead times); delivery, installation and commissioning of all equipment can be achieved within the project time frame.

1.16.4 Quality management

The Tenderer shall maintain an ISO9001 series compliant Quality Management System for the duration of the contract. The quality file shall be kept on site and shall be made available for inspection by the Engineer, Employer or his agents.

Signed off quality control checklists, commissioning schedules and test certificates shall be provided prior with all invitations for inspection by the contractor.

The Engineer reserves the right to charge the contractor at the prevailing Engineering Council rates for abortive inspections.

Only the highest possible standards of workmanship will be accepted. No inferior quality of workmanship will be tolerated.

1.16.5 Scrutiny of drawings

All drawings, circuit or schematic diagrams prepared by or on behalf of the Contractor for submission to the Engineer in terms of the requirements of this specification shall have been thoroughly checked, corrected where necessary and signed as approved by the Contractor, prior to such submission.

The Engineer's scrutiny of any drawings will cover the arrangement, type and operational suitability of the equipment in general only. Such approval will not release the Contractor from his responsibility for the proper operation of the installation or for its full compliance with the specification, drawings, local authority and statutory requirements, or for ensuring that the equipment can be physically accommodated within the space and via the access provided.

1.17 DOCUMENTATION

Documentation shall be provided to demonstrate compliance with all applicable Quality, Regulatory and specified requirements.

The following list of documentation will be required, as a minimum, in order to complete the commissioning phase of the project. All will be subject to approval by the Engineer before implementation:

2.5.1: Contract particulars including contact details and company details of all parties to the contract
2.5.2: Emergency contact details for use in case of emergency and service callout
2.5.3: Functional design specification
2.5.4: P&IDs
2.5.5: Calibration certificates for each type of probe, sensor, gauge or measuring instrument
2.5.6: General arrangement drawings, approved workshop drawings and As-builts
2.5.7: Critical spares list
2.5.8: Full parts list including component manufacturers part numbers and contact details
2.5.9: Component manufacturers datasheets
2.5.10: Equipment configuration details
2.5.11: Inventory List with Serial and Part Numbers and drawing references
2.5.12: Electrical and control panel layout drawings and wiring diagrams
2.5.13: Drainage and Wet Services diagrams, suitably laminated and indicating the design criteria of each zone
2.5.14: Safety certification for the complete system
2.5.15: Operating and maintenance manuals Factory acceptance test report – where applicable
2.5.16: Commissioning report.
2.5.17: Product, equipment and material Warranties
2.5.18: Escalation steps and basic troubleshooting guide

1.17.1 Handover documentation

The contractor shall provide a list of items and documentation for verification at handover.

This list shall be circulated a minimum of 14 days prior to the request for handover of the project such that the list may be reviewed and amended as may be required.

The handover of the project is conditional upon receipt and verification of the accepted list of items.

A list of typical handover requirements is provided below in order to guide the compilation of the handover list by the contractor. This list is not exhaustive however and is provided as a guideline to the contractor.

Note: All required items below are to be checked and submitted by the responsible contractor via the responsible engineer and agent to the client.

Item	Designation	Qty
1	O & M manuals with As built drawings (Hard copy together with one CD containing its soft copy)	3
2	Certificate Of Compliance, in **pdf** as well as hard copy	3
	- For Hot Water Systems	3
	- For the entire wiring installation fed from and between DB's from and to equipment including terminations thereof and all in accordance with the relevant legislation.	3
	- Laminated As Built Electrical single line schematic for each DB	

3	A full commissioning report including actual test results of all systems after commissioning	3
4	All pressure test results for each area wherever applicable	3
6	Certificate of commitment for the maintenance & guarantee period as applicable via the contract.	2

1.18 TESTING, BALANCING & COMMISSIONING

All safety devices shall be checked for effective operation by simulating the abnormal or overload conditions.

All tests and results shall be recorded, and a test report shall be compiled for insertion in the operating and maintenance manual.

1.18.1 Drainage and Wet Services Testing and Commissioning - Methodology

A normal working test shall be carried out with the drainage and wet services design working pressures. During this test all necessary adjustments and regulation of valves, meters and fixtures will be reported to the Employer. Provision shall be made to obtain the required system balancing and performance.

When the systems have been set to work the Contractor shall employ the services of the commissioning Engineer to carry out the final commissioning of all services.

The final commissioning of the systems shall not take place until the building is complete with all its building works and process services in place or as directed by the Engineer and Employer.
The balancing of the system shall be witnessed, with 100% of the readings retaken in automatic system operation, including all pitot traverses and grille/ diffuser readings checked by means of a barometer (air flow hood) or similar approved device.

All the tests and test schedules shall be drawn up by the Contractor in collaboration with the Engineer. Testing and Commissioning shall be carried out to satisfy the following final design requirements:

2.6.1: The correct operation of all drainage systems.
2.6.2: The correct operation of all safety systems.
2.6.3: Correct water flow rates and pressures

The site tests shall be carried out over several days and shall be long enough to allow the taking of all the measurements as required to demonstrate that the performance of the installation meets the design requirements.

1.19 WORK ALLOCATION

The work allocation will consist of the following:

a) The end user will provide the necessary permanent electric power supply to a point required by the Drainage and Wet Services Contractor.

b) Alterations, which may be required by the contactor, such as drilling of access holes, will need to be approved by the engineer and is for the contractors account.

c) The Contractor shall provide a Site Instruction Book.

d) The Contractor shall provide his own tools, labour, temporary storage and accommodation, material, plant, transport and equipment and execute the contract with a minimal disturbance to the end user. Prefabrication must preferably and where possible be done at his own works.

e) The Contractor shall provide his own sheds and site offices if so required.

f) The Contractor shall prepare all working drawings and eventual “As Built” drawings, constituting the entire installation. Two sets of hard paper prints of working drawings are required for scrutiny before construction is commenced. Two set of hard prints and copies of the electronic files (preferably on CD) are required of the “As Built” at completion.

1.20 HANDLING OF MATERIAL

The Contractor shall be responsible for providing all the required equipment for the off-loading and proper handling of the material on site. He shall also be responsible for the installation in the correct position.

1.21 SETTING OUT OF WORK

The Contractor shall be responsible for the correct setting out of any holes, sleeves, penetrations, plinths, plant hangers and openings that may be required.

1.22 SHOP DRAWING SUBMITTAL

2.10.1: The contractor shall submit detailed “shop” drawings indicating the works to be completed.

2.10.2: Shop drawings shall be provided to the Engineer within 14 days following confirmation of the intent to appoint or sooner as directed by the Employer, Engineer or agent.

2.10.3: Shop drawing submittals shall be made in triplicate, at full scale, and shall include a cover sheet, date stamp, and approval stamp.

2.10.4: Shop drawings shall clearly indicate works to be completed by others, i.e. power supplies, drains, water supplies, builder’s openings, sleeves and penetrations.

2.10.5: Shop drawings shall be compliant with ISO standards.

2.10.6: Shop drawings shall indicate the particulars of the parties responsible for the design drafting, review and approval of the drawings.

2.10.7: The scale, drawing size, revision number date and drawing particulars shall be clearly indicated on the drawings.

2.10.8: Drawings shall include all sections, 3D views, assembly views, plan views and layouts as required to fully understand the works to be executed.

2.10.9: Works shall be executed strictly in accordance with shop drawings approved by the Engineer.

2.10.10: Three (3) copies of the approved shop drawings shall be maintained on site for the inspection of the Engineer at all times.

1.23 WORKING DRAWINGS

One (1) copy of the approved shop drawings shall be maintained up to date to reflect the as built conditions on site. This drawing shall be marked up with all deviations from the approved drawings and shall be highlighted to show installation progress. This marked up drawing shall be copied and issued to the Engineer on a monthly basis.

1.24 OPERATION AND MAINTENANCE MANUAL SUBMITTAL

The contractor shall compile and submit one (1) booklet of the operation and maintenance manual to the Consulting Engineer two months prior to practical completion for approval.

On approval by the consulting Engineer, the contractor shall prepare and submit four (4) copies of the approved operation and maintenance manual on practical completion sign off in both hard and soft copies.

The Operation and Maintenance booklet shall consist of:

1. Cover page stating the project name, the client, the consulting engineer and the contractor with contact persons and details

2. The index page stating the contents and sections of the submittal with page numbers

3. General information on the project:

    i. Name of project
    ii. Address of project
    iii. Start and completion date
    iv. The professional team and contacts
    v. The contracting team and contacts
    vi. Emergency contact details of the contractor
    vii. Maintenance start and completion date
    viii. Major equipment suppliers and contact details

4. Description of the System

    i. Design conditions and technical specification
    ii. Salient points of the installation

iii. Detailed description of the systems
iv. Health and safety considerations associated with the systems
v. Detailed technical specification and description of all installed equipment and system

5. Table of the equipment capacity of all equipment and systems installed on the project showing the following:

    i. Equipment name and designation
    ii. Area served
    iii. Operating capacity
    iv. Dimensions (length, width, height and weight)
    v. Starting current, running current and voltage
    vi. Compliance with specification

6. Supplier details and catalogues/technical manuals for each major equipment installed on the project

7. Operating and Maintenance procedures

    i. Procedures for the service, replacement and maintenance of all equipment and systems.

8. Operating and maintenance schedules and checklists:

    i. Weekly maintenance
    ii. Monthly
    iii. 3 monthly
    iv. Quarterly
    v. Yearly
    vi. Minor service
    vii. Major service
    viii. Every 5 years
    ix. Every 10 years
    x. Others

9. Commissioning results and details of each equipment and system

10. Training of end user details and attendance register sign off

11. Recommended spares

12. As built drawings and documentation

13. Equipment submittal approved page

14. Conclusion

15. Approval page for signature and date:

i. The contractors name and responsible person signature
ii. The consulting Engineers name and responsible person signature
iii. The client's signature and responsible person
iv. Approval stamp by consulting engineer.

1.25 DEFECTS LIABILITY PERIOD

The defects liability period shall be in accordance with the form of contract but shall not be less than two years (24 months). During the defects liability period all patent and latent defects shall be attended to by the contractor without cost to the client.

Any item which is repaired or replaced during the guarantee period shall be guaranteed for a further Twelve (12) months. The guarantee shall include parts, labour, shipping, transportation, consumables. No cost associated with equipment or workmanship failure or defect shall be attributed to the client during the defects liability period.

1.26 WARRANTY

The contract works shall remain under warranty for Twelve (12) months following practical completion of the works. Sectionalized practical completion shall necessitate sectionalized warranty.

A warranty schedule shall be provided for the installation and contained within the O&M manual.

1.27 MAINTENANCE

After first delivery of the installation (practical completion), there will follow a 12-month free maintenance and guarantee period.

No costs of maintenance shall be incurred by the client during the free maintenance period.

1.28 TEMPORARY USE OF EQUIPMENT

No equipment forming part of the permanent installation shall be operated or used, during the construction period without the Engineer's written permission.

Equipment shall be handed over to the Employer in an as new condition for the beneficial use of the client.

1.29 DIVISION OF WORK

The division of work between the Main-Contractor and the Drainage and Wet Services contractor together with other specialist contractors are as stated in the detailed technical specification.

1.30 STORAGE OF MATERIALS

2.18.1: Materials shall be stored in places allocated by the Main-contractor, Employer or his agent.
2.18.2: Stored equipment and materials shall be protected against damage, dust and dirt, corrosion, theft and vandalism.
2.18.3: Stored materials shall be safely stacked and shall not overload the construction beyond design limits.

1.31 ACCESSIBILITY & MAINTAINABILITY

2.19.1: All equipment shall be so installed as to be readily accessible for operation, maintenance and repair.

2.19.2: All items of the installation shall be readily accessible for quick and easy replacement. Adequate space shall be left around all items for the removal and replacement of parts.

1.32 INSTRUMENTATION

Provide all necessary instrumentation for the successful monitoring and logging of the system and equipment. Test certificates and correction graphs shall be obtained for all portable equipment prior to any site measurements being taken.

1.33 MATERIAL SELECTION

2.21.1: All materials shall be selected to ensure compatibility with local conditions, the environment of application and suitability with the fluid or service carried.

2.21.2: Where multiple materials are utilized in an assembly or construction the compatibility of the materials shall be ensured.

2.21.3: Galvanic corrosion risk shall be mitigated by the use of non-conductive spacers, cathodic protection or active protection.

2.21.4: All insulation and cladding shall be applied by experts in the field. Joints shall be as far as possible out of immediate view.

1.34 INSULATION

2.22.1: Insulation shall not be applied prior to the signoff of associated pressure tests and leak tests and acceptance of the installation by the responsible construction manager, engineer, and client representative.

2.22.2: Insulation shall not be compressed beyond two millimeters (2 mm) for pipes.

2.22.3: Support brackets for insulated services shall be designed not to compress the insulation material and shall not be fixed directly to the insulated service. A thermal break shall be maintained.

2.22.4: Ensure higher density insulation material is placed at locations of support to avoid over compression of insulation materials. Ensure insulation, vapour seal and cladding as applicable is continuous where pipes are supported.

2.22.5: Material compatibility between the insulated service, insulation, vapour seal and cladding as applicable shall be ensured by the Tenderer.

2.22.6: All insulation systems shall be applied and utilized in accordance with manufacturer's guidance.

1.35 PIPING

All hot and cold water piping shall be carried out in copper piping and has to be fully SABS approved to SANS 15874 part 2, 3 and 5 and SANS 460 and as set out below:

LOCATION	MATERIAL	SPECIFICATION
External spaces	Copper	SANS 460 CLASS 0

1.36 PIPE JOINTING AND FITTINGS

Copper piping shall be joined by means of compression type fittings or solder capillary fittings. Soldered capillary fittings are preferred. All fittings used shall be in accordance with the SANS Specifications and shall be certified after passing the SABS dezincification test.

Compression fittings shall be of the type employing a cone and screw connections. No jointing compound shall be used with these fittings, except as recommended by the manufacturer.

Capillary fittings for piping shall be in compliance with ISO 2016, Din 2856 or relevant SANS Specification (when it becomes available) and suitable for the system testing pressure. Welding shall be performed by qualified artisans.

To ensure the uniform flow of solder by capillarity along the annular space between the outside of the tube and the inside of the socket of the fitting and consequently making a satisfactory joint, it is essential that the inside diameter of the socket shall be dimensionally accurate within the close limits laid down in the aforementioned specifications.

When joining tubes with capillary solder fittings, tube and tube ends shall first be mechanically cleaned. Tubes shall then be joined using manufacturers cold water soluble flux (Din 8511 or equal), and recommended soft solder. The Solder shall be distributed 0.97 tin: 0.03 copper or 0.97 tin: 0.03 silver to a recognised standard (Din 1707 or equal). Soft lead solders shall not be used.

Care shall be taken that joints are not overheated and that all residual flux be thoroughly removed from the outside of the tubes.

If preferred all copper runs may have capillary fittings throughout provided flanges or unions are used at valves, fittings, equipment or other places to enable section to be removed for maintenance where this may be necessary. Compression type fittings shall not be built into walls.

Copper Cold Water pipes to be PN10 or PN12.5 and Hot Water pipes to be PN16

Pipe supports to be as per manufacturer specification.

Insulation to be Tube type Closed cell foam (Flexi-Therm). All insulation Inside Diameter (ID) to match Outside Diameter (OD) of pipes (ISO standard size). All insulated pipes need to reach a minimum R-value of at least 1.

PPR will also save water. When turning on a hot water tap the hot water will filter through a lot quicker than when running through a metal pipe. In metal pipes a lot of the heat of the water is transferred into the pipe, thus taking longer to reach the outlet.

Note: This should however not discourage the use of copper piping and prospective Tenderer's are invited to quote for both if possible.

Due to the low conductivity of the Atlas pipe the heat loss on to the pipe is negligible when compared to the metal options. This allows the hot water to reach the outlet a lot quicker therefore saving energy and water.

Copper 50 kcal/h/m^{o}C

Special attention should be paid to the higher expansion rate of PPR pipes compared to the metal pipes. Pipes can be installed in/on the wall. Since the weights of the PPR pipes and fittings are about one ninth of the metal pipes, installation of PPR pipes is easier and adjustment for expansion can be done in one direction. However, one should make certain that pipes move without hindrance in the axial direction. If the expansion can't be managed in one direction, U bends or OMEGA compensators should be added to the design. Fixed supports and sliding supports should be chosen in such a way that they do not damage the outer surface of the pipe.

Fixed supports are used to fasten the pipe at certain points against undesired pipe movement. Fixed supports should be stronger compared to the sliding supports. Fittings are used to construct fixed supports.

At the points where direction changes, fixed supports should not be used. The distance between the fixed supports should be chosen in such a way that pipe elongation is not affected. In general elongation of the pipes is provided by a free bending section.
All plastic pipework water services shall be designed in accordance with SANS 10508:2008 / ISO 10508:2006.

All cold and hot service pipework and fittings within the building constructed from Crosslinked polyethylene (PE-X) shall conform to SANS 15875-2:2004 / ISO 15875-2:2003 (2009-07-31), SANS 15875-3:2004 / ISO 15875-3:2003 (2009-07-31). SANS 15875-5:2004 / ISO 15875-5:2003 (2009-07-31) and SANS 15875-1:2004 / ISO 15875-1:2003 (2009-07-31).

All cold and hot service pipework and fittings within the building constructed from Polybutylene (PB) shall conform to SANS 15876-2:2005 / ISO 15876-2:2003 (2010-11-26), SANS 15876-3:2005 / ISO 15876-3:2003 (2010-11-26), SANS 15876-1:2005 / ISO 15876-1:2003 (2010-11-26) and SANS 15876-5:2005 / ISO 15876-5:2003 (2010-12-09).

All cold and hot service pipework and fittings within the building constructed from Polyethylene of raised temperature resistance (PE-RT) shall conform to SANS 22391-2:2008 / ISO 22391-2:2007, SANS 22391-3:2008 / ISO 22391-3:2007, SANS 22391-1:2008 / ISO 22391-1:2007 and SANS 22391-5:2008 / ISO 22391-5:2007.

All cold and hot service pipework and fittings within the building constructed from Polyethylene (PE) shall conform to SANS 4427-2:2008 / ISO 4427-2:2007, SANS 4427-3:2008 / ISO 4427-3:2007, SANS 370:2009. SANS 4427-1:2008 / ISO 4427-1:2007, SANS 4427-5:2008 / ISO 4427-5:2007 and SANS 4427:1996 / ISO 4427:1996 (2009-07-31).

All cold and hot service pipework and fittings within the building constructed from copper shall conform to SANS 460:2011, SANS 460:2011, SANS 1067-1:2005, SANS 1067-2:2005, SANS 1808-10:2005 (2010-08-20) and SANS 1857:2005 (2010-08-20).

1.37 PIPE SUPPORTS

Hot and cold water piping shall be supported as set out in the table below

Pipe diameter (mm)	Spacing for horizontal (m)	Spacing for Vertical (m)
15	1.2	1.8
15 to 28 mm	1.2	2.4
32 to 54 mm	1.8	3.0
67 to 108 mm	2.4	3.7

1.38 EXPANSION JOINTS

Approved Expansion bellow types shall be provided where necessary on long straight runs, as shown. Where possible, expansion shall be taken up at the bends. Slide supports and anchors shall be provided at suitable positions to control pipe movement. The specified cold pull shall be provided to give the required pretension at the expansion bellows and bends. The complete installation shall be in accordance with the manufacturer's recommendations.

1.39 THERMAL INSULATION

2.27.1: All hot water piping shall be insulated with flame retardant, preformed, expanded, polyethylene foam, sections.

2.27.2: Joints shall be sealed by means of tape, glue, or a proprietary jointing system, in accordance with the manufacturer's recommendations.

2.27.3: All joints, bends, valves, and other fittings shall be insulated. The thickness of the insulation shall not be less than the associated pipes. Adhesive shall be used where necessary, in accordance with the manufacturer's recommendations.

2.27.4: For smaller size pipes with slow bends the insulation can be drawn around the bend. For larger pipes (40 mm & above) with short radius bends, standard or segmented bends shall be used, in accordance with the manufacturer's recommendations.

The insulation thickness shall be as follows:

Thermal Conductivity (W/mK)	Pipe Diameter (mm)	Insulation Thickness
0.034	up to 40	15
0.034	50 to 100	20

1.40 INTERNAL SANITARY DRAINAGE INSTALLATION

2.28.1: The proposed internal waste drainage system will be based on single stack gravity drainage systems with waste fittings connected to the same stack. The stack system shall be ventilated were required via air admittance valves.

2.28.2: Certain Sub stacks will be used for the waste drainage. All branch connections shall be of suitable length to avoid the use of venting the branches.

1.40.1 Sanitary Fixture Connector

Washbasins : 32 mm diameter bottle trap
Sinks : 40 mm diameter tubular trap
Dishwasher : 40 mm diameter tubular trap

1.41 PIPEWORK SUPPORTS

The drainage pipework shall be supported using the ductile iron bracket with acoustic dampener for pipework up to 110 mm diameter.

1.42 UTILITY CONNECTION

It is intended that the drainage systems shall connect to the underground drainage systems via a connection / coupling provided by the installer of this specification.

1.43 DESIGN PARAMETERS

The above ground drainage system shall be based on a primary and secondary ventilated stack arrangement.

The systems are based on the discharge unit method as per System III BS EN 12056-2, Table 2, and using the following frequency factors:

- "Frequent" K = 0.7
- "Congested" K = 1.0

1.44 FIXINGS

2.32.1: Install pipes, fittings and accessories in accordance with relevant Building Regulations and manufacturer's recommendations to ensure the complete discharge of drainage from the building without any leaks, ingress to the building or nuisance.

2.32.2: The pipes shall be fixed in straight runs and all horizontal runs are to be laid to gradients in accordance with SABS 0400 Table 13.

2.32.3: Allow for thermal and building movement when jointing and fixing drainage pipework in accordance with the manufacturer's recommendations.

2.32.4: Ensure pipe routes are shortest practicable, with minimum number of bends, unless indicated otherwise.

1.45 PIPELINES AND FITTINGS

All drainage pipework and fittings shall be installed in the positions as indicated on the drawings.

1.46 UPVC PIPING

2.34.1: The drainage pipes and fittings shall be coloured grey (or as specified by the Architect), unplasticised PVC, manufactured in accordance with SANS and shall, where appropriate, bear the SANS mark.

2.34.2: The method of jointing shall be that of solvent welding, using the manufacturer's approved cleaner and cement.

2.34.3: All Fittings shall be coloured grey, unplasticised PVC manufactured in accordance with SANS and shall, where appropriate, bear the SANS mark.

2.34.4: Seal ring fittings shall be used where necessary to accommodate thermal movement or where the manufacturers recommend. The rubber seals for seal ring joints shall be of section that gives more than one point of contact with the pipe. Horizontal and vertical

pipework shall include allowance for thermal expansion in accordance with the manufacturer's recommendations. All expansion units shall be anchored.

2.34.5: Access shall be provided by means of an integrally moulded door in an access fitting with an externally fitted rubber seal and secured with two galvanized bolts and nuts, or alternatively by a two-piece clamp type door fitted into the pipe run. Access shall be installed on all vertical drainage pipes at the specified height above each finished floor level.

2.34.6: The waste pipes and fittings shall be in uPVC manufactured in accordance with SANS. The tubes shall be straight, smooth, of true cylindrical bore and free from all flaws.

1.47 CONNECTIONS BETWEEN PIPES OF DIFFERENT MATERIALS

1.47.1 Connect Cast Iron

Cast iron pipework to vitrified clay pipework using purpose-made, proprietary, approved couplings.

1.47.2 UPVC

Connect uPVC pipework to cast iron pipework using purpose-made, proprietary approved adapters.

1.47.3 Copper

Connect copper pipework to vitrified clay/concrete pipework using purpose-made proprietary, approved adapters.

Connect copper pipework to cast iron using purpose-made proprietary approved copper to iron connectors.

1.47.4 Others

Connect pipework of different materials to vitrified clay pipework for underground installation using purpose made, proprietary approved adapters.

Connect pipework of different materials to cast iron pipework for underground installation using an appropriate adaptor or stepped coupling, to suit the pipework diameters.

1.48 ACCESSORIES

1.48.1 Traps

2.36.1.1: Traps shall be moulded from white PPR or be copper with brass nuts. The traps shall bear the SABS/SANS insignia.

2.36.1.2: Traps shall have seal depths and diameters in accordance with SANS 0400.

2.36.1.3: Traps shall be fitted with a universal compression outlet in accordance with the following unless otherwise specified:

- Wash Hand Basins – 32 mm deep seal resealing trap or bottle trap
- Sinks – 40 mm deep seal tubular trap
- Urinals – 40 mm deep seal tubular or bottle trap
- Showers – 40 mm deep seal trap with top access
- For condensate or for other situations where there is insufficient water flow to replenish a traditional water seal trap HepvO self-sealing waste valves (waterless traps) should be used.

1.49 COATINGS AND COATED PIPES

2.37.1: Install pipes, fittings and accessories in accordance with SABS 0400 and manufacturer's recommendations to ensure the complete discharge of drainage from the building without any leaks, ingress to the building or nuisance.

2.37.2: Obtain all components for each type of pipework from the same manufacturer, unless otherwise indicated.

2.37.3: Inspect components carefully before fixing and reject and which are defective. Ensure cut ends of pipes are clean and square with burrs removed.

2.37.4: The pipes shall be fixed in straight runs and all horizontal runs are to be laid to gradients in accordance with Building Regulations and this specification. Horizontal runs should be connected with 45/135° branches swept in the direction of flow.

2.37.5: Allow for thermal and building movement when jointing and fixing drainage pipework in accordance with the manufacturer's recommendations.

2.37.6: Form junctions using fittings intended for the purpose, ensuring that jointing material does not project into bore of pipes and fittings.

2.37.7: Avoid contact between dissimilar metals and other materials, which would result in electrolytic corrosion.

2.37.8: In convenient locations, provide access covers and cleaning eyes as necessary and in accordance with local authority requirements, to permit adequate testing and cleaning of pipework.

1.50 MAXIMUM SPACING OF PIPE SUPPORTS

Type of piping	Size of pipe	Spacing for horizontal (m)	Spacing for vertical (m)
Cast iron*	All sizes	2.0	3.0
uPVC	32-40 50 75-100 150	0.5 0.6 0.9 1.2	1.2 1.2 1.8 1.8
ABS	32-40 50	0.5 0.7	1.2 1.2
Polypropylene	32-40 50	0.5 0.7	1.2 1.2

2.38.1: Prevent entry of foreign matter into any part of system by sealing openings during construction. Fit all access covers and cleaning eyes as work proceeds.

2.38.2: Handle, store and securely fix all products and accessories in accordance with manufacturer's recommendations.

2.38.3: All pipework and fittings shall be properly cleaned, where necessary following completion of the installation.

1.51 PIPE ROUTES

2.39.1: Ensure pipe routes are shortest practicable, with the minimum number of bends, unless indicated otherwise.

2.39.2: It is a requirement of this specification that all branch connections to horizontal runs at high level on any floor shall be made using 45° branches swept in the direction of flow, where possible.

1.52 FIXINGS

2.40.1: Fix pipes in accordance with requirements stipulated in this specification. Provide additional supports as necessary at junctions and changes in direction. Fix every length of drainage pipework at, or close below the socket collar.

2.40.2: Where not indicated otherwise, use plated, sheradised, galvanized or non-ferrous fastenings, suitable for the purpose and background, and compatible with the material being fixed or fixed to.

2.40.3: Vertical fixing shall be fixed via purpose-made two-piece galvanized mild steel bolted drop rod type clips, drilled to accept M10/M12 rod.

2.40.4: Install adequate restraint couplings to ensure that the system is capable of withstanding all likely accidental static water pressures.

2.40.5: Where drainage pipework is required to be installed prior to the erection of supporting walls, supply and install independent adequate galvanized mild steel support framework from floor slab to soffit.

2.40.6: Provide and install protection of openings and fire stopping in accordance with the Building Regulations.

2.40.7: Provide and install on all plastic pipework passing through fire compartment floors or walls and exceeding 40 mm internal diameter an intumescent fire sleeve in accordance with Building Regulations. The fire sleeve shall have a fire rating compatible with the floor, wall or cavity barrier to which it is fitted.

1.53 EARTH BONDING

Carry out equi-potential bonding and tests of the drainage system (above ground) to prove the effectiveness of the earthing system. All tests shall be fully recorded and included within the operating and maintenance manuals.

1.54 THERMAL INSULATION

2.42.1: Provide and install pipe insulation to pipework where required which would be prone to the formation of condensation or to prevent freezing. All insulated drainage pipes are to be labelled to aid identification. Labels shall be provided at a maximum of 3 m centres.

2.42.2: Insulation shall comprise 25 mm foil faced mineral wool and shall be securely located on the pipe by utilising self-adhesive aluminium tape.

Or,

Insulation shall be 25 mm thick plain finish rigid fibre glass sections 915 mm long of 80-110 kg/m^3 density, split for fixing, neatly cut with mitres at all bends and fittings and fastened with 0.9 mm galvanized wire, unless specified otherwise.

2.42.3: Insulation shall be protected with 0.8 mm thick polyisobutylene (PIB) sheet, having a tensile strength of not less than 2.5N/mm^2. Note: PIB coat is to be encased in aluminium sheet or another robust finish determined by architect. The PIB sheet material shall be adhered to the external surface of the insulation and all joints shall be laped, secured and sealed by adhesive or solvent welding. All jointing, sealing materials and methods of application shall be strictly in accordance with the manufacturer's recommendations.

2. PROJECT TECHNICAL SPECIFICATION

2.1 GENERAL

This project involves the installation, commissioning and testing of drainage and wet services systems in building for the Batlhalerwa Primary School

The drainage and wet services that shall be detailed within this specification includes:

- Drainage and Water Supply,

The SANS requirements as well as the standard specifications for drainage and wet service installation and all related standards are to be adhered to. If in doubt, kindly clarify with the engineers prior to the procuring and installation of services.

2.2 SITE CONDITIONS

The prevailing site conditions are:

Outdoor design	(°C dry bulb/°C wet bulb)	:	35/20.0	
Winter Outdoor	(°C dry bulb/°C wet bulb)	:	0.0/1.5	
Indoor General	(°C dry bulb/%RH - uncontroled		:	22/51.5 ± 1°C&10%
Altitude above sea level		:	1134m	
Atmospheric Pressure		:	87.4 kPa	
Wind Speed		:	3.2 m/s	

3.3.1: The drainage and wet services works shall be scheduled to minimize interruption to ongoing site activities.

3.3.2: In event of a need to work outside normal hours to avoid client disturbance, this will be agreed with the client and detailed methodology provided.

3.3.3: In event of a need to work outside normal working hours in order to achieve program commitments such time shall not be recoverable as a variation to the contract.

2.3 GENERAL SCOPE OF WORKS

The following installations will form part of this drainage and wet services specification. The works required will be completed without damage, hindrance or interruption to existing services and operations.

2.4 DETAILED SCOPE OF WORKS

The following installations will form part of this drainage and wet services specification and only these services are addressed in this specification;

2.4.1 Drainage and Wet Services

The drainage and wet services installations, testing and commissioning contained within this scope will consist of:

- Installation of hot water storage system complete with electrical element; hot water circulation pumps all necessary accessories associated with the water storage system/s.
- Installation of drainage with all the access caps and other sewerage outlets proposed by the responsible engineers. The pipework shall be complete with all the necessary fittings and the systems are to be naturally ventilated.
- Installation of cold-water pipe system to circulate in ceiling void and walls of the buildings and distribute to the fixtures in the building.

2.4.2 Tender Drawings

- The Tender drawings are noted in the drawing register included within this Tender specification. These drawings are also available on CD for ease of reference by the Tenderers.

The scope shall be executed in accordance with this project specification and project drawings

DOCUMENT NUMBER	DESCRIPTION	REV	SIZE	TYPE
NT06/2023/1159/201/001	PLANT ROOM LAYOUT – DOMESTIC WATER SUPPLY	F1	A0	PDF

2.5 DIVISION OF WORK SCHEDULES

The following work related to the Contract will be executed as follows:

2.5.1 Electrical Work

3.6.1.1: An appropriate single phase or three phase isolator to supply power to any hot water geyser or POU hot water heater is to be provided within 1 meter of the mechanical equipment by the electrical Contractor. The cost of which shall be included under the electrical contractor. Any and all switchgear, wiring and distribution boards upstream from this isolator shall be provided for under the electrical contractor.

3.6.1.2: It is the responsibility of the wet services contractor to timeously confirm the location and electrical requirements with the electrical contractor. The final connection to the mechanical

equipment from the provided isolator shall be by the wet services contractor – the cost of which shall be included under the wet services contractor contract.

2.5.2 Building Work

The provision of any openings or core drilled holes, sleeves where pipes and equipment pass through brick walls and concrete slabs as well as any subsequent fire stopping shall be completed by the main contractor and the cost thereof shall be included in the building contract. It is the responsibility of the wet services contractor to timeously confirm the location and size of any required openings and sleeves to the Architect and the Engineer. The wet services contractor shall be responsible for the correct setting out of any builder's work relating to the Plumbing installation.

2.5.3 Plumbing Work

3.6.3.1: The provision of drain points for each and every indoor Plumbing unit shall be completed by the plumbing contractor – the cost of which shall be included under the main contract. It is the responsibility of the wet services contractor to timeously confirm the location and size of any required drain connections to the Architect and Engineer.

3.6.3.2: The provision of water connection points for each and every indoor Plumbing unit shall be completed by the plumbing contractor - the cost of which shall be included under the main contract. It is the responsibility of the wet services contractor to timeously confirm the location and size of any required water connection points to the Architect and the Engineer.

3.6.3.3: The final connection between the Plumbing units and the water connection or drain connection provided shall be included in the main contract and the cost thereof shall be for the Contractors account.

2.6 BUILDING WET SERVICES

2.6.1 Hot Water Supply for the Batlhalerwa Primary School Building

- Hot Water Services Installation – The supply and installation of hot water storage and heating systems. The hot water storage tank system is located by the roof area and storage water at the desired temperatures between 55 – 60 ºC. The water is supplied to the sanitary fixtures within the building, and the "dead leg" within the piping is prevented by hot water circulation pumps.
- Pipe insulation to be 13mm-fibre or equal. All hot water piping shall be insulated with flame retardant, pre-formed, polyethylene foam sections. All joints, bends, valves and other fittings shall be insulated. The thickness of the insulation shall not be less than the associated pipes. Adhesive shall be used where necessary, in accordance with the manufacturer's recommendations.
- The piping shall be Class 1 or 0 copper. All exposed hot water pipework and pipes run in ceiling void are to be insulated, excluding pipework that is cast in building walls, floors and underside slabs.

- Cold Water Services Installation – The provision of cold water to all cold-water outlets and appliances within the building.
- Drainage Installation – The provision of vented/non-vented gravity drainage system to all wet services appliances and drip trays within the building, to connect to underground drainage (provided by the main builder).

2.6.2 Excluded Services

The following installations are specifically excluded from this specification and will be designed by others:

- Fire Services (Portable firefighting equipment, Fire Hose Reels and Internal fire water reticulation),
- Water supply to Site,
- Site Sewer Reticulation
- Rainwater Drainage Installation,
- Site Storm water Drainage Installation

The scope shall be executed in accordance with this project specification and project drawings.

2.7 INCOMING MAINS COLD WATER SUPPLY

The Civil engineer will be responsible for providing a metered mains cold water supply to the site boundary. The water supply shall enter the site boundary in the demarcated area of the site. After the water meter and the extend of the pipework reticulating internally on the site has been provided, the internal site water reticulation 1 m into the building will be the responsibility of the wet services engineer. The mains cold water shall run on the perimeter of the site as per SANS requirements underground. The mains cold water shall branch into the site, to rise and reticulate in the ceiling spaces and walls of the buildings.

2.8 COLD WATER INSTALLATION

3.10.1: The water supply pipework shall reticulate within the ground inside trenching, which runs on the perimeter of the site at a particular distance away from the buildings. The pipes will branch from the underground pipe (specified by the Civil Engineer) and transform in the reticulation.

3.10.2: The contractor will install Isolating valves, non-return valves, pressure regulating valves, and other necessary fittings at the entry of such a pipe into the buildings.

3.10.3: The water supply shall have a minimum of 4 bar (400 kPa) water pressure. Reliance shall be made on municipal water pressure as detailed within the tender drawings (to be investigated by the Civil Engineer).

3.10.4: After entering the building/s, the pipework shall rise into the ceiling and walls further reticulating into the building. The pipework will be supported by hangers and other

supporting fittings that run through the trusses. The pipework will then branch towards the individual fittings, supported by pipe hangers as required inside the ceiling void. The pipework is then to be chased in the wall (at low speeds as per SANS requirements) to the dedicated sanitary appliance. The wet services contractor is to install the pipe to suit the position of the sanitary appliance and will install this pipe such that connection to the appliance is easily maintainable.

3.10.5: Each building shall have its own cold water supply that will branch from the ring main feed and have a stop cock for ease of maintenance.

3.10.6: The water services shall be designed in accordance to SANS 241. The cold water service installation shall be in accordance with SANS 10252-1:2004 Water supply and drainage for buildings Part 1: Water supply installations for buildings.

2.9 HOT WATER GENERATION INSTALLATION

The hot water pipework that reticulates in the ceiling void shall be insulated with a minimum R-value of 1.00; and the pipework chased in the wall shall be covered in building wrap to avoid condensate build-up on the walls.

The hot water for the building shall be generated via a combination of an electric element and heat pump system, of which are secondary and primary source of water heating.

The heat pumps system is required to heat water to the desired 55-60ºC of water temperature.
The electric Hot Water Tanks will be placed on the roof or dedicated service areas and the contractor is to provide access to these equipment for ease of maintenance.
The entire hot water supply system is to be supported and installed in such a way that it does not temper with any electrical wiring, appliance or any other equipment installed on the roof. The wet services contractor shall also provide water channels for condensate build-up for the heat transfer from the hot water storage tank.

Note: Provision shall be made for upgradability of the system in order to allow, in future, a minimum of 50 % by volume of the annual average hot water heating requirement by either heat pumps or solar systems as stated in the SANS 204 requirement.

3.11.1: Drainage piping shall be constructed of minimum size of 25 mm uPVC or copper piping.

3.11.2: The contractor shall insure all drains are laid to a fall to allow proper and complete drainage. All openings, brackets, etc. required for drainage piping forms part of this contract.

3.11.3: The water service design and requirements for water installations in buildings shall be in accordance with SAN 241, SANS 10252-1 and SANS 10254.

3.11.4: Hot water usage should be minimized, and the system maintained in accordance with the requirements given in SANS 10252-1. The hot water storage shall be designed to satisfy the hot water demand and shall comply with the requirements of SANS 10252 –Part 1 water supply installations for buildings.

3.11.5: The hot water geysers shall be a stainless-steel insulated vessel built in accordance with SANS 151:2010, SANS 60335-2-21, SANS 60335-2-73:2003 / IEC 60335-2-73:2002 (2008-12-12 and SANS 10254.

2.10 INTERNAL DOMESTIC WATER DISTRIBUTION INSTALLATION

3.12.1: The contractor shall provide isolation valves to each catering outlet to allow maintenance to be carried out individually to that fitting but retaining the distribution elsewhere.

3.12.2: Air release valves will be installed at high points to release any air in the system to prevent air locks.

3.12.3: The contractor shall supply and install pressure-reducing valves at floor levels as necessary to ensure correct flow to outlets.

3.12.4: The contractor shall supply and install flow restriction valves where required to ensure excessive water consumption through fittings is prevented.

3.12.5: All control valves and safety valves associated with the cold and hot water distribution shall conform to SANS 198:2010.

3.12.6: All hot water piping shall be insulated to limit heat gain and/or loss to not more than 5 % from source to furthest point of delivery on a system.

3.12.7: Pipework layouts shall be installed by the contractor to allow for thermal expansion.

3.12.8: The routing of the cold water service pipes will be such so that separation from any adjacent hot water service is achieved to avoid heat gain to the cold water service causing its temperature to rise.

3.12.9: The distribution pipework shall be installed to minimize dead-legs, and thus the risk of stagnant water occurring within pipework.

3.12.10: The contractor shall supply and install water conditioners as necessary to prevent the build-up of limescale.

3.12.11: The insulation shall be protected from mechanical damage using finishes suitable for the location in which it has been installed. All pipework within plant rooms and regularly accessed areas, such as but not limited to, risers, cleaners cupboards and regularly accessed areas.

3.12.12: Insulating materials shall meet Green Guide rating A, with a Global Warming Potential (GWP) of zero, and an Ozone Depletion Potential (ODP) of zero.

3.12.13: All exposed pipes to and from the hot water cylinders shall be insulated with pipe insulation material with an R-value in accordance with table below.

Minimum R-values of pipe insulation:

Internal diameter of	*Minimum R-value - W/m2K*

pipe (mm)	
< 80	1.00
≥ 80	1.50
Determined with a hot surface temperature of 60 °C and an ambient temperature of 15 °C.	

3.12.14: The piping insulation requirements do not apply to water piping, encased within a concrete floor slab or in masonry.

3.12.15: These pipes shall comply with SANS 10252-1.

3.12.16: Pipework materials to be as follows:

3.12.17: All internal domestic services pipework to be copper

3.12.18: All exposed internal COPPER pipework to be provided with a chrome finish.

3. SCHEDULE OF INFORMATION

All schedules which accompany this specification form an integral part of it and shall be duly completed in every detail; FAILING which, the Tender in question may be rendered ineligible for consideration.

Under no circumstances will statements such as: -

- see attached pamphlets,
- refer to catalogue,
- data to follow,
- as given by supplier, the Employer.

  Be acceptable to the Engineer & end user.

Equipment offered and listed on the schedules shall be capable of performing the specified duties and complying with the specification requirements in all respects. **SHOULD** it transpire that such equipment, even when offered by make, model and/or type, is unsuitable or incapable of meeting, or performing in accordance with the specification requirements in any respect, the contractor or sub-contractor shall nevertheless be responsible for any additional costs incurred in providing the required or suitable equipment.

Whenever a specific make, model or type of equipment has been prescribed in the specification and the Tenderer offers an alternative or equal make or type of equipment in his Tender, the Engineer will on acceptance of such a Tender inform the prospective contractor in writing as to make, and/or type of equipment accepted. **HOWEVER**, it should be noted that the use of words “OR EQUAL” by the Tenderer is to be discouraged and lead to the disqualification of the Tender.

HOT WATER TANK

Name of supplier ….....

Type of equipment and description ….....

Material properties ….....

Compliance with Standards
- Specification/Code

….....

4. SCHEDULE OF EQUIPMENT

4.1 PLANT EQUIPMENT

TAG NO:	QTY	Area	Make & Model	Flow Rate	Dimensions	Electrical Power Supply	
						V/Ph/Hz	kW
FLTR-01	1	Plant Area	Filtration vessel complete with accessories and 5000 LPH raw water pump	5	TBD	380/3/50	3
RO-01	1	Plant Area	4000 LPH Reverse Osmosis system	4	TBD	380/3/50	TBD
PP-01	2	Plant Area	Booster pump with duty point @0,984 l/s and 0.6 bar of head	4.6	TBD	380/3/50	0.9

Fire Services Technical Specification
For

Construction of the Blyde Canyon Nature Reserve Water Supply

Mechanical Engineering Services

LIST OF CONTENTS

PART V

FIRE PROTECTION INSTALLATION

STANDARD SPECIFICATION

1. GENERAL

1.1. The contract works to be carried out consists of the detailed design / shop drawing preparation, engineering, manufacturing, supply, delivery, offloading, erection, testing and commissioning into service, guarantee and maintenance of a pumped water supply for the fire water reticulation system.

1.2. The engineering, quality control and inspections, equipment selection, preparation of shop drawings, testing, balancing, commissioning and preparation of operating and maintenance manuals, are to be executed in a systematic manner, once programmed, under the Engineer's general supervision and direction.

2. DRAWINGS AND SUBMISSIONS

2.1. Engineer's Drawings

2.1.1. The drawings prepared by the Consulting Engineer show general layout of all equipment and distribution systems, complete with schematic arrangements. These, together with the specification, give sufficient information to enable the Subcontractor to estimate the cost and to determine how the system must be installed, tested, inspected, operated, serviced and maintained.

2.1.2. These drawings are not dimensioned Shop Drawings, and cannot be used as Shop Drawings. Location dimensions shown are only indicative of the routes and zones in which the service must be installed.

2.1.3. Design / Selection / Construction Details and Installation Arrangements for Equipment and
/ or Distribution Systems which are available from either the Manufacturer / Supplier in their officially published literature / documentation, design / application manuals, or other authoritative sources shall be used as the basis for Shop Drawings and specific source identified at submission stage.

Where these details are non-existent or not sufficient, reference might be made to the Sections and Detail Drawing.

2.2. Sub-Contractor's Drawing, Equipment Selection and Sample Submissions

2.2.1. Shop Drawing Submissions

2.2.1.1. Shop Drawings shall indicate all equipment, distribution systems, testing / inspection / instrumentation positions, access requirements and builder's work requirements. Builder's work requirements shall include all work to be provided by others (holes in concrete and masonry bases, etc.) as well as the sizes, capacities and positions of service connections.

2.2.1.2. Shop Drawings shall be based on the Engineer's design concept shown on the tender drawings, approved equipment selections and samples. The Shop Drawings shall be checked and passed by the Subcontractor's Chief Draughtsman and Project Engineer / Manager. The Shop Drawings shall be stamped to confirm that co-ordination with Architects, Structural and other affected Sub-contractor's drawings, has taken place.

2.2.1.3. Copies of Shop Drawings of all parts of the subcontract works shall be submitted to the Engineer for approval.

2.2.1.4. The Subcontractor may, if he so desires, obtain "electronic / e-mail" copies of the Engineer's drawings for modifications and updating if required. These drawings shall be re-titled in accordance with the Subcontractor's system and shall thereafter be submitted as the Sub-contractor's Shop Drawings. No portion of the Sub-contractor's works shall be commenced until the shop drawing has been approved by the Engineer and Architect.

3.2.2. "As-Built" Drawing Submissions

3.2.2.1. "As-Built" drawings are the Shop Drawings embodying all modifications made during construction. They shall include floor and ceiling layout drawings indicating all outlet positions. SICO drawings are also "As Built" drawings indicating the intended functioning, capacity data and control functioning of all systems.

3.2.2.2. Copies of "As-Built" drawings shall be submitted to the Engineer for approval.

3.2.3. Equipment Selection Submissions

3.2.3.1. The Subcontractor shall select equipment which complies with these specifications. These selections shall be submitted to the Engineer for approval.

3.2.3.2. No equipment shall be installed until the equipment selection submission has been approved by the Engineer if the selected equipment deviates from the design concept and/or deviates from the accepted equipment offered.

3.2.4. Sample Submissions

Samples are any samples required by the Architect or Engineer. Samples shall be physical examples to illustrate materials, equipment or workmanship, and to establish standards by which the works may be judged. Such samples, after approval, will be retained by the Architect or Engineer for a period sufficient to ascertain that the relevant component is actually provided as per such sample, but will then be returned to the Subcontractor for incorporation in the works.

3.3. Submission Procedures

Submission for approval will consist of the following activities executed by the Subcontractor and other parties involved:

3.3.1. The Subcontractor shall review, stamp, date and sign to signify his approval and submit in the manner required by the Engineer and with reasonable promptness and in orderly sequence so as to cause no delay in the work, all Subcontractor's drawings, equipment selections and/or samples required by the Subcontract documents or subsequently by the Architect or Engineer. Subcontractor's drawings, equipment selections and samples shall be properly identified as specified or as the Architect or Engineer may require.

3.3.2. At the time of submission the Subcontractor shall inform the Engineer in writing of any deviation in the Subcontractor's drawings, equipment selection or samples from the requirements of the subcontract documents.

3.3.3. Each individual Equipment Selection Submission shall be accompanied by a copy of the applicable detailed technical specification. Each clause of this specification shall be marked "complies" or "Does not comply", complete with reason stated and countersigned by the Subcontractor's Project Engineer/Manager.

3.3.4. Equipment Selection Submissions shall be indexed similar to the index for Part II Equipment of the "Operating Instructions and Maintenance Manual" as described under Part IIIa in order to form part of the O&M Manual.

3.3.5. The drawings and Equipment Selections shall be submitted in a number of copies and along the channels agreed.

3.3.6. By submitting drawings, Equipment Selections and / or samples, the Sub-contractor represents that he has determined and verified all site measurements, site instruction criteria, materials, catalogue numbers and similar data, or will do so, and that he has checked and co-ordinated each Contractor's drawing and sample with the requirements of the Works and of the Subcontract documents.

3.3.7. The Engineer, on behalf of the Contractor, will review Sub-contractor's drawings, Equipment Selections and samples with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the Subcontract Works and with the information given in the Sub-contract documents. The Engineer's approval of a separate item shall not indicate approval of an assembly in which the item functions.

3.3.8. The Subcontractor shall make any corrections required by the Engineer and shall re- submit the required number of corrected copies of the Sub-contractor's drawings, Equipment Selections or new samples until approved. The Sub-contractor shall direct specified attention in writing on resubmitted drawings to revisions other than the corrections required by the Engineer on previous submissions.

3. WORK PROVIDED BY OTHERS

3.1. General

3.1.1. The following related work to the Fire Water Installation (FWI) contract will be provided by others. The FWI Contractor shall be responsible for the detailing, checking and ensuring that the work as listed in the schedules and shown in principle on the drawings is provided as per his detailed builder's work and related services drawings.

3.1.2. Instructions for FWI Contractor's exact requirements shall be transmitted to the Contractor timeously in the form of builder's and associated services drawings in accordance with an agreed Contractor's programme. Should these instructions be issued after the completion of relevant areas, then this work will be carried out at the expense of the FWI Contractor.

4.2. Contractor and FWI Sub-Contractor

The provision and making good of all openings, sleeves, etc. through the structure shall not form part of this contract. The sub-contractor's shop drawings are to be prepared taking the location of these openings into account.

Item	**Contract Documents**	
	Contractor	FWI
Construction of pump house	X	
Holes through structure and brickwork	X	
Access routes, holes for equipment	X	
Maintenance space for equipment		X
Access to shafts	X	
Access to outlets and control	X	
Construction of tank bases	X	
Construction of tanks		X

4. COMPLIANCE WITH REGULATIONS AND STANDARDS

The Subcontractor shall comply with all Acts of Parliament and all regulations and bylaws of local and or other authorities having jurisdiction regarding the execution of the works in particular the following:

- ASIB 11th Edition Rules 2014 Edition (Revision 4 [August 2014]);
- National Building Regulations and Building Standards Act (Act 103 of 1977);
- The Subcontractor is to comply with all requirements of the Occupational Health and Safety Act (Act 85 of 1993) and all subsequent revisions thereof. Further, the Contractor undertakes to employ only people who have been duly authorised in terms thereof and who have received sufficient health and safety training to ensure that they can comply therewith. In addition, the Sub

Contractor warrants that it shall enforce the terms of this clause on any Sub-Sub Contractor employed by the Sub-Contractor in connection with the Contract;

- Government, Provincial and Local Authorities Ordinances, Regulations, By Laws, Rules and other Statutory requirements; and
- Specifications and Codes of Practice issued by the South African Bureau of Standards and British Standards Institute. The former shall have precedence over the latter where both bodies have issued conflicting specifications or codes of practice.

5. APPROVALS

The subcontractor shall, before building starts, submit the following to the Consulting Fire Engineer:

a) the application for the approval of the design;

b) a signed declaration that the installation has been designed in accordance with this standard by a competent person;

c) a signed undertaking that the installation will be installed by an approved installer, in accordance with the appropriate plans and drawings, and as specified in this specification and relevant standards;

d) appropriate plans, drawings, details and information required in terms of this specification;

e) particulars of the power supplies; and

f) a statement that the installation will comply with this standard, together with details of any deviation(s), and

The consulting fire engineer shall be provided with a summarized schedule that contains all the relevant information relating to the system.

6. HOISTING AND RIGGING

6.1. Hoisting

If at time of tendering the Contractor is known, the tenderer shall check with the Contractor which of his proposed equipment and/or materials could be hoisted by the Contractor and at which cost.

If the Contractor is not known, the Tenderer shall make due allowance for the hoisting of his equipment and/or materials.

6.2. Rigging

The Tenderer shall be responsible for rigging of his equipment in position.

7. PROGRAMMING

7.1. Subcontractor shall submit to the Engineer within two weeks of appointment, a

practicable work programme, based on the building completion date for matching with and final incorporation in the Main Contractor's programme in accordance with the relevant clauses of the main contract P & G.

This Sub-contractor's programme shall state:

- Access dates to various areas to start installing equipment.
- Access dates to clean, safe vertical shafts to start vertical reticulation.
- Access dates to either ceiling and / or floor plenums of the different floors (or section of floors) to start installing in these areas (so called 1st Fix).
- Access dates to the various rooms with completed walls and partitioning (fully cleaned out) to start installing room equipment and connect these (so called 2nd Fix).

7.2. The section of the programme covering submission of structural and Installation Drawings, equipment selection, submission of inspection reports of completed sections of the installation, preparation of Operating Instructions and Maintenance Manuals, Testing and Commissioning shall be presented in the form GANT CHART.

7.3. The network graphic representation must clearly depict the sequence of the activities planned by the Sub-contractor, according to the Main Contractor's requirements, their interdependence and time required to perform each activity. In developing the project network, the Sub-contractor shall use arrow or precedence notation (on which available computer programmes are based).

7.4. The Sub-contractor shall furnish with the initial programme, a tabular listing of all activities listed on the programme. For each activity there shall be listed the earliest and latest finish times and the "float". Activities on the critical path shall be so indicated.

7.5. The Subcontractor shall regularly, throughout the progress of the works, amend and update the work schedule (both the network graphic representation and the tabular list of activities) to incorporate all variations, new drawings and site instructions, and all such amendments are to be subject to the Contractor's approval and shall not amend the completion date of the project unless extensions of time have been granted by the Contractor's.

7.6. If, in the opinion of the Contractor, the Sub-contractor falls behind the programme, the Subcontractor shall take such steps as may be necessary to improve his progress. The Contractor may require him to increase the number of shifts and / or overtime operation, days of work and / or the amount of construction plant, and to submit for approval revised programmes in the form required above in order to demonstrate the manner in which the required rate of progress will be achieved, all without additional cost to the Employer.

7.7. Regular meetings to monitor progress will be held under the chairmanship of the Contractor. The meetings must be attended by as many of the representatives of

the Sub-contractor as the Contractor shall require.

7.8. The purpose of such meetings will be to review progress against the programme, to investigate and establish actual or impending causes of delays, to instruct on such remedial action as may from time to time be necessary and generally to ensure that the progress of the work remains on programme at all times.

8. CONTRACT MANAGEMENT

8.1. All activities, information required, approvals, etc. shall be managed by the officially appointed Sub-contractor's Project Engineer / Manager to ensure completion of the Sub- contract at the agreed completion date and of specified quality.

8.2. It shall be the duty and responsibility of this Project Engineer / Manager to identify any item such as delays, activity time overrun, late information and/or approval at least fortnightly, and describe in his standard report to the Contractor proposed action to overcome the adverse conditions to maintain the planned construction schedule.

8.3. It shall be the duty and responsibility of this Project Engineer / Manager to prepare a detailed tabulated construction activities breakdown with related earliest and latest dates for information required, approval, area availability and inspection.

Construction activities are:

1. Drawing Submissions.
2. Equipment Selection Submissions.
3. Off-Site Manufacturing.
4. Installation on Site.
5. Testing and Commissioning Procedures Submission.
6. Testing, of the complete works.

8.4. The Project Engineer / Manager shall weekly, throughout the progress of the Sub-contract, amend and update the 'tabular list of activities' to incorporate all variations, delays and remedial action to ensure that the completion date will be met. He shall particularly note and report to the Contractor on unusual conditions encountered which may (or has) delayed progress of the work related to the contractor's programme.

8.5. The Project Manager shall monthly report to the contractor, with copies to the Architect and Engineer, in writing only and shall sign each progress report, equipment submission, drawings and inspection checklists.

8.6. The Project Manager shall be capable of using network diagrams to explain the sequence and actual dates used by him in his tabular form monthly report in order to prove that 'cut off' dates are realistic and factual and not an attempt to

formulate claims for delays.

8.7. On the request of the Engineer and / or Contractor, the sub-contractor shall remove from the works a person who is negligent in his contractual obligations.

9. PROTECTION AGAINST DAMAGE

9.1. Special care shall be taken in transport, delivery, storage on site and installation to ensure
that the entire system is in "as new" condition at start up.

9.2. Packaging material shall be of sufficient strength and/or temporarily reinforced during transport to, and handling on site, until installed in its final position, to ensure that the equipment "packed" retains its structural and dimensional integrity during these phases of the contract.

9.3. The Subcontractor shall remain responsible for equipment in "as new condition" and is not allowed to install equipment in areas or spaces where it can be subjected to damage through weather or trades for which it has not been designed.

10. ACCESS TO EQUIPMENT AND SYSTEMS

10.1. The Subcontractor shall familiarise himself with the proposed location of the equipment and shall be responsible for ensuring that sufficient access is available on site to allow the largest component parts to be brought into position.

10.2. The required unobstructed space shall be left around the equipment for access, maintenance and service of the equipment in accordance with the manufacturer's instructions.

10.3. Equipment shall be installed so as to be readily accessible for testing, operation, maintenance and repair. Minor deviations from drawings may be made to accomplish this, but changes of magnitude or which involve extra costs shall not be made without approval of the Engineer.

11. CLEANING AND START UP

11.1. Repaired equipment/components will be accepted at "handover" of system if defects become apparent during start up, testing and commissioning only at the discretion of the "Engineer".

11.2. All necessary system cleaning, flushing, must be completed before system is started up.

12. TESTING, COMMISSIONING, OPERATING OF PLANT AND HANDOVER

12.1. Concurrent with equipment submissions the subcontractor shall submit full testing, balancing and commissioning procedures for each item of equipment.

12.2. Prior to the pre-start inspection the sub-contractor shall submit, and have obtained approval of a fully detailed commissioning programme.

12.3. After physical completion of the sub-contract works the Sub-contractor shall carry out all preliminary tests necessary to satisfy himself that the materials and equipment comply with the provisions of the sub-contract and are in a state suitable to satisfy the requirements of the acceptance tests by the Engineer. The preliminary tests shall then be completed satisfactorily before the Sub-contractor, through the Contractor, requests the Engineer to witness the acceptance tests.

12.4. The Engineer may request the Sub-contractor to replace any portion of the subcontract work which does not conform to the requirements of the subcontract documents.

12.5. In the event of the plant or installation not conforming to the requirements of the sub- contract documents, the Employer shall be at liberty to either recover from the Sub- contractor or to deduct from the subcontract price all reasonable expenses incurred by himself or his agents attending the repeated test.

12.6. After physical completion has been reported and all defects made good, "start-up" shall take place and the above check out procedures shall be carried out.

12.7. Prior to the carrying out of acceptance tests the Subcontractor shall operate the entire system for as long a period as may be required to provide satisfactory performance in this specification and ASIB 11th Edition Rules at all times for 24 hours a day continually.

12.8. The Subcontractor's Operator(s) shall be fully conversant with the equipment operation and experienced in running similar installations. The Subcontractor shall train the Employer's operator(s) to enable them to be responsible for and capable of operating the equipment.

13. GUARANTEE

The Subcontractor shall guarantee that the automatic sprinkler installation is installed and commissioned in such a manner that it will function to the true intent and meaning of the sub-contract documents.

14. CERTIFICATION

14.1. Background

In order to obtain a Fire Clearance Certificate on completion of the project, it will

be necessary to prove that the systems specified and as installed under this Contract have been correctly installed and are fully operational.

14.2. Certification Required

Upon completion of the installation of a system contained in this document, the contractor shall provide to the Fire Engineer two certificates:

14.2.1. A signed written statement in form as follows:

"The undersigned, having installed the pumped water supply at Itireleng Primary school confirms that the above-mentioned system was installed in accordance with the specification provided and the instructions and directions provided to us by the manufacturers."

14.2.2. The contractor shall allow for as many inspections by the ASIB of the works as necessary in order to obtain a Certificate of Full Compliance without qualification. The works will only be considered complete when ASIB issues an unequivocal approval of the system without any reservation.

15. QUALITY MANAGEMENT SYSTEM – TESTING - INSPECTION

15.1. The tender adjudication will take into account the Tenderers official Quality Manual and Quality Control Systems.

15.2. The manual shall not only describe in detail the qualifications, responsibilities and authority of the proposed Project Engineering, Managing and Quality Assurance personnel but also the firm's technical standards and detail procedures for:

1. Programme Submission and Contract Management.
2. Equipment Selection Submissions.
3. Installation / Shop Drawing Submissions.
4. Sub-systems(s) Testing and Commissioning Manual Submission.
5. Site Installation Inspection Report Submissions.
6. Progress Payments and Evaluation.

15.3. The quality of managing, as reflected in the Subcontractor's submission of:

1. Work programming.
2. Equipment selection.
3. Shop drawings.
4. Testing and Commissioning Documentation.
5. Operating Instructions and Maintenance Manuals.
6. Inspection Record Cards / Checklist

shall be in accordance with ISO-9000 or otherwise / approved.

15.4. No portion of the work shall commence before the Quality Manual has been approved by the Engineer.

16. OPERATING AND MAINTENANCE MANUALS

The Subcontractor shall supply five (5) comprehensively indexed Operating and Maintenance Manuals, bound in loose leaf plastic covers.

The manuals shall be arranged in two sections:

16.1. Operation Manual

This manual should consist of two parts.

16.1.1. Part I - Operation Instruction

Contains information a qualified operator needs.

1) to start and stop equipment.
2) to control and monitor the performance of the equipment in normal modes of operation.
3) to change from one mode of operation to another and
4) to operate equipment in emergency situations.

Operation procedures with proper flow charts for all integrated systems are also required. The system function should be represented pictorially and in writing.

Full trouble analysis procedures shall also be included.

16.1.2. Part II - Performance Verification Procedures

Contains all the information a qualified operator needs to verify equipment and overall system performance. Any design calculations needed for performance verification shall be included in this manual.

16.2. Maintenance Manual

This manual should also consist of two parts.

16.2.1. Part I - Inventory

Contains a listing of all systems and pieces of equipment to be maintained as well as all the technical information needed to order spare parts. Manufacturers' catalogues are considered useful adjuncts only.

The full names, addresses and contact details of all suppliers of equipment shall be included.

16.2.2. Part II - Maintenance Programme

Contains the information necessary to perform breakdown, preventative, and predictive maintenance. These programmes include written information regarding when or how often to perform maintenance in the most efficient and economical

fashion to satisfy tenant needs.

17. FIRST YEAR'S MAINTENANCE

17.1. The Subcontractor shall furnish free of charge all maintenance on the entire subcontract works for a period of twelve months after completion of subcontract works.

17.2. The Subcontractor shall in the course of such maintenance or on call during the maintenance period, repair or replace defective parts, and shall use only genuine parts produced by the manufacturer of the original part.

17.3. The Subcontractor shall supply all replacement parts, lubricants, fuses, etc. during the free maintenance period.

17.4. The first year maintenance contract can be extended in accordance with the Detailed Maintenance Specification.

17.5. The maintenance activities shall comprise the activities as listed in Annexure B

18. SPECIAL ATTENDANCE

The subcontractor will be required to provide labour only for a period of two months after handover in order that equipment can be repositioned, moved or relocated to suit the Employer's requirements.

19. TRAINING

The sub-contractor will at no additional cost train the staff selected by the Client.

The training shall be continued until the Client is satisfied that the selected staff is capable in the operation and maintenance requirements of the system(s).

20. QUALITY

20.1. Standard of Workmanship

20.1.1. General

All aspects of the installation (e.g. setting out, alignment, levels, positions, etc.) must be checked on site and the installation installed correctly within the parameters of the ASIB 11th Edition Rules.

20.1.2. Visual Appearance

The visual appearance of the system is important, and the sub-contractor must ensure that the lines and levels followed by the installations are correct not only within the tolerances specified but also look aesthetically correct to the satisfaction of the Client and Engineer.

20.2. Sub-Contractor Requirements

The sub-contractor responsible for the installation of the automatic sprinkler system must comply with the following requirements:

- Employ at least two people who hold a certificate of competency issued by a training establishment (such as the ASIB) to the Engineer's approval;
- Employ their own erection workforce with a minimum of two fitters deemed competent by experience and / or qualification;
- Maintain a suitably stocked, staffed and equipped workshop capable of servicing the contractual obligations and emergency repairs;
- Have 24-hour availability for emergencies;
- Successfully completed other installations of at least the size and scope of this project

Note: Proof of compliance with these requirements is to accompany the tender submissions.

20.3. Quality Assurance

The Subcontractor shall submit quality plans in conformance with ISO 9000, for approval by the Engineer. The subcontractor shall establish, document and maintain throughout this project an effective and economical quality system to ensure and demonstrate that material or services conform to the specified requirements. The documented Quality

ystem shall include Quality Management objective policies, organisation and procedures to demonstrate compliance.

The tenderer shall submit with this tender:

- The level of Quality Assurance which will be provided for this project to ensure the quality of material and services.
- Sufficient information and data to allow the evaluation of the proposed Quality Management System in order to provide the purchaser with assurance that the quality of material and service is provided in a rational and cost-effective manner.

No portion of the work shall commence before these quality plans have been approved by the Engineer.

21. EQUIPMENT SELECTION

Only equipment and components specifically designed for the proposed use may be used. To this end, all equipment must be either listed / approved by an approved testing laboratory / authority. Proof of such compliance must be provided for each item.

Equipment Selection Submissions shall be indexed in order to form part of the O&M Manual.

The drawings and Equipment Selections shall be submitted in a number of copies

and along the channels directed by the Architect for approval. By submitting drawings, Equipment Selections and / or samples, the subcontractor represents that he has determined and verified all site measurements, site instruction criteria, materials, catalogue numbers and similar data, or will do so, and that he has checked and co- ordinated each Contractor's drawing and sample with the requirements of the Works and of the Sub-contract documents.

The Engineer, on behalf of the Architect, will review Sub-contractor's drawings, Equipment Selections and samples with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the Subcontract Works and with the information given in the Subcontract documents. The Engineer's approval of a separate item shall not indicate approval of an assembly in which the item functions.

The Sub-contractor shall make any corrections required by the Engineer or subsequently the Architect and shall re-submit the required number of corrected copies of the Sub- contractor's drawings, Equipment Selections or new samples until approved. The Sub- contractor shall direct specified attention in writing on resubmitted drawings to revisions other than the corrections required by the Engineer on previous submissions.

22. PAINTING AND PROTECTION AGAINST CORROSION

22.1. General Requirements

The sub-contractor shall be responsible for ensuring that the coating manufacturer's instructions, including, but not limited to:

- Surface preparation and cleaning;
- Preparation and application of coating materials; and
- Shelf life and storage requirements are adhered to.

Only approved coating materials as detailed in the specification shall be used. These shall not be mixed with materials from different manufacturers. The sub-contractor shall ensure that piping and proprietary equipment are adequately protected when stored on site to prevent internal corrosion.

22.2. Piping

22.2.1. Above-Ground Pipework

All above ground fire water pipework installed inside buildings up to and including 150mm diameter shall be of Medium Grade Black Piping to SANS 62. Where above-ground pipework exceeds 150 mm diameter, this shall be of Medium Quality Black Piping to SANS 719 having a wall thickness of at least 6mm.

22.2.2. Pipework Below Ground

All piping below ground level smaller than 150 mm is to be of medium grade black

piping to SANS 62 suitably protected against corrosion with two layers of fully overlapping Denso wrap or equally approved, or Class 16 PVC-U may be used for pipes always under pressure as per SANS 966 Code of Practice. Pipes in excess of 150 mm diameter shall be medium grade quality black piping to SANS 719 with two layers of fully overlapping Denso wrap or equally approved or PVC-U piping to SANS 966 as above.

22.3. Welding

No welding will be allowed to take place on site. All welding (off site) is to be SANS 044. Only coded welders shall be allowed to weld pipe work, and welders certification shall be submitted prior to commencing the installation.

22.4. Surface Preparation

All sharp edges, burrs, rags and weld splatter shall be removed and weld areas shall be abraded and/or ground. The surface shall be degreased and rinsed with solutions supplied by the coating manufacturer prior to mechanical cleaning (Section 4.4 of SANS 064 Code of Practice). Surface preparation shall be in accordance with ISO 8501-1 and SANS 064 and shall be conducted before erection of pipes.

22.5. Priming of Pipework

All concealed and exposed piping shall have a red oxide prime coat which is factory applied. All damaged areas are to be wire-brushed and re-primed where necessary.

22.6. Use of Denso Wrap

Where Denso protection is required, the following specifications must be adhered to:

- Piping to be prepared using Denso Primer, Denso HT Inner Wrap and Denso PVC Outer Wrap;
- Fittings and pipework other than cast iron must be hot dip galvanised prior to wrapping;
- Denso HT shall be applied by hand and wrapped in a clockwise direction with a minimum 55% overlap; A second layer shall then be installed.

- Denso PVC Outer Wrap must be wrapped in an anti-clockwise direction with a minimum 25% overlap;
- Buried flanges are to be encapsulated in Denso Mastic prior to the application of the Denso HT tape; and
- The wrapping of pipework must extend at least 150mm above finished ground level and be secured with bandit strapping. In such cases, the PVC tape must be painted with an appropriately compatible ultraviolet resistant paint.

22.7. Alternative Products

Should the applicator or manufacturer wish to propose alternative products or coating materials, he shall submit a detailed motivation to the Engineer. The motivation shall include, but not be limited to the following:

- Benefit to the Client;
- Product licensor and technical back-up available;
- Location, experience and ISO quality rating of the production facility;
- Detailed case histories;
- Performance guarantee offered; and
- Manufacturer's data sheets for each product.

22.8. Coating of Pipework

All exposed pipework is to be coated with a high quality paint of an exact specification acceptable to the Architect. Painting shall be properly repaired where damaged during erection.

Paint shall be as follows:

Description	**Type of Paint**	**Colour**
Concealed Pipework	Primer Only	Red Oxide
Exposed Pipework	Enamel	Signal Red

22.9. Coating Application

The sub-contractor shall submit a quality plan to ensure that the application work is carried out in strict accordance with the most recent Product Data Sheet from the coating manufacturer. The product data sheet shall be deemed to be part of this specification. Coatings shall not be applied when surface may become damaged due to rain, dust, condensation, surface temp or excessive humidity (>85%). All surfaces shall be coated as specified. Special attention shall be given to cracks, crevices and edges to ensure complete coverage and paint thickness. The primer shall be applied as soon as possible after the surface preparation operation, but within 4 hours. Concealed surfaces shall be completely coated. All edges, corners, bolt holes and cut ends shall be stripe coated by brush application, prior to the application of the second coat. No coating shall be applied to any surface containing traces of grit, grease, soil, loose rust, surface contaminants (i.e. dust) or loose corrosion product of any kind. Surface rust on

steelwork shall not exceed Grade B of ISO 8501-1.

22.10. Fasteners

All nuts and bolts shall be either hot dip galvanised or stainless steel unless otherwise specified. All galvanised nuts and bolts shall be de greased, patch primed and finish coated in accordance with the specification for the respective area of the plant.

22.11. Prevention of Galvanic Corrosion

Care must be taken to prevent or mitigate the corrosion caused by dissimilar metal contact on cooling coils, tubes and tube plates, pipes, flanges, frames etc. Typical metals encountered would be copper, aluminium, zinc, mild steel and stainless steel. The junctions between dissimilar metals must be electrically insulated where possible. Pipe flanges between dissimilar metals must be insulated using insulating gaskets for the flange faces and insulating sleeves and washers for all nuts and bolts. Where the insulation of the junction between dissimilar metals is not practical, the cathode surface on the electrolyte or "wet" side must be coated for a minimum distance of 100 mm from the junction. The applied coating must effectively isolate the coated surface from the electrolyte.

22.12. Inspection and Testing

The following inspections and tests shall be performed by the sub-contractor and witnessed by the design team in accordance with the approved Quality Plan on corrosion protection. Visual inspection for paint film defects shall be performed after each coat is applied. All defects including pinholes, sags and runs shall be corrected before the next full coat is applied. Dry film thickness shall be measured in accordance with SANS Method 141 Clause 3.3 (smooth disc). The required dry film thickness given in "windows" for each coat in the relevant coating specification, i.e. required minimum and acceptable maximum. Any reading outside this range is cause for rejection and may require the removal of the entire coating and reapplication thereof. Actual readings and not averages shall be recorded.

22.13. Quality Assurance

22.13.1. Sub-Contractor Qualification

The design team may, at its discretion, require a Quality Audit of the painting sub-contractor to ensure that he has the management, facilities, skilled staff and quality control facilities and staff, to carry out quality control during application of coatings to ensure compliance with specification. The sub-contractor shall accept full responsibility for the quality of his work and of materials used, irrespective of any quality surveillance that may be carried out by the design team.

22.13.2. Guarantees

Performance guarantees for the applied coating systems shall be offered jointly by the coating manufacturer and coating applicator. Whilst the period of guarantee will vary from situation to situation, the criteria for failure will not exceed Re2 on the European Scale of Degrees of Rusting. All guarantees in the terms of protection against corrosion shall be ceded to the client.

22.14. Protection

Special care shall be taken in transport, delivery, storage on site and installation to ensure that equipment and/or components are protected, installed and cleaned to ensure that the entire system is in "as new" condition at start-up. The Subcontractor shall be responsible for all hoisting and rigging of equipment/material into its final position in the building. Equipment enclosed packaging shall be of sufficient strength and/or temporarily reinforced during transport to - and handling on site, until installed in its final position, to ensure that it retains its structural and dimensional integrity during these phases of the contract. No "repaired" equipment/components (after damage by either own or other parties/construction trades either prior to, during or after installation) will be accepted at handover. Subcontractor shall remain responsible for equipment in "as new condition" and is not allowed to install equipment in areas or spaces where it can be subjected to damage through weather or trades for which it has not been designed.

23. SIGNS

23.1. Block Plan

A block plan of the system with the position of the main control valves clearly indicated thereon shall be fitted in the valve chamber.

The block plan shall show the following:

a) the installation number and the location of the corresponding valve(s);

b) the height, in meters, above the pump of the highest hydrant or hose reel fed from the pump;

c) each separate building, the relevant details;

d) the calculated hydraulic criteria of the installation(s);

e) by means of colour shading or hatching, the area covered by each installation and, if required by the fire brigade, the routes through the premises to those areas; and

f) the location of subsidiary valves.

23.2. Stop Valve Signage

A location plate suitable for fire protection use, of weather-resistant material and

lettering, shall be fixed on the outside of an external wall as close as practicable to the entrance nearest to the control valve, and shall bear the following wording:

FIRE INSTALLATION CONTROL VALVE

Each Fire Installation Control Valve shall be fitted with a sign corresponding to the area protected as depicted on the block plan.

23.3. Labelling

A sign bearing the wording:

CONTROL VALVE

in letters of height at least 20 mm shall be fitted close to the main and any subsidiary control valves.

NOTE: The wording should be in white letters against a red background.

Where the control valve is enclosed by a door, the sign shall be on the outside of the door, and a second sign in white letters against a blue background, bearing the wording:

KEEP LOCKED / SHUT

in letters of height at least 5 mm shall be on the inside of the door.

23.4. Signage Material

All fire signs such as stack storage heights, terminal test points, valve location plates, block plans, operating instructions and so forth are to be fabricated from material such as anodised aluminium or chromodeck.

23.5. Non-Return Valves

A reflux / non-return valve is to be fitted to the water supply connection with testing arrangement. This valve must be so positioned that is can easily be tested and maintained.

A non-return valve-suitable for use shall be installed at the following positions:

a) on each water supply from a main;

b) on a fire brigade inlet or a booster pump connection;

c) between a pump connection and the communication pipe that serves the installation; and

d) on any pipe that is provided with a fire brigade or a booster pump connection and that is connected to a storage tank in such a position and way as to prevent the flow of water into the tank when the pump connection is in operation.

24. BOOSTER CONNECTIONS

Twin 65mm booster connection must be provided with 65mm instantaneous male

fire hose couplings to enable the fire department to boost the pressure of the fire water installation. The boosters shall be mounted on the site boundary as indicated on the drawings for easy access by the Fire Department. A sign instructing a maximum pressure of 1 200kPa not to be exceeded must be provided at the connection point.

25. PRESSURE GAUGES

25.1. Gauges

Glycerine-filled pressure gauges fitted to sprinkler installations shall be suitable for sprinkler use and shall conform to BS 1780. The maximum scale value shall be approximately 150% of site maximum pressure. Scales shall have divisions not exceeding 0.20 Bar. Pressure gauges shall be installed with gauge cocks to enable each pressure gauge to be readily removed without interrupting the system water supply.

25.2. Installation of Gauges

The subcontractor shall ensure that all permanently installed instrumentation necessary for monitoring of status and performance of the system shall be of such dimensions and mounted in position so that they are easily and accurately readable by an operator standing on the floor.

26. MINIMUM CAPACITY OF WATER SUPPLIES

The minimum capacities of stored water entirely reserved for the fire water reticulation system, shall be derived from 90 times the intercept of the system curve for the most remote and favourable areas of operation, whichever is the greater, when overlaid against the pump curve (Q_{max}).

Whilst this specification calls for a specific volume of water to be stored, this must be verified by the sub-contractor as being correct prior procuring or installing the tanks.

27. PUMP SUCTION TANKS

27.1. General

This tender document provides for full holding pump suction tanks only. The suction tank shall be subdivided into two equal divisions so that 50% of the required supply shall be available during maintenance. Alternatively, two separate tanks of 50% capacity may be proposed and will be considered if physical space allows. Provision must be made for each section of the suction tank to be isolated for cleaning and maintenance purposes.

There must be means available to refill the tank automatically. In order to measure the inflow, a direct reading flow measuring device shall be fitted to the water inlet pipe. The inflow to a tank shall not be less than that required in order to fill the

tanks within 36 hours.

The tank infill must include the allowance for a quick fill option where a (normally closed) ball valve is supplied in addition to the flow control valve. This can be used during initial fill, as well as refill after maintenance.

If, with the means available, the tank cannot be refilled at the above rates, the capacity of effective stored water must be increased by one third in excess of the calculated requirement or by the appropriate amount of the shortfall, whichever is the greater.

Flow control for tank in-fill and all other associated valves shall be readily accessible for exercising, testing and maintenance.

Where the pressure characteristic of the town main is not capable of operating a flow control valve, ball valves will be permitted for tank in-fill.

All steelwork, including any roof steel of a suction tank shall be protected against corrosion. This shall include sand-blasting, priming and coating making use of an epoxy paint.

Content gauges must be provided which shall be an indicator of the flag and ball float type or other approved indicator type, showing the depth of water therein. The use of glass or plastic tube which indicates the level of the water is not acceptable due to clouding.

Overflow pipes and drainage facilities must be provided. Where necessary these shall be taken to a suitable drainage point.

Tanks must be completely enclosed with a roof to exclude daylight and to ensure that water does not become contaminated with extraneous matter.

An easily accessible roof hatch with a minimum dimension of 750 mm shall be provided for the roof. The hatch cover shall be of steel plate construction with a minimum thickness of 4,8 mm. The opening shall have a curb of not less than 100 mm high and the cover shall have a minimum downward overlap of 50 mm. A substantial lockable catch shall be fitted to the cover to keep it closed.

Outside and inside steel ladders that are arranged for convenient passage from one to the other and through the roof hatch shall be provided. Ladders shall not interfere with the opening of the roof hatch cover and shall not incline outward from the vertical at any point.

A town main bypass connection shall be provided. The connection is to be taken to the delivery side of the pump downstream of the non-return and stop valve. The bypass shall be the same diameter of the water supply connection and shall be fitted with a non-return valve. Stop valves, chained in the closed position, shall be fitted on the upstream and the downstream side of the non-return valve.

Where necessary, provision shall be made at the point where the supply water enters the tanks for suitable baffles to ensure the minimum entrainment of air.

The pump suction tank suction pipe shall be fitted with a suitable vortex inhibitor which allows for the low water level of a suction tank to be taken as the underside

of the flange attachment to the suction pipe.

28. AUTOMATIC PUMP

28.1. General

The approved and listed installer shall be responsible for the supply and installation of automatic pumping sets which must conform to this tender document.

Under no circumstance may any pump be stopped for any reason whatsoever other than that which is allowed in this tender document. Specifically an automatic pump shall start automatically and shall be stopped manually.

28.2. Pump Room

The pump house shall be constructed from brick or concrete by others.
The temperature of the pump room shall be maintained above 10° Celsius as a diesel engine driven pump is being installed. If it proves to be impractical to heat the pump house to the required temperature, all equipment within the pump house shall be heated to 10° Celsius.

Adequate ventilation must be provided and increased if necessary to limit the temperature rise in the pump room to not more than 10° Celsius above the ambient temperature under stationary to engine or motor full load conditions.

The pump room must be locked at all times and a notice stating where the keys are obtainable must be mounted on the door.

The pump room shall be sprinkler protected.

There shall be a controlling stop valve, (secured in the open position), fitted on the supply pipe to the fire water system together with an approved alarm device with visible and audible indications of the operation of the fire water equipment provided at the pump house. This shall be in an approved position at a responsibly manned location in the plant or on the premises. A 15 mm drain valve must be provided downstream of the flow alarm to permit a practical test of the alarm system.

Sprinklers for the protection of a pump room shall have a minimum operating temperature of 141° Celsius. No sprinkler shall be located within 800 mm of the diesel engine exhaust pipe.

Sufficient natural and artificial light shall be provided in the pump house. Access doors are not acceptable as providing natural lighting.

As a diesel engine is being used, the pump house must have adequate mechanical ventilation for engine aspiration. Louvers or air bricks alone are not deemed to provide adequate ventilation. It must be ensured that the following minimum air changes take place:

Size of engine	Minimum air changes

2 and 3 cylinder naturally aspirated or air cooled	6 m³ per minute
4 cylinder naturally aspirated	6 m³ per minute
4 cylinder turbo charged	6 m³ per minute
6 cylinder naturally aspirated	6 m³ per minute
6 cylinder turbo charged	12 m³ per minute
8 cylinder engines	15 m³ per minute
Above 7 litre capacity	20 m³ per minute

Provisions shall be made for natural drainage of the pump room. The cooling water from the engine jacket and the leak off water from the pumps shall be taken to a point external to the pump room. If required, a sump pump must be provided and a warning device fitted at the top of the sump.

The pump house must be arranged and sized so as to allow easy access to pipe work, pump units and controlling equipment.

All pressure gauges within the pump house must be glycerine filled with a dial face of not less than 100 mm.

To minimise the amount of time the fire pump is inoperative for maintenance or other reasons there shall be a suitable number of flanged joints on the pipe work to allow any of the equipment to be removed for overhauling or replacement.

All pipe work must be suitably supported with at least one support on both suction and delivery as close to the pump casing as possible and no strain shall be imposed on the pump casing by the pipe work. It shall be possible to unbolt suction and delivery flange bolts on the pump and no visible movement shall be observed in the pipe work at this time.

The pump and driver shall be mounted on a common base plate and connected by the means of a flexible coupling. A suitable coupling guard shall be fitted. Provision shall be made for suitable lifting lugs permanently attached to the base plate.

The base plate shall be securely attached to a solid foundation. A substantial foundation is important in maintaining alignment. The foundation shall be made of reinforced concrete.

The base plate with pump and driver mounted on it shall be set level on the foundation. After the pump and driver unit have been placed on the foundations, the coupling halves shall be disconnected and the pump and driver checked for alignment; they shall be checked for alignment again after all pipe work has been connected, the base plate levelled, and the base plate and foundation bolts grouted in concrete. Only after alignment shall the coupling halves be reconnected.

28.3. Suction Pipework and Fittings

All suction lines shall be fitted with suitable strainers.

All pump suction stop valves must be of the gear driven butterfly type and be

secured in the open position by 25 mm link chains and keyed alike padlocks.

In this case, i.e. positive head conditions, the strainer shall be fitted between the suction tank and pump outside the pump house and shall have a stop installed on the upstream side.

Valves shall not be fitted directly to the suction inlet.

The pipe work must be laid truly horizontal or with a continuous rise towards the pump to avoid the possibility of air locks or, in this case where the pumps are under positive head conditions, a fall towards the pump may be allowed provided no air can be trapped in the pump suction pipe.

Means must be provided for the release of air which might become trapped in the upper part of the pump case.

As the suction pipes supply more than one pump under positive head conditions, the suction piping layout at the pumps shall be symmetrical so that each pump will receive its proportional supply.

When the suction pipe and the pump suction are not of the same size, they shall be connected with an eccentric tapered reducer, (transition piece), in such a way as to avoid air pockets in the pipe work, i.e. belly down. The transition piece shall have a maximum included angle not exceeding 15° and shall be at least 2 diameters long.

Bends in the suction pipe work shall be kept to a minimum. Bends shall be of the swept long radius type having a radius of curvature of not less than twice the diameter of the suction pipe plus 100 mm.

Stop valves shall be installed on all the pump suction pipes in suitable locations to allow servicing and maintenance of all equipment.

To provide relief from the strain when the pump and its suction supply are on separate foundations with rigid interconnecting pipe work, there shall be at least one approved flexible coupling on the suction pipes.

A glycerine filled compound pressure and vacuum gauge having a dial not less than 100 mm in diameter shall be connected to the suction pipe either in the position provided by the pump manufacturer or as near to the pump casing as possible with a 10 mm isolating gauge valve. The face of the dial shall read in kilopascals and have a maximum pressure range of minus 100 kPa to plus 150 kPa.

Under standard conditions, the diameter of the suction pipe must be such that a velocity of
1.8 metres per second is not exceeded when the pump is operating at maximum flow rate.

The minimum acceptable diameter of suction pipe for this installation shall not be less than 250mm.

28.4. Delivery Pipework and Fittings

When the delivery pipe work and the pump delivery are not of the same size, they

shall be connected with a concentric reducer, i.e. a nozzle shaped transition piece.

A non-return valve shall be installed on all pump delivery assemblies.

A stop valve shall be installed on the downstream side of the non-return valve to make the non-return valve and pump accessible for repair.

A glycerine filled pressure gauge having a dial not less than 100 mm in diameter shall be connected to the delivery pipe work between the non-return valve and the pump delivery via a 10 mm isolating gauge cock. The face of the dial shall read in kilopascals and have a pressure range of at least twice the rated working pressure of the pump.

There must be a test valve and pipe connection coupled to the pump delivery branch downstream of the back pressure valve, including an orifice plate, if necessary, to facilitate a running pressure test on the pump at approximately the full load condition when the test valve is fully open.

Alternatively, an approved direct reading flow meter may be used to test the pump. Where the pump draws its water from a sump, care shall be taken to avoid aeration of the water during testing.

The test water shall be returned to the suction tank.

Where it is impracticable to dispose of the water discharged under a full load test condition, details of the facilities available must be submitted to the consultant for consideration.

As more than one pump forms the source of supply to the fire protection system, they shall have identical characteristics. The test pipe may be taken from the common delivery pipe, provided a stop valve is fitted in the delivery pipe downstream of the test connection.

While not testing, the stop valves on the test pipe must be secured in the closed position by 25 mm link chains and keyed alike padlocks.

All pump delivery stop valves must be of the gear driven butterfly type and secured in the open position by 25 mm link chains and keyed alike padlocks.

A direct connection without isolating facilities for the starting mechanism must be taken from downstream of the delivery stop valve and shall be not less than 20 mm diameter. Each pump must have separate starting arrangements.

All pump delivery pipe work, inclusive of the installation pipe work, must be pressure tested to at least one and a half times the working pressure of the systems subject to a minimum pressure of 2 000 kPa at a ground level hydrant or hose reel.

29. JOCKEY OR MAKE UP PUMP

A jockey or make up pump must be fitted to maintain pressure in the system.

The jockey or make up pump shall have a rated capacity of not less than any normal leakage rate. They shall be of centrifugal pump design having a discharge

pressure sufficient to maintain the desired fire protection system pressure. It shall have steep head to capacity characteristic to avoid excessive flow when pumping within the pressure operating range.

The jockey pump must be sized so as to prevent this pump from maintaining one hose reel in operation without the main fire pump starting.

The jockey or make up pump pressure operating range shall not exceed 600 kPa and shall not be less than the pressure switch setting to start the fire pump.

The jockey or make up pump shall be set to start automatically when the pressure in the system has fallen to a value of not less than 85% of the churn pressure of the primary pump and to shut off automatically when the system pressure has reached either the jockey or make up pump churning pressure or 600 kPa, whichever is the lesser.

A fire pump shall not be used as a pressure maintenance pump.

The horsepower of the jockey pump motor shall be sufficient to drive the jockey pump from no flow to maximum flow condition without overloading.

A jockey or make up pump shall be of cast iron casing construction with bronze internal parts and high tensile steel shaft.

The suction pipe for the jockey or make up pump shall be taken from the side or top of the main fire pumps common suction line.

A non-return valve shall be installed in the jockey or make up pump discharge pipe.

Stop valves shall be installed in such places as needed to make the jockey or make up pump and non-return valve along with other miscellaneous fittings accessible for maintenance and repair.

Means must be provided to reduce the applied water pressure to the jockey or make up pump starting device to simulate the conditions of automatic starting and stopping at the requisite pressures.

Full details for the approval of the proposed jockey pump must be submitted to the ASIB simultaneously with the details required for pump approval testing.

30. PUMPS - GENERAL

The nominal duty of the electric and diesel driven pumps shall not be less than the values cited in Part VII measured at the pumps:

Note: It is the contractor's responsibility to ensure that all shop drawings are accompanied by hydraulic calculations proving that they remain within this curve at all times.

Note: The pumps may not be ordered before the hydraulics have been checked, verified and signed off by the Engineer.

The performance characteristics of pumps shall be such that the pressure falls progressively with the rate of demand, so that whilst being capable of providing

the rate of flow and pressure required at the highest and most remote parts of the protected premises, the output will be so controlled that there is not an excessive rate of discharge at the lowest level in areas close to the installation valves.

Applications for approval shall show that the pressure over flow characteristics of the pump will adequately satisfy the calculated requirements of the most remote and most favourable areas of operation.

It is recommended that the Nett Positive Suction Head, (NPSH), required for any pump when discharging at the maximum flow rate shall not exceed 5.9 metres. It shall be ensured that the differential between the NPSH available and the NPSH required will not be less than 1.5 metres.

The closed outlet valve pressure, under installed conditions must not exceed 600kPa. In selecting pump characteristic curves, allowance shall be made for the increase in pressure at zero flow due to an increase in shaft speed of the prime mover and for an increase or decrease in pressure due to a positive or negative pressure at the pump suction flange.

Pumps shall be of centrifugal horizontal shaft design.

Where the following pump parts are used, the following materials shall apply:

Part	**Material**
Bearings	Ball/Roller
Casing	Cast Iron
Case wear rings	Bronze
Gland	Bronze
Gland packing	High Grade Graphite Cotton
Impeller	Bronze
Lantern Rings	Hi-dur
Mechanical Seals	Carbon Ceramic
Shat	E N 8 Steel

Part	Material
Shaft sleeves	Bronze
Stuffing box bushes	Bronze

For end suction pumps bronze case wear rings shall be fitted to the pump casing.

Cast iron shall not be used for any wetted rotating component or stationary part in close running contact with the rotating member. Pumps constructed other than as above shall have the design features approved by the ASIB.

All pump parts shall be standard stock items with no special treatment, i.e. impeller under- filing, polishing or other changes are not permissible.

For end suction pumps it must be ensured that the bearing housing is adequately supported.

The coupling between the engine or motor and the pump must allow each unit to be removed without disturbing the other.

The pump shall be fully operational within 15 seconds after starting.

Pumps must have a direct drive and must start automatically.

The automatic starting device for pumps must be of an approved pattern and set to operate the primary pump when the pressure in the trunk main has fallen to a value not less than 80 per cent of the pressure of the primary pump when churning.

Means shall be provided for manual starting by reproducing the pressure reduction. Once started, the pump must run continuously until stopped manually.

A fall in water pressure in the water system, which is intended to initiate the automatic starting of the pumps shall at the same time provide a visual and audible alarm in an area with responsible manning. The starting of the pump or pumps shall not cause the cancellation of the alarm. The visual and audible alarm shall form part of an alarm system approved by the ASIB and shall be initiated by electrically separate contacts. These contacts shall consist of one change over moving contact and two fixed contacts, one normally open and one normally closed, or two completely separate contacts, one normally open and one normally closed. The contacts shall be wired to clearly identified terminals on the terminal strip of the controller. The contacts shall be of the positive make or break type, but the alarm system shall be designed to operate on "fleeting" signals and shall latch on to either momentary make or break signals.

In all cases each pump must be provided with a plate stating the following;

- The ASIB approval number
- The churn pressure of the pump
- The calculated flow rating
- The pressure at the calculated flow rating
- The pump model number

- The pump serial number
- The impeller diameter
- The rotational speed
- The maximum power absorbed at the flow rate given

Where the performance characteristic is achieved with an orifice plate not integral with the pump delivery, the plate must carry a reference to the fact that the performance given is that of the pump and orifice plate combination, together with the K-Factor of the orifice plate calculated in accordance with accepted formulae.

Sufficient water must be permitted to circulate when the pump is running to prevent it from overheating when operating against a closed discharge valve. The quantity of water discharged may not be less than the equivalent of 10% of the numerical kilowatt rating of the prime mover and must be taken into account when sizing a pump. When the pump set is shut down, no water must circulate. In any event the manufacturer must be consulted and his recommendations adhered to. A flow indicator or sight glass must be provided upstream of an isolating valve which shall be locked in its correct operative position.

Means must be provided to reduce the applied water pressure to the starting device to simulate the condition of automatic starting at the requisite pressure.

This can take the form of a drain valve on the hydraulic connection to the pump starting pressure switch and suitable permanent drainage facilities must be provided. In order that the pressure may be dropped at a suitable rate to judge the pump cut in pressure, this drain valve may be fitted with an orifice plug. To facilitate testing and servicing, an isolating valve, with a bypass, shall be fitted on the hydraulic connection. The bypass shall incorporate a 3 mm orifice and a back pressure valve allowing flow towards the trunk main. A glycerine filled pressure gauge with a dial face of not less than 100 mm and fitted with an isolating gauge cock to indicate the pressure at which the pump starts must be placed between the isolating and drain valves in such a position that it can be read during the starting test.

Power sufficient to drive the pump at the required pressure must be available at all times throughout the year.

Power for the warning systems must be taken from a separately switched sub-circuit to that feeding the pump in the case of the electric motor driven pump. In the case of the diesel engine driven pump, the power for the warning system may not be taken from the battery which is used for automatic starting.

The warning system shall be equipped with its own batteries which shall have an ampere- hour capacity to provide 48 hours of monitoring the complete system and 1 hour of audible and visual alarm. The term "sub-circuit" means a circuit connected to a switch supplied directly from the low or medium voltage bus-bars on the fire pump room distribution board.

30.1. Pump Approval

Each complete engine/motor and pump set must be tested on the suppliers test bed and witnessed by the ASIB.

The ASIB requires a minimum of 14 days notice on receipt of the detailed information in order that they may witness the test. Copies of a certificate showing the records of the test which shall be conducted in the following manner must be supplied to the ASIB.

Pump

- The pump manufacturer
- The pump model
- The pump serial number
- The pump impeller diameter
- The pump efficiency curve
- Fire water system installers calculated flow
- Pressure at calculated flow
- Nett Positive Suction Head required at calculated flow
- Power absorbed at calculated

flow Diesel Engine

- Make of engine
- Speed of engine
- Rated power

output Electric

Motor

- Make of motor
- Speed of motor
- Rated power output

Endurance Test – Electric Motor and Diesel Engine Driven Pump

- The pump set shall be run at the calculated flow rate for 6 hours.
- At the end of the test the engine speed, the suction and delivery pressure must be recorded at zero, 25%, 50%, 75%, 100% and 110% of the calculated flow rate or at any design flow rate which may be required.

The following hourly records shall be made:

- Ambient temperature
- The lubricating oil temperature
- The rise in temperature of the cooling water
- The cooling water flow rate

- The engine speed
- If the engine is fitted with a heat exchanger, the initial temperature and the rise in temperature of the engine closed-circuit cooling water
- The pump gland temperature
- Ambient temperature
- Motor bearing temperatures
- Stator temperature

30.2. Diesel Engine Driven Pump

The diesel engine must be of the compression ignition mechanical injection type capable of being started without the use of wicks, cartridges, heater plugs or ether, at an engine room temperature of 4° Celsius and must accept full load within 15 seconds from the receipt of the signal to start.

The diesel engine must be naturally aspirated, supercharged or turbo-charged and either air or water cooled. Charge air cooling must be water cooled. Radiator cooling is not an acceptable or suitable for South African climatic conditions.

The diesel engine must be capable of operating continuously on full load at the site elevation for a minimum period of 6 hours.

The diesel engine must be provided with a governor to control the engine speed within 4.5% of its rated speed under any condition of load up to the full load rating.

The diesel engine must not have any manual device fitted to the engine which could prevent the engine starting. Any device must return automatically to the reset position for automatic starting.

The diesel engine must be provided with a tachometer and hour meter which must be permanently attached to the engine or the controller panel.

The diesel engine must be provided with, if necessary, an excess fuel device for the automatic cold starting of the engine. The device is to return automatically to the reset position for automatic starting.

The following are the permitted maximum speeds for a diesel engine:

Diesel engine size	**Maximum speed**
2 or 3 cylinder	2600 rpm
4 cylinder naturally aspirated	2400 rpm
4 cylinder turbocharged	2200 rpm
6 cylinder naturally aspirated	2400 rpm
6 cylinder turbocharged	2200 rpm
8 cylinder	1800 rpm

The diesel engine selection must be based on the continuous rating in accordance with BS 5514 or DIN 6271 B2 or SA Equivalent.

30.3. Cooling System

The following systems are acceptable:

- Cooling by water from the pump direct into the engine cylinder jacket(s) via a regulating valve of not less than 10 mm diameter to limit the applied pressure to a safe value as specified by the engine manufacturer. The outlet connection from this system must terminate at least 150 mm above the engine water outlet pipe and be directed into an open tundish or sight glass so that the discharge water is visible.
- A heat exchanger, the raw water being supplied from the pump via a regulating valve, of not less than 10 mm diameter, if necessary, to limit the applied pressure to a safe value as specified by the engine manufacturer. The raw water outlet connection from this system must terminate at least 150 mm above the water outlet pipe and be directed into an open tundish or sight glass so that the discharge water is visible. The water in the closed circuit must be circulated by means of an auxiliary pump driven from the engine and the capacity of the closed circuit must not be less than that recommended by the engine manufacturer. If the auxiliary pump is belt driven, there must be multiple belts such that should half the belts' break, the remaining belts must be capable of driving the pump.
- Direct air cooling of the engine by means of a multiple belt driven fan. When half the belts are broken, the remaining belts must be capable of driving the fan.
- Any valve on the cooling water must be so designed that under a fully closed position, it will allow the correct amount of water required by the engine manufacturer to pass through it for cooling purposes.

The cooling water line must have a suitable strainer fitted prior to entry into the engine jacket or heat exchanger.

All cooling water pipes must be of galvanized steel or copper.

The total water consumption rate for cooling the engine either directly through the cylinder jackets or as raw water supplied to a heat exchanger plus the cooling water consumed to prevent the pump overheating whilst churning must be taken into account when sizing the units.

Where engines use cooling water from the pump discharge, a vee-port flow regulating valve(s) with non-corrosive internals must be fitted to prevent excessive pressure on the engine cooling system. The regulating valve(s) must be set during site commissioning and locked in the "set-open" position to limit the applied pressure to a safe value as specified by the engine manufacturer. Once pre-set, the regulating valve must be completely enclosed in a locked housing to prevent the valve working loose due to general vibration of water movement or tampering. A 0-250kPa, glycerin filled pressure gauge shall be fitted in the line between the regulating valve(s) and the inlet to the engine jackets or heat exchanger. To prevent an excessive build-up of pressure in the engine jacket, no thermostat device is to be fitted and the cooling water lines between the "set-

open" regulating valve on the inlet side and the ultimate open discharge shall be free of any other valves or restrictive fittings.

A flow indicator sight glass or tundish shall be fitted on the engine cooling water discharge pipe. The piping must not be returned directly to the pump suction branch. In all cases care shall be taken to ensure that no flow through the engine jacket takes place whilst the engine is stationary. Spring loaded or electrically operated devices are not permitted.

30.4. Air Filtration

The air intake must be fitted with a filter of adequate size to prevent foreign matter entering the engine and must be protected from water discharge where sprinklers are fitted in the engine room.

30.5. Exhaust System

The exhaust must be fitted with a suitable silencer and the total back pressure shall not exceed the engine manufacturer's recommendation.

Where the exhaust system rises above the engine, means must be provided to prevent any condensate flowing into the engine.

The exhaust system must run at least 300mm above engine base plate level.

The engine exhaust system shall be lagged or guarded, as necessary, for the safety of personnel.

Attention is drawn to the need to ensure that the point of exit of the exhaust pipe from the engine house does not pose any fire risk to the structure, and that exhaust fumes cannot be drawn into the engine house or into any occupied building.

Note: The tenderer shall allow for all exhaust pipework from the pump room to the exterior of the building.

30.6. Engine Shut-Down Mechanism

An extended accessible fuel stop control or other approved means, clearly labelled must be manually operated and return automatically to the starting position after use.

30.7. Fuel

The engine fuel must comply with the engine manufacturer's requirements. There must be kept on hand at all times sufficient fuel to run the engine on full load for six hours in addition to that in the engine fuel tank.

Note: The fuel tank shall be full at the time of hand over to the client.

30.8. Fuel Tank

The fuel tank must be of welded steel conforming to British Standard 814:1 or SA equivalent for Mild Steel Drums.

The tank must be mounted above the engine fuel pump.

The capacity of the tank must be sufficient to allow the engine to run on full load for 6 hours.

Fuel tanks must not be fitted to or above either the engine or the batteries, neither must they be positioned such that any spillage or leakage from the fuel tank can come into contact with any hot surface on the engine.

The fuel tank may be fitted above the end of the pump set furthest away from the pump house or outside the pump house.

The fuel tank must be installed in an area surrounded by a bund wall. The bund will have a volume of 1.5 times that of the fuel tank.

30.9. Fuel Feed Pipes

Pipes that carry lubricating oil or fuel oil shall be of metal or suitable fire-resistant material.

Any valve in the fuel feed pipe between the fuel tank and the engine must be placed adjacent to the tank and it shall be locked in the open position. Pipe joints must not be soldered and plastic tubing must not be used.

30.10. Fuel System Auxiliary

Equipment The following must

be provided:

- A sludge and sediment trap
- A readily visible fuel level gauge which must not be of the glass or plastic tube level indicating type
- Damage or fracture of the fuel level gauge must not result in fuel spillage.

- An inspection and cleaning hole
- A filter between the fuel tank and fuel pump mounted in an accessible position for cleaning
- Means to enable the entire fuel system to be bled of air

Air relief cocks are not allowed, screwed plugs are permitted.

30.11. Starting Mechanism

Provision must be made for two separate methods of engine starting as under noted. Two separate batteries of adequate capacity must be provided for automatic and manual starting of the engine. Where electric starting is used, the system must operate from a battery supply recommended by the engine supplier.

Automatic starting by means of a battery powered electric starter motor of the axial displacement type having no retaining catches or inertial features. The pinion must rotate at reduced speed during the process of engagement with the flywheel ring, but during the initial engagement the pinion and armature shaft assembly must mesh by moving axially towards the gear ring. The starting sequence must be initiated by a fall in pressure in the water supply pipe to the sprinkler installation, and repeat engagement facilities must be provided should the starter pinion fail to engage with the engine flywheel ring.

When the engine fires, the starter motor pinion must be withdrawn from the flywheel ring automatically by means initiated by a directly driven tacho generator or centrifugal speed switch or proximity switch. Flexible drives are not permitted. Battery charging, voltage generators, alternators and pressure switches on the engine lubricating system or water pump outlet, as a means of de-energising the starter motor, are not permitted.

The starter motor in combination with each battery power supply shall have a design capability to rotate the engine for at least 3 minutes or 12 cycles of not less than 15 seconds cranking and not more than 6 seconds rest.

30.12. Batteries

Batteries shall be mounted and securely clamped against displacement on wooden base stands or stillages and located in a readily accessible position where the likelihood of contamination by oil, fuel, damp, pump set cooling or flooding water or being damaged by vibration or mechanical means is unlikely. The battery shall be installed as close to the starter motor as possible to minimise voltage drops between the battery and starter motor terminals.

Current carrying parts shall be at least 300 mm above finished floor level.

Dual, continuously rated, heavy current solenoid operated contactors for connecting the batteries to the engine starter motor shall be located on the engine or bedplate immediately adjacent to the engine starter motor or batteries.

Sealed maintenance free batteries only are acceptable.

A built in hydrometer shall be provided to enable the state of the batteries to be determined. An information chart pertaining to the built in hydrometer must be mounted on the battery case.

Each battery used for starting must be of a type suitable to accommodate the method of charging with an expected life of approximately 4 years and not less than 3 years with a capacity to provide 3 minutes continuous cranking or 12 cycles of cranking a cold engine of 4° Celsius according to the method of starting employed.

Batteries not used for the automatic starting of diesel engine-driven pumps, when fully charged and disconnected from the charger, shall be of sufficient capacity to monitor of all specified circuits in accordance with this tender document.

Any battery used for an automatic power failure alarm shall not be used for the automatic starting of a diesel engine driven pump or for any purpose other than protection against fire.

30.13. Battery Chargers

The battery voltage shall be as specified by the engine manufacturers, 24 volts are preferred, but 12 volts are acceptable.

The means of charging the batteries must be by a fully automatic continuously connected constant voltage, constant current charge having automatic trickle and boost charge facilities.

The equipment must indicate that each battery and the relevant charger circuits are connected and carrying direct current.

The charging rate shall be set so that the battery does not gas excessively at any stage during the charging and the rate shall be automatically adjusted to suit the state of the battery.

The circuits of the batteries must not be linked so that power may be transferred from one to the other.

The charger must have self-resetting overload protection and shall be capable of operating on a short circuit.

The charger shall operate on a short circuit and operate even when the battery is totally flat.

The charger shall float a fully charged battery continuously.

The charger shall be designed to be protected against damage when an attempt is made to charge a reverse connected battery and shall initiate an alarm when the charger output has failed.

30.14. Tools

A standard kit of tools as recommended by the engine manufacturer must be provided with the engine and kept on hand at all times.

30.15. Spare Parts

Spare parts recommended by the engine manufacturer must be supplied with and kept on hand.

30.16. Deration Factors

The following deration factors must be allowed for when determining the kilowatt output of the diesel engine:

Altitude Deration	
Altitude Deration	
Naturally Aspirated Engines:	3,5% every 300 metres above 150 metres above sea level
Turbo Charged Engines:	1,5% every 300 metres above 150 metres above sea level

Temperature Deration	
Inter-cooled Turbo Charged Engines:	1% every 300 metres above 150 metres above sea level
Naturally Aspirated Engines:	2% every 5,5° Celsius above 30° Celsius ambient
Turbo Charged Engines:	3% every 5,5° Celsius above 30° Celsius ambient
Intercooled Turbo Charged Engines:	1% every 5,5° Celsius above 30° Celsius ambient

The engine shall have 10% power in excess of that absorbed by the pump at 110% of the calculated maximum flow after deductions for altitude, temperature and ancillary components using the continuously rated curve at the engines selected speed.

Power available shall be understood as the net power at the driver shaft after derating for altitude and temperature, and for engines and auxiliary drives such as fans and cooling water pumps.

31. ELECTRICAL INSTALLATIONS

31.1. General

Each pump room shall be equipped with a distribution board which shall be designed to interrupt the fault current. The board shall be fitted with current limiting devices to ensure that the controller, monitoring panel or any other accessory which is connected to the switchboard is afforded suitable short circuit back up protection.

The distribution board shall be fitted with a separate switched fuse unit or circuit breaker of suitable rating to supply each:

- MV Electric drive controller
- Compression-ignition engine drive controller
- Jockey pump controller
- Pump room monitoring panels
- Pump room heating circuits
- Pump room lighting circuits
- Pump room plug circuits
- Accessories

Taking of power for light and plug circuits or any other devices from drive controllers or monitoring panels is strictly prohibited and will invalidate the ASIB Clearance Certificate.

Pump room electrical power connections from the distribution board to the pump drive controllers, annunciator panels, audible and visual signalling devices, pressure, flow and evel monitors and interconnections between these items shall be to the approval of the ASIB.

These power supplies shall be protected by means of suitably rated switch-fuse units or circuit breakers on the main HV or MV switchboards. These protective devices shall be clearly labelled:

FIRE PUMP POWER SUPPLY

NOT TO BE SWITCHED OFF IN EVENT OF FIRE

The lettering shall be in 25 mm capitals and the label shall conform to the requirements of this tender document.

The pump room MV switchboard, pump drive controllers, monitoring panels, etc., may be incorporated in one common panel within the pump room, provided that general arrangement drawings, detailed wiring diagrams, component scheduled and operating instructions are submitted to the ASIB for approval. A Clearance Certificate for this arrangement will only be issued after inspection of the completed panel at the manufacturer's works by the ASIB.

Separately switched power sub circuits shall be used to supply power

- For alarm devices connected to pump(s) and for any mains failure alarm system, and
- For any pump that would be the first to come into operation because of a drop in the sprinkler installation pressure and any mains-powered low-water pressure alarm system.

The indicating equipment shall be mains-powered by an uninterruptible power system that complies with the requirements of SANS 1474.

31.2. Power Supplies

Control and monitoring panels shall be designed for an electrical fault level of 31mVA at 400V, three-phase 50 Hz.

In the case of diesel engine drive controllers, the following shall apply:

- All DC electrical components shall be capable of functioning effectively at the reduced voltage levels that occur during engine cranking; and
- Relays shall not chatter on drop-out and solid state circuits shall not "switch" under reduced voltage conditions.

The battery power supply for indicator panels or alarm systems shall not be supplied from the batteries provided to start the diesel engine(s).

31.3. Cables and Wires

Electric cables shall be:

- Suitable for fire water installation use
- Selected, handled and installed in accordance with SANS 10198-2; SANS 10198-4 and SANS 10198-8
- Protected from direct exposure to fire
- Rubber-insulated and rubber-armoured, or enclosed in steel conduit, or mineral- insulated and copper-sheathed.

31.4. Wires

Electrical wires shall:

- Be single core, PVC-u-insulated, annealed copper conductors of 600 V grade in accordance with SANS 1507
- Be continuously rated
- Not use conductors that have fewer than seven strands or that are of cross-sectional area less than 2.5mm^2.

The following are normally deemed suitable for sprinkler use (depending on the particular application):

- Wiring and wireways that comply with the requirements of SANS 529, SANS 950 and SANS 1065: Part 1
- Cross-linked polyethylene-insulated (XLPE-insulated) electric cables that comply with the requirements of SANS 1339
- In the case of cables to motors inside buildings, cable that are
  - armoured and rubber-insulated in accordance with the requirements of SANS 1574, or
  - enclosed in screwed steel conduit and that are rubber-insulated in accordance with the requirements of SANS 1574 or that are mineral-insulated and copper- sheathed, and
  - wireways for electrical cables that comply with the requirements of SANS 1197: Part 1.

Steel conduit shall be threaded in accordance with the requirements of SANS 1306: Part 1.

External overhead cables are not permitted.

31.5. Circuit Breakers and Switches

Circuit breakers, isolators and switches shall be suitable for sprinkler use.

Moulded-case circuit breakers shall comply with the requirements of SANS 156 and earth- leakage protection units shall comply with the requirements of SANS 767: Part 1.

The following are deemed suitable for sprinkler use (depending on the particular application):

- Electrical switches that comply with the requirements of SANS 60669: Part 1
- Moulded-case circuit breakers that comply with the requirements of SANS 156
- High-voltage AC circuit breakers that comply with the requirements of SANS 60056
- Manually operated air break switches that comply with the requirements of SANS 152
- AC disconnectors and earthing switches that comply with the requirements of SANS 60129
- Electrical high-voltage switches that comply with the requirements of SANS 60265: Part 1 and SANS 60265: Part 2.

31.6. Fuses, Fuse Cartridges and Fuse Switchgear

Fuses, fuse cartridges and fused switchgear shall be suitable for sprinkler use. Fused switchgear that complies with the requirements of SANS 60298 is normally deemed suitable for sprinkler use (depending on the particular application).

31.7. Busbars, Contactors, Fused Switchgear and Instruments

Busbars, contactors, fused switchgear and instruments shall be suitable for sprinkler use. The following are deemed suitable for sprinkler use:

- Busbars that comply with the requirements of SANS 1195
- Electrical terminals and connectors that comply with the requirements of SANS 1433: Part 1 or SANS 1433: Part 2.

31.8. Power Supplies

31.8.1. General

The equipment and materials shall be installed in accordance with SANS 10142: Part 1 and shall comply with the requirements of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).

Power supply voltages, currents and insulation levels for sprinkler installations shall comply with the requirements of SANS 1019.

Power supply circuits that serve sprinkler equipment and services shall function independently of any other main or sub-main circuits that do not serve the sprinkler installation.

Power for light and plug circuits or any other device shall be not taken from

drive controllers or monitoring panels.

31.8.2. Main Power Supplies

The power supply shall be obtained from a public electricity supply or other suitable reliable source. Diesel engine driven generator sets are not classed as a reliable source.

If the electricity supply is not taken from a public source, full particulars of the generating plant shall be submitted to the consulting engineer at the planning stage.

Main power supplies for the installation shall be taken direct from:

- The main high voltage (HV) switchboard for HV electric motor-drive controllers
- The main medium voltage (MV) switchboard for all MV

equipment The power supplies for the pump room shall be

derived direct from:

- The main HV switchboard, in the case of the HV electric motor-driven controllers
- The main MV switchboard, in the case of the pump room MV switchboard

Pump room electrical power connections from the distribution board to the pump drive controllers, annunciator / repeater panels, audible and visual signalling devices, pressure, flow and level monitors and interconnections between these items shall be such as to be approved by the ASIB.

The power supply circuit for electric motor-driven pumps shall be separate from all other circuits in the premises.

Power to drive the pumps shall be available at all times.

All wiring associated with the electric motor-driven pump shall be in accordance with SANS 10142.

31.8.3. Protection

The protection of the main and the control circuit power supplies shall be

- designed to suit a design fault level of 31 MVA at 400 V three-phase 50 Hz in situations of varying fault levels
- provided with either high-rupturing capacity fuses of suitable rating or circuit breakers of suitable rating and breaking capacity (or both).

Switches that control the power supplies shall be readily accessible to the fire brigade.

Power supply connections to any sprinkler equipment or services shall incorporate suitable isolating protective devices and these devices shall be secured against unauthorized operation.

Separately switched fuse units or circuit breakers of suitable rating shall, for example, be provided for all electric drive controllers, diesel engine drive controllers, jockey pump drive controllers, pump room monitoring panel(s), pump room heating and lighting circuits and plug circuits.

Power supply connections to the pump room shall be protected by means of suitably rated switch fuse units or circuit breakers to interrupt the fault current on the HV or MV switchboards.

The following shall apply in the case of electric motor-driven pumps:

- The electricity supply to motors shall incorporate fuses of high-rupturing capacity that are capable of carrying the stalled motor current for a period of not less than 75 % of the period needed for the motor windings to fail
- Any no-volt release mechanism shall be of the automatic resetting type so that, on restoration of the supply, the motor can be restarted automatically if the trunk main pressure falls
- Magnetic and thermal overload trips shall be not used.

31.9. Control Panels

Control circuit power supplies shall be maximum of 220 V AC or 24 V DC and shall be derived from a separate suitably rated double wound air cooled transformer within the enclosure of each controller, monitoring panel or power supply unit.

Current-carrying parts of any control circuits and panels shall be at least 300 mm above floor level.

31.10. Electrical Earthing

All exposed metalwork in installations shall be efficiently earthed to prevent the metalwork from becoming electrically charged.

Sprinkler pipe work shall be not used as a means of earthing electrical equipment.

Electrical equipment below sprinkler installations shall have normal earthing and

overload protection.

Sprinkler installation metalwork and metal wire-ways for electric cables shall be efficiently connected to the main earthing terminal of the electrical installation.

Cables and cable routes for electrically driven pumps

External overhead cables shall be not used for electrically driven pumps.

To protect cables from direct exposure to fire they shall be run outside the building, or through those parts of the building where the fire risk is negligible and that are separated from any significant fire risk by walls, partitions or floors with a fire-resistance rating of at least 60 minutes, or they shall be given additional direct protection.

31.11. Pump Drive Controllers

31.11.1. General

Each pump must have its own controller which shall be specifically designed for sprinkler fire pump service and approved by the ASIB.

All pump manufacturers must use the panels which were approved in conjunction with their units.

A certificate of approval will be issued by the ASIB or its nominated representative and any modifications without prior approval will invalidate the certificate.

The controller shall be completely assembled, wired and tested by the manufacturer and an independent authority before shipment from the factory to site.

The controller shall be labelled in accordance with this tender document and the nameplate shall show plainly the name of the manufacturer, the identifying designation, the complete electrical rating, and the certificate of approval number.

It shall be the responsibility of the approved sprinkler installer to make the necessary arrangements for the services of a manufacturer representative, when needed, for installation and adjustment of the equipment.

31.11.2. Labels

Labels shall consist of a composite red/white/red plastic sandwich type to show white letters on a red background. Anodised aluminium type labels with red background are acceptable.

Label descriptions shall be in both English and any other required official

language. The following letter and numeral sizes shall be used for labels:

Label Type	**Letter Height**
Main panel designation	12 mm
Individual component designations	6 mm

Small component designations	3 mm
Control/signal device designations	2,5 mm

Plastic embossed stick-on tape labels are not

acceptable. Labels for control fuses shall indicate

function and fuse rating.

Each operating component of the controller shall be marked to plainly indicate the identifying letter or number referenced to the wiring diagram and the markings shall be located so as to be visible after installation.

31.11.3. Starting and Control

In the control circuit there shall be provided a pressure actuated switch having high and low calibrated adjustments or two pressure actuated switches, one having high and the other having low calibrated adjustments and responsive to water pressure in the fire protection system. Suitable means shall be made for relieving pressure to the pressure actuated switch, to test the operation of the controller and the pump.

When the pump supplies special water control equipment, (deluge valves, dry pipe valves, etc.), and it is desired to start the pump before the pressure actuated switch(es) would do so, the controller shall be equipped to start the pump upon operation of the fire detection equipment.

The controller shall be wired for manual shut down.

Shut down shall be accomplished by operation of the stop/reset push button on the outside of the control enclosure and, in the case of automatic controllers, shall return the controller to full automatic position.

31.11.4. Location

The controller shall be located as close as it is practical to the motor/engine it controls and shall be within sight of the motor/engine.

Diesel engine controllers shall be located in a position whereby the fuel shut off lever and controller panel buttons can be accessed simultaneously.

The controller shall be so located or so protected that it will not be damaged by water escaping from the pump or pump connection.

31.11.5. Construction

All controller equipment shall be incorporated within a total enclosed, damp, dust and flash proof enclosure in accordance with SABS 0108.

All equipment excepting those items fixed in the door shall be mounted on a removable 2 mm thick rolled mild steel chassis plate which shall be folded and braced to ensure rigidity.

The controller enclosure shall be constructed from 2 mm thick cold rolled mild steel

and shall be equipped with a hinged door supported on robust hinges and secured by a sufficient number of substantial catches to ensure proper sealing of the gasket.

The door shall be fitted with a non-deteriorating gasket made from butyl sponge rubber or similar material.

The following shall be provided in a suitable pocket permanently secured inside the enclosure door:

- Wiring diagrams with clearly identifiable letters and numbers for all components and wires
- Complete component schedule giving wiring diagram reference, make, type, size and supplier
- Operation and maintenance instructions.

Complete operating instructions, in English and any other official language that may be required, a wiring diagram and a component schedule shall be mounted in a glazed frame permanently fixed in the pump room.

Electrical terminals and both ends of all wires shall be plainly marked to correspond with the as made wiring diagrams for the controller.

31.12. Electric Motor Drive Controllers

The controller shall be labelled: ELECTRIC MOTOR DRIVEN PUMP CONTROLLER

All busbars and connections shall be readily accessible for maintenance work after installation of the controller without disconnecting the external circuit conductors.

Circuits which are depended upon for proper operation of the controller shall not have over current protective devices connected in them. Maximum short circuit protection with current limiting facilities shall, however, be provided for all circuits.

All switching equipment for manual use in connecting or disconnecting or starting or stopping the motor shall be externally operable.

A manually operated fused isolating switch shall be mounted within the controller enclosure.

The switch shall be equipped with one fuse in each phase and the switch rating shall be determined by the fuse size.

The fuses shall conform to this tender document and the fuse rating shall be in accordance with the Fuse Table detailed in this document, irrespective of method of starting.

High rupturing capacity, (HRC), cartridges of a suitable rating mounted in insulated withdrawable fuse holders, conforming to this tender document shall be provided for the protection of each branch circuit conductor.

The removal or blowing of any HRC fuse will initiate an alarm or fault condition at the alarm annunciator panel.

One complete set of spare main motor circuit and control circuit HRC fuse cartridges shall be secured on approved brackets inside the enclosure door.

The ampere rating of the switch shall be determined by the fuse size as mentioned above but shall be at least 115% of the name plate current rating of the motor.

No over current protective devices shall be installed in the motor circuit.

The motor starter shall be of the AC automatic type, incorporating magnetically operated air break contactors.

For electrical operation of reduced voltage starts, timed automatic acceleration of the motor shall be provided and the period of acceleration shall not exceed 10 seconds.

Starting resistors shall be designed to permit 15 second starting operation in each 80 seconds for a period of not less than 1 hour.

Direct on-line starting is preferred but Star/Delta, Auto Transformer or Stator and Rotor type starters may be used if the supply authority and/or user insist on this because of electric power supply limitations. The installer shall establish what type of starting is permissible.

A fully integrated combined phase failure and phase reversal relay must be incorporated in the panel. Electrically separate contacts shall be provided on the phase failure relay, and these shall be wired out to clearly identified terminals on the controller.

Such a phase failure/reversal relay shall not prevent the motor from attempting to start nor must it stop the motor while it is operating when any such phase failure/reversal occurs.

FUSE TABLE

HIGH RUPTURING CAPACITY CARTRIDGE FUSE RATING SELECTION CHART

On 380 volts		**On 500 volts**	
Maximum motor rating - kW	Fuse rating Amps	Maximum motor rating - kW	Fuse rating Amps
15	15	22	15
30	20	40	20
375	25	55	25
45	30	90	35
55	35	125	40
75	40	185	60
11	60	22	80
22	80	33	100
25	100	45	125
45	150	67	150

55	200	75	200
80	250	93	250
132	350	120	300
160	400	165	350
185	450	220	400
215	500	300	500
250	600	325	600
320	700	425	800
375	1000	550	1000

For motors in excess of these ratings, the manufacturer shall submit details of a proposed back up protection for approval to the ASIB.

A voltmeter complete with fuses and a voltmeter selector switch arranged to select phase to phase and phase to neutral readings shall be provided.

An Ammeter, 3 current transformer and a selector switch shall be fitted on the controller connected in such a way as to test each phase in order to check the loading of the motor.

The controller shall be fitted with electrically separate potential free contacts to make provision for the following conditions to be maintained:

- Fire alarm
- Power failure, (main electrical supply)
- Pump failure
- Pump running
- Control circuit failure, (wired from the end of the control circuit)

Indication on the controller shall be in the form of indicating lamps in duplicate to show the following:

- Fire alarm
- Pump failure to start.
- Pump running

A reset push button shall be fitted on the controller to reset the controller.

The controller shall latch on to a starting signal until the reset push button is pressed.

A push button shall be fitted on the controller for emergency starting which will bypass the automatic starting circuit.

A separate test push button shall be fitted on the controller to initiate the automatic starting sequence operation.

Should the power requirements of the fire pump be such that it cannot be started at the same time as the plant is operating, an electrically separate contact and timer shall be provided on the controller to initiate tripping of the plant circuit breaker before power is applied to the motor terminals.

31.13. Compression-Ignition Engine Drive Controllers

The controller shall be labelled: DIESEL ENGINE DRIVEN PUMP CONTROLLER

All switching equipment for manual use in connecting or disconnecting or starting or stopping the engine shall be externally operable.

A manually operated isolating switch shall be mounted within the controller enclosure.

Fuses for protection of both the AC and DC circuits shall be provided and shall conform to this tender document and the fuse rating shall be in accordance with the Fuse Table.

High rupturing capacity cartridge fuses of suitable rating mounted in insulated withdrawable fuse holders shall be provided for the protection of each branch circuit conductor. The removal or blowing of any HRC fuse will initiate an alarm or fault condition at the annunciator panel.

One complete set of spare HRC fuse cartridges shall be secured on approved brackets inside the enclosure door.

Automatic starting will be initiated by one of two external monitoring devices wired in parallel and the starting components will be arranged to crank for a maximum period of 15 seconds and dwell for a period of not more than 6 seconds. Both time periods shall be adjustable and set to suit engine and site conditions.

A presentable counter arranged to count each cranking period shall be provided and shall be capable of being preset for up to 9 counts but shall normally be preset for 6 counts. If the engine has not started after the preset number of counts, the cranking must be stopped, and the pump failure indication and alarm must be initiated. Only actual cyclic counters are acceptable. A timer set for the overall calculated time for the preset number of starts is not acceptable.

The components shall be arranged to connect each of the two batteries to the engine starter motor on alternate cranking cycles and so designed that the first cycle of a fresh attempted start shall alternate between one battery and the other.

A suitable voltage relay shall be connected across the load side of the main fuses and electrically separate contacts on this relay shall be wired out to clearly identified terminals for initiating the power failure alarm.

An AC voltmeter shall be provided to indicate the input voltage to the

controller. A DC voltmeter shall be provided to indicate the terminal

voltage of each battery. A DC ammeter shall be provided to indicate the

charging rate of each battery.

Electrically separate potentially free contacts wired out to clearly identified terminals are to be provided for the following conditions to be monitored:

- Fire alarm

- Power failure, (battery charger electrical supply)
- Pump failure
- Pump running
- Low oil pressure
- Charger failure, (from both charger outputs in parallel)
- Control circuit failure, (from the end of the control circuit)

Indication in the form of duplicate indicating lamps shall be provided to show the following:

- Fire alarm
- Pump failure
- Pump running
- Low oil pressure

A reset push button shall be provided to reset the controller.

The controller shall latch on to a starting signal until the reset push button is pressed.

One "emergency start" push button shall be provided for each battery and the circuitry shall be arranged so that each push button will bypass the automatic starting circuit and will energize its associated starter motor solenoid. It shall be possible to depress both push buttons and apply power from both batteries simultaneously to the starter motor.

An adjustable voltage sensitive device shall be provided to sense the potential generated by the tacho generator mentioned in this tender document. One set of normally open contacts of one voltage sensitive relay shall be wired in parallel with that of the other relay to initiate the pump running relay.

- Each engine shall be fitted with two tacho generators taken off different drive points on the engine, or,

- A combination of one tacho generator and one proximity sensor may be fitted to the engine to monitor engine motion. Where such a sensor is used, the panel must be fitted with a matching sensing relay with one set of normally open contacts to be wired in parallel to those of the voltage sensitive relay to initiate the pump running relay.

Manual isolating and/or selector switches in the battery to engine starter motor circuits are not permitted.

A separate test button shall be provided to initiate the automatic starting sequence.

Controllers mounted on the engine bedplate shall be supported by a substantial frame securely bolted to the engine bedplate and the controller shall be secured to this frame by means of approved resilient mountings.

Plug-in components such as fuses, relays, pc boards, etc., in controllers which are mounted on the engine bedplates shall be provided with suitable spring clips or securing facilities to prevent unplugging due to vibration. The removal of any relay must initiate either a "Fault" condition or the "Control Circuit Failure" alarm at the annunciator panel.

All DC electrical components shall be capable of functioning effectively at the reduced voltage levels that exist during cranking. Relays shall not chatter or drop out and solid-state circuits shall not "switch" under these low voltage conditions.

The control circuit shall be arranged to operate across the full battery voltage. Connections for any reduced voltage shall not be taken by tapping-off cells in the battery.

The controller shall be equipped with one battery charger in accordance with this tender document for each battery.

31.14. Electric Motor Driven Jockey Pump Controllers

The controller shall comply with the paragraphs pertaining to the electrical installations and general section pertaining to pump drive controllers.

The controller shall be labelled: JOCKEY PUMP CONTROLLER

Starting and stopping of the motor will be initiated by a pressure actuated switch having high and low calibrated adjustments and which is responsive to water pressure in the fire protection system. Suitable means shall be made for relieving pressure to the pressure actuated switch to test the operation of the controller and the pump.

The controller shall be fitted with the following:

- Suitably rated triple pole isolators with auxiliary contacts as may be necessary.
- Suitably rated contactors.
- Adjustable, ambient temperature compensated thermal overload relay for motor protection.
- Hand/auto selector switch.

- A timer with a 0 to 30 second setting normally set to 20 seconds.

When the hand/auto selector switch is in the hand position, the pump shall run continuously, and when the switch is in the auto position, the pump will start and stop automatically under the control of the pressure switch.

Selector switches incorporating off positions are not acceptable.

32. ANNUNCIATORS FOR PUMP ROOM INSTALLATIONS

32.1. General

The controller shall be labelled: PUMP HOUSE ANNUNCIATOR PANEL

The pump room shall have its own annunciator panel, audible and visual signalling devices and, where required, a repeater panel, all of which shall be approved by the ASIB.

Unapproved audible and visual signalling devices such as sirens, bells, hooters, beacons and lamps will not be accepted for use in conjunction with approved annunciator and repeater panels.

It shall be the responsibility of the approved sprinkler installer to make the necessary arrangements for the services of a manufacturer representative, when needed, for installation and adjustments of annunciator and repeater panels and equipment.

Each component of the alarm or annunciator and/or repeater panel shall be marked to clearly indicate the identifying letter or number referenced to the wiring diagram and the markings shall be located so as to be permanently visible after installation.

All circuits, including the pressure switches and battery connections, shall be monitored as follows:

- Open circuits shall indicate a "fault" condition.
- High impedance closed circuits shall constitute a normal condition and no indication is required.
- Short circuits shall indicate an "alarm" or "warning" condition.

A "fault", "alarm" or "warning" as described above shall initiate the audible alarm which shall be silenced by means of an "accept" push button.

When a "fault", "alarm" or "warning" condition occurs, the circuit annunciator shall flash on and off until the signal has been accepted, when the annunciator will change from a flashing to a steady visual signal. When the circuit is restored to a normal condition as described above, the steady signal shall extinguish.

A first alarm condition must cause the audible alarm to sound and, after acceptance, a second alarm must again cause the audible alarm to sound. Systems in which the audible alarm is negated after acceptance will not be approved.

The pump house repeater panel shall be mounted in an approved position at a responsibly manned location in the plant or on the premises.

The two audible and one visual signalling device shall be mounted immediately outside the pump room in an approved position.

The audible range of the two audible signalling devices shall be adequate to suit the distance to be covered and the noise environment of the location. Where this is not practical, a repeater panel as described in this tender document must be installed at a permanently manned position.

A steady audible alarm and a flashing visual alarm shall be initiated when a "fire" condition
exists.

An intermittent audible alarm shall be initiated when a "pump failure" condition exists. The "Pump house Protection" alarm shall initiate the steady audible and flashing visual alarms.

The signaling devices shall be suitable for operation from the battery powering the annunciator system.

Battery chargers and batteries shall not be housed in the same enclosure as the annunciator or repeater panels.

The charger and batteries may be housed in a common enclosure but in separate compartments suitably divided and sealed to ensure that charger components are not subjected to battery fumes.

32.2. Pressure Switches, Flow Switches, Patens or Specialized Valves and Components (Approval)

These components and others shall be submitted for approval to the ASIB and subsequent changes of design after initial approval shall be similarly submitted before being put into use.

32.3. Pump House Remote Alarm Notification and Data Logger Module

The pump house shall be equipped with a remote alarm notification and data logger module to enable remote monitoring of the pump house events and retrieval of data.

32.3.1. Functionality

The data logging module shall have:

- The ability to locally log all events that occur within the pump house facility.
- The ability to remotely log all events that occur within the pump house facility.
- Send pump house alarms to personnel via SMS or pager.
- Send pump house alarms to a computer via SMS or pager.

The remote alarm module device shall be located inside the pump house within a metal IP55 enclosure. All controller panels shall have the remote alarm module

factory fitted during panel construction before ASIB certification tests.

The hardware product must operate independently from all installed panel systems, i.e. Electric, Diesel, Annunciator or Jockey controllers. The device shall send alarm notification messages via cell phone SMS or pager to both personnel, and or remote offsite computers. The device must have the capability log events internally if pager or cell phone services are unavailable.

The remote alarm module shall conform to the following technical specifications:

- Store up to 1000 events internally on a FIFO (First in first out) basis
- Both a local and remote event log upload facility to obtain log files
- A Minimum of 6 personnel contact numbers. (Cell phone or pager)
- A minimum of 20 potential free (dry contact) alarm inputs
- A minimum of 2 relay outputs (2A)
- A minimum of 4 counters and timers so that required pump house rules can be defined
- A 24/7 schedule for daily tests and weekly statistic reports

The remote logger shall conform to the following pump house alarm rules:

- If the jockey pump runs longer than 5 minutes, then send an alarm
- If the jockey pump starts more than 10 times within a 1-hour period, then send an alarm
- If the system is in maintenance mode, then disarm the cell phones or pagers.

To facilitate weekly tests the panel must have a maintenance button that disables remote alarms messages to cell phones or pagers while the pump house is being tested or repaired, however data is still logged on a remote computer for hard copy test reports.

The following are deemed to be the minimum alarms that shall be monitored:

Alarm Monitoring		
1	Panel	Maintenance MODE SWITCH
2	Jockey Controller Panel	ALARM – Pump RUN
3	Jockey Controller Panel	ALARM – Pump FAIL
4	Electric Motor Driven Pump Controller Panel	ALARM – Fire ALARM
5	Electric Motor Driven Pump Controller Panel	ALARM – Pump RUN
6	Electric Motor Driven Pump Controller Panel	ALARM – Mains FAIL
7	Electric Motor Driven Pump Controller Panel	ALARM – Control Circuit FAIL
8	Electric Motor Driven Pump Controller Panel	ALARM – Pump FAIL
9	Diesel Engine Driven Pump Controller Panel	ALARM - Fire ALARM

10	Diesel Engine Driven Pump Controller Panel	ALARM - Pump RUN
11	Diesel Engine Driven Pump Controller Panel	ALARM - Pump FAIL
12	Diesel Engine Driven Pump Controller Panel	ALARM – Mains FAIL
13	Diesel Engine Driven Pump Controller Panel	ALARM - Control Circuit FAIL
14	Diesel Engine Driven Pump Controller Panel	ALARM - Low oil pressure FAIL
15	Diesel Engine Driven Pump Controller Panel	ALARM - Battery charge FAIL
16	Diesel Engine Driven Pump Controller Panel	ALARM - Engine over temperature FAIL

Alarm inputs are to be connected directly to the electric, diesel, jockey or annunciator panels.

All alarms signal wires shall be potential free, (dry contact).

No voltage shall be sent to or received from the existing pump house panels. If the unit is in a standalone cabinet, it must operate from its own power source. No AC power, 12V shall be drawn from any existing pump house panel.

PART VI

FIRE PROTECTION EQUIPMENT INSTALLATION

PROJECT SPECIFICATION

FIRE PROTECTION EQUIPMENT INSTALLATION PROJECT SPECIFICATION LIST OF

CONTENTS

1 GENERAL

1.1 In this document where the term "Main Contractor", "Building Contractor" or "Builder" is used, it shall mean the Principal Contractor and where the term "Subcontractor" is used; it shall mean the Contractor appointed in terms of this document.

2 APPLICABLE DOCUMENTS AND DRAWINGS

2.1 The supply and installation of the mechanical systems are subject to the following documents forming part of this specification:

- Standard Technical Specification
- Project Specification
- Schedules of Materials and Equipment Offered
- Bills of Quantities

2.2 List of Specifications

All specifications listed hereafter refer to the latest version as issued by the relevant body.

2.3 SANS SPECIFICATIONS*

SANS 11200	:	Standardized Specifications for Civil Engineering Construction
SANS 10400	:	The application of the National Building Regulations (all parts)
SANS 11200 HC	:	Corrosion protection of structural
steelwork SANS 11091	:	National colour standards for
paint		
SANS ISO 11461	:	Hot-dip galvanized coatings on fabricated iron and steel articles – Specification and test methods.
SANS ISO 13575	:	Continuous hot-dip zinc-coated carbon steel sheet of commercial, lock forming and drawing qualities
SANS 10214	:	The design, fabrication and inspection of articles for hot-dip galvanising
SANS 10103	:	The measurement and rating of environmental noise with respect to annoyance and speech communication
SANS 1186-1	:	Symbolic safety signs – Part 1: Standard signs and general requirements
SANS 1475-2	:	The production of reconditioned fire-fighting equipment – Part 2: Fire hose reels, hydrants and booster connections.
SANS 9227/ISO 9227 (SABS ISO 9227)	:	Corrosion tests in artificial atmospheres – Salt spray tests.

SANS 200	:	Copper alloy ingots and castings.
SANS 665-1	:	Wedge gate and resilient seal valves for general purposes – Part 1: General. Amdt 1
SANS 1109-1/ISO 7-1	:	Pipe threads where pressure-tight joints are made on the threads – Part 1: Dimensions, tolerances and designation.
SANS 1128-2	:	Fire fighting equipment – Part 2: Hose couplings, connectors and branch pipe and nozzle connections.
SANS 1700	:	Fasteners (all parts).
SANS 4633/ISO 4633	:	Rubber seals – Joint rings for water supply, drainage and sewerage pipelines – Specification for materials
SANS 10252: 1	:	Water supply and drainage for buildings: Water supply installations for buildings
SANS 193	:	Fire Dampers
SANS 306-4	:	Fire extinguishing installations and equipment on premises – Part 4: Specification for carbon dioxide systems
SANS 428	:	Fire performance classification of thermal insulated building envelope systems.
SANS 543	:	Fire hose reels (with semi-rigid hose)
SANS 1128-1	:	Fire fighting equipment – Part 1: Components of underground and above-ground hydrant systems.
SANS 1128-2	:	Fire fighting equipment – Part 2: Hose couplings, connectors and branch pipe and nozzles connections.
SANS 1186	:	Symbolic safety signs (all
parts). SANS 1253	:	Fire doors and fire shutters.
SANS 1910	:	Portable refillable fire extinguishers.
SANS 10087	:	The handling, storage and distribution of liquefied petroleum gas in domestic, commercial and industrial installations (all parts).
SANS 10089 - 3	:	The petroleum industry – Part 3: The installation, modification and decommissioning of underground storage tanks, pumps/dispensers and pipework at service stations and consumer installations.
SANS 10131	:	Above ground storage tanks for petroleum products.
SANS 1464-22	:	Safety of luminaires – Part 22: Luminaires for emergency lighting

2.4 BS SPECIFICATIONS*

BS 10	:	Specification for flanges and bolting for piping, valves and fittings.
BS 5000-99	:	Machines for miscellaneous applications.

2.5 OTHER SPECIFICATIONS*

ACT 45	:	Atmospheric Pollution Prevention Act.
ACT 103	:	National Building Regulations and Building
Standards. OHS ACT 85 of 1993.	:	The Occupational Health and Safety Act, Act
EN 1092-1		Flanges and their joints – Circular flanges for pipes,
		EN 1092-2

EN 1561			Founding – Grey cast irons
	EN 12163		Copper and copper alloys – Rod for general purposes.
	EN 12165		Copper and copper alloys – Wrought and unwrought forging stock.
	EN 694		Fire-fighting hoses – Semi-rigid hoses for fixed systems Building Hardware – Panic devices operated by a
	EN 1125	:	horizontal bar, for use on escape routes – Requirements and testing methods.

EN 12101	:	Smoke and heat control systems (all parts)
EN 14064	:	Thermal insulation products for buildings – In-situ formed loose fill mineral wool products.

3 SCOPE OF SUBCONTRACT AND SYSTEM DESCRIPTION

3.1 The system described in the specifications below is for a school being built and renovated in Bathlarelwa School.

3.2 The scope of this subcontract includes the engineering, drawings, manufacture, supply, delivery, installation, testing, commissioning, handing over, contract guarantee, servicing and maintenance of the fire protection equipment and booster pump and tank installation as specified in this document and the attached drawings.

3.3 The new fire protection equipment installation shall comply with the National Building Regulations and Building Standards Act, 1977 (as amended) and SANS 10400 (as amended) and all applicable documentation.

3.4 The fire protection equipment installation consists of the following:

a) Installation of SABS approved above ground fire hydrants.

b) Installation of non-swing type 30m fire hose reels and associated piping and valves.

c) Installation of fire protection water piping reticulation.

d) Installation of portable fire extinguishers and purpose made boards.

e) Installation of fire signage.

3.5 The booster pump and tank system installation consists of the following:

a) The installation of a fire water storage tank.

b) The installation of a booster pump set, including a jockey pump, electric pump and diesel pump.

c) The associated piping for the installation, including the auto start and direct testing line.

d) All required electrical installations, including the panel, controls, all cabling and cable trays.

3.6 Compilation and submittal of new Operation and Maintenance Manuals including maintenance schedule.

3.7 The Tenderer shall include in his tender prices for the supply, fitment and painting of all the supports and brackets within the relevant equipment prices as the supports are not billed.

4 GENERAL REQUIREMENTS

4.1 The Building:

The facility is in Bathlarelwa School.

4.2 Water Supply

The connection to the new installation will be from the existing municipal system. The connection point from the existing mains will be as per the Site Development Plan.

4.3 Fire Protection by Others

The following fire protection measures will be provided by others:

- Fire detection and alarm system in the building (not the pump room)

4.4 Site supervision by Subcontractor

This installation will be a subcontract and all site supervision and management will be the responsibility of the Subcontractor appointed in terms of this specification.

4.5 Submissions by Subcontractor

4.5.1 Submissions with regard to equipment

a) The Subcontractor should take note that all equipment selections approved (or not rejected) by the Engineer shall not free the Subcontractor to comply with the specification.

b) The following information with regard to equipment selections shall be submitted to the Engineer before ordering and installation:

- Manufacturer name and model
- Diagrams, tables and graphs to explain the functioning of equipment, where applicable
- Applicable pamphlets or catalogue information
- Name and address of manufacturer and/or distributor
- Number of years that equipment has been available in RSA
- Any other relevant information required by the Engineer

c) The above submissions are required after appointment by the Subcontractor and in accordance with the requirements of the main contract programme.

d) The following submissions will be approved by the Engineer before ordering and installation:

- Mounting brackets method statement and drawing details.
- Hydrant, hose reel and extinguisher type and specifications.
- Tank type and supplier details.
- Tank details in the form of a typical drawing (not the workshop drawing).
- Pumps selected for the application. This also includes the technical details of the pumps showing how the pump complies with the specification.
- All valves and fittings to be used in the pump room.
- Annunciator panel selected. All technical details to be included.
- Any other components as required by the engineer.
- Commissioning and maintenance methodology of all systems.

4.5.2 Marked-up Drawings and Shop Drawings:

a) Refer to part IV.00, Clause 3 and part IV.01, Clauses 3

b) Marked-up structural and other drawings:

The marked-up structural, architectural drawings and other drawings referred to, shall be submitted two weeks after appointment of the Subcontractor and shall include the following information:

- All dimensions and positions of openings and sleeves through both brick,

roof and concrete building structures required to fit the piping installation,

- Dimensions and positions of supporting brackets required to locate equipment,Installation positions of wooded, glass fibre or steel frames or sleeves to be built in by the principal contractor.

c) Shop Drawings and As-built Drawings

- All shop drawings shall be approved and signed by the Engineer, before the installation commences,
- Shall indicate the required service space around equipment.

d) The successful Subcontractor shall verify that provision has been made for all openings, wooded frames, sleeves, etc. as described above and that such openings, frames, etc. are in the correct position before any concrete casting or building work is done.

4.6 Performance of Systems and Equipment

The systems, equipment and layout with regard to installation and performance shall be accordance with the specification. This also implies that the performance of the equipment in the system supplied and installed by the Subcontractor, shall be in accordance with the design and performance figures as published by the manufacturers and/or suppliers.

The efficiency of the design of the specified system is not the responsibility of the Subcontractor. It is, however, the responsibility of the Subcontractor to see to it that the quality of the workmanship and the installation of the equipment as well as the re- commissioned equipment conform to the requirements of the Engineer and to the satisfaction of the manufacturer and/or supplier.

It is furthermore accepted that the Subcontractor has assured himself that all equipment supplied and installed under this contract shall perform within the given limits, as stated by the manufacturer/supplier, to confirm to the specification.

4.7 Protection, Cleaning, Adjustments, Commissioning, Test and Operating Maintenance Manuals

a) The Subcontractor shall be responsible for the installation, including the maintenance and replacement of worn parts, from the start-up date until it

is handed to the Owner.

b) The fire protection installation shall be maintained for one (1) year after the final hand over to the client. The cost for the one year (12 months from hand over to the client) maintenance shall be included in the tender price.

c) The contractor shall provide the entire operating and maintenance manual in electronic format. The contractor shall, in addition, provide three (3) hard copies of the entire manual, and three CD's of the entire manual and as built drawings. Drawings shall be in AutoCAD and PDF format.

4.8 Language

All notices on equipment shall be in English.

4.9 Standard Specifications

The subcontractor shall in all instances refer to the standard specifications as it forms an integral part of this document. This includes Part IV, SANS specifications and BS specifications.

5 FIRE HYDRANTS

5.1 This contract includes the supply and installation of SABS approved Ø65mm fire hydrants, including associated piping, hangers, brackets and painting. The type of connection will be as per the local municipality requirements.

5.2 The contractor is to do a formal submission on the choice of fire hydrant to be installed. The hydrant is subject to the approval of the engineer.

5.3 The water supply to the fire hydrant shall be installed to provide a flow rate of no less than 1250l/min at a pressure of 300kPa. The contractor is to ensure that the water supply is adequate to supply this rate of flow.
Any communication pipe serving a fire hydrant shall be no less than 75mm.

5.4 The fire hydrants shall be installed as per the drawings in the positions indicated.

6 FIRE HOSE REELS

6.1 This contract includes the supply and installation of SABS approved fire hose reels - 20 mm x 30 m semi-rigid hose and non-swinging type.

6.2 The contractor is to do a formal submission on the choice of fire hose reel to be installed. The hydrant is subject to the approval of the engineer.

6.3 The hose reels water supply shall be permanently connected and shall be capable to supply water at any hose of not less than 300kPa pressure and 0.5l/s per hose reel.

6.4 The fire water installation piping shall be as is indicated on the drawings.

6.5 Where a fire hydrant and hose-reel is to be installed in the same location, the supply pipe to the hydrant shall be no less than Ø75mm and a tee-off may be made for the hose reel of Ø25mm.

7 WATER SUPPLY PIPING, FLUSHING AND TESTING

7.1 The supply piping from the main fire water supply shall be uPVC piping for all underground installations, and galvanized mild steel piping, above ground, to the fire hydrants and hose reels, installed in accordance with SANS 10400 and other relevant SANS specifications.

7.2 The water pipe installation for the fire hydrants and hose reels shall be installed as per the drawings. The installation shall be inspected by the engineer, in order to ensure the installation is as per the drawings, ensure there is no visible damage to the material and equipment installed, and to ensure best practice methods were applied during the installation of the system. The contractor shall ensure that the installation is completed timeously and inform the engineer of completion in order to do an inspection, either of the full system or parts of the system, while the system is visible and can be reached for inspection.

7.3 The installation shall be flushed after the inspection to ensure the system is free of any debris and any possible foreign matter. This shall be done by connecting the system to the municipal supply and opening the highest and furthest installed hydrant in the system. The highest point of each riser should also be opened to ensure all branches are cleaned. Care should be taken during this process of where the water will flow.

7.4 After flushing and confirmation that the system is free of any foreign matter, the system shall be pressure tested by a qualified plumber. The tests shall be as per the requirements of SANS 10252 Part 1. All pressure tests on the complete, or parts of the, system, shall be at least 2 000 kPa, and twice the maximum operating pressure. The pressure test needs to be witnessed by the engineer and a representative from the client, if so required by the client.

7.5 The piping supports for all fire piping are critical. Each section of pipe will have to be supported with brackets, as well as riser or droppers will have to be

appropriately supported to ensure the brackets are able to carry the weight of the pipe filled with water.

7.6 All testing certificates must be made available to the engineer upon completion. This includes all pressure testing as well as all equipment testing required by the engineer.

8 PORTABLE FIRE EXTINGUISHERS

8.1 This contract includes the installation of SABS approved portable Fire Extinguishers; as required and indicated by the drawings.

8.2 The portable fire extinguishers shall be installed in locations in accordance with the fire protection plans.

8.3 The portable fire extinguishers shall be installed on purpose made boards, fixed to the wall, where they are not likely to be blocked or hidden.

8.4 All portable fire extinguishers shall comply with the requirements of SANS 1910, and will be installed, maintained and serviced by competent persons in accordance with SANS 1475-1 and SANS 10105-1.

9 SIGNPOSTING AND MARKINGS

9.1 All escape doors, routes and equipment shall be clearly marked with SABS approved signs, as indicated on the fire signage drawings.

9.2 All signposts shall comply with the requirements of SANS 1186 (all parts, as required on the drawings) and SANS 1464-22, and will comply with the requirements of SANS 10114-2 with regard to the maximum viewing distance of the sign in proportion to the height of the sign.

9.3 All signposts shall be suspended from the ceiling or mounted on the walls at a maximum height of 2100mm from the finished floor level to the base of the sign. Any deviation from this should be communicated to the engineer urgently.

9.4 All markings and signs shall be of type as specified on the drawing and be no less than 190mm in height.

9.5 All markings and signs shall be fitted with an aluminum frame and back plates as indicated on the drawings and fitted with hanging/mounting brackets.

9.6 All signs shall be mechanically fixed, and no adhesive shall be used as the fixing method.

PART VII

FIRE INSTALLATION

SCHEDULE OF CAPACITIES

SCHEDULE OF CAPACITIES PART VII

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PART VII

FIRE WATER PUMP INSTALLATION

SCHEDULE OF CAPACITIES

With regards the fire water installation, the following is applicable:

Description	**Quantity**	**Value**
Electric motor driven pump	1	Duty point of 1 500 l/min at 450 kPa (to be confirmed prior to final ordering)
Diesel driven pump	1	Duty point of 1 500 l/min at 450 kPa (to be confirmed prior to final ordering)
Water storage tanks	1	Capacity of 80m³ (to be confirmed prior to final ordering)