CLUSTER

Trading Services

UNIT

Water and Sanitation

DEPARTMENT

Sanitation Operations

PROCUREMENT DOCUMENT

INFRASTRUCTURE

Documents are to be obtained, free of charge, in electronic format, from the National Treasury's eTenders website or the eThekwini Municipality's website.

Contract No: 30661-5W

Contract Title: Construction of the Southern Wastewater Treatment Works Multidisciplinary Upgrades

Est. CIDB Grade/ Class: 9 9EP and 9ME

CLARIFICATION MEETING AND QUERIES

Clarification Meeting: Compulsory Clarification Meeting

Meeting Location, Date, Time: Southern Wastewater Treatment Works (@ co-ordinates - 29.955135360820552, 30.97299685576011) on 13 June 2025 at 11h00

Queries can be addressed to The Employer's Agent's Representative:
Name: Shanir Ramjathan
Tel: +27 (0)31 254 5700
eMail: Shanir.r@ixengineers.co.za.co.za

TENDER SUBMISSION

Delivery Location: The Tender Box in the foyer of the Municipal Building 166 KE Masinga Road, Durban

Closing Date/ Time: Friday, 04 July 2025 at 11h00

FACSIMILE, eMAIL, or POSTED TENDERS WILL NOT BE ACCEPTED

Issued by:

ETHEKWINI MUNICIPALITY

Deputy Head: Water and Sanitation

Date of Issue: 30/05/2025

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VOLUME 8 OF 9

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Tenderer Name:			VAT Registered: Yes No
	Price (excl)	VAT	Price (incl)
Submitted:	R	R	R
Corrected:	R	R	R

INDEX to TENDER DOCUMENT - VOLUMES

This Tender Document consists of 9 (Nine) Volumes as indicated in the table below.

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1 of 9	Tender Document	Tendering Procedures Returnable Documents Agreement and Contract Data Scope of Work Site Information
2 of 9	Pricing Data	Pricing Assumptions / Instructions Bill of Quantities
3 of 9	Standard Specifications	Standard Specifications Amendments to standard Specifications
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8 of 9	**Annexures (This Document)**	**Quality Assurance, Transport, Installation, Testing and Commissioning** **Environmental Management Plan** **Employer's Health and Safety Specification** **Employers Standard Electrical Standard Specifications** **Employers Standard Mechanical Specifications** **Employer Control Instrumentation Project Specification**
9 of 9	Drawings	General Drawings Electrical Drawings Mechanical Drawings Building Work Drawings Structural Drawings HVAC Drawings Civil Drawings

Declaration by Tenderer

I, the undersigned, hereby declare and confirm that I have obtained all 9 (Nine) of the Tender Document Volumes as indicated in the table above.

NAME (Block Capitals): _____ **Date**

SIGNATURE: ---------- ----------

This Tender Document (Volume 8 of 9: ANNEXURES) consists of the following Documents.

QUALITY ASSURANCE TRANSPORTATION, INSTALLATION, TESTIGN AND COMMISIONING SPECIFICATION
ENVIRONMENTAL MANAGEMENT PROGRAMME
EMPLOYER'S HEALTH AND SAFETY SPECIFICATIONS

QUALITY ASSURANCE, TRANSPORTATION, INSTALLATION, TESTING AND COMMISIONING

Contents

QUALITY ASSURANCE, TRANSPORTATION, INSTALLATION, TESTING AND COMMISIONING

1 SCOPE

This Particular Specification covers the general and overall requirements for the Transportation of Equipment and Goods required for the completion of project, the Quality Assurance and Control Requirements, the Testing and Commissioning of the Works, the Training of Operators, and the Completion Documentation for the Works.

This specification does not override or take precedence over the requirements of the project specifications and individual product specifications but provides the common requirements for the phases of the project.

Each item or component within the Works will be fabricated, tested, installed and commissioned in accordance with individual product specifications, and detailed records thereof shall be kept by the Contractor as part of his Quality assurance system. The Testing of the whole of the Works shall only commence once sections have passed testing. Partial Taking Over of sections of the Works is NOT applicable under this Contract.

2 QUALITY ASSURANCE

2.1 Scope

This document outlines the Employer's general requirements of the quality assurance system that the Contractor is to institute under this project.

The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The Engineer shall be entitled to audit any aspect of the system.

Details of all methods to be employed, procedures and compliance documents shall be submitted to the Engineer for information or for approval (where approval is required) before each design and execution stage is commenced.

When any document of a technical nature is issued to the Engineer, evidence of the prior approval by the Contractor himself shall be apparent on the document itself.

Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

2.2 Responsibility for Quality

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

The cost of quality assurance, supervision and process control, including testing carried out by the Contractor, will be deemed to be included in the rates in the Contract for the related items of work.

The Contractor's Quality Management System shall be in accordance with ISO 9000, or an equivalent internationally recognised Certification Body.

In keeping with the principles contained in the above practice, the Contractor or any nominated and/or approved Sub-Contractor(s) shall –

a) be responsible for compliance with all the clauses of this specification in every respect.
b) where called for in the specification; carry out all inspections and tests to meet the requirements of the specification, in the presence of the Employer or the Engineer, or alternatively, arrange to have the testing witnessed by an internationally accredited third party inspectorate
c) prepare a quality control plan, for manufacture, and comply with this quality plan for all components indicating all the intended stages of testing during manufacture, and the records to be kept, as well as for cleaning, preparation and application as well all interventions (witness points, hold points, etc.) for independent quality surveillance (i.e. that which will be carried out by the Employer, the Engineer or a third part inspector), where applicable.

The quality control plans will not be compromised once submitted and approved by the Employer or Engineer (where approval is required) and shall be adhered to at all times, and records kept in accordance with the Quality Assurance Plan.

Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

2.3 Contractor's Quality Assurance and control Plan

Within six (6) weeks of the award of the Contract, the Contractor shall furnish the Engineer with a comprehensive Quality Assurance and Control plan that incorporates all the requirements of the documents comprising the contract, for his own quality management as well as describing the Quality Control process that will provide for regular inspection and signing off of work by the Employer or the Engineer.

The Contractor shall implement this comprehensive Quality Control programme and accept full responsibility for the quality of his workmanship and material used, irrespective of any quality surveillance that may be carried out by the Employer, or the Engineer.

The Quality Plan will provide all forms and documentation to be signed by inspectors as necessary to generate a complete record of Quality Management.

All equipment delivered to site will not be accepted without completed Quality Control Records for manufacture and factory testing.

2.4 Specific Requirements of the Quality Control Plan

The Contractor's Quality Management System shall be in accordance with ISO 9000, or an equivalent internationally recognised Certification Body. The Quality Management System shall comply in all respects with the requirements of the ISO 9000-9004 series (as applicable). The Quality System shall take the form of a coordinated and formally documented statement and shall include quality management objectives, policies, organisation, procedures, and work instructions that demonstrate the Contractor's implementation of the requirements of ISO 9001 Code for Quality Management Systems.

The Contractor's Project Quality Plan for the Contract shall indicate how the Contractor's Quality System shall apply to the specific requirements of the Contract. It shall clearly indicate, by way of written description, schedules, flow diagrams and procedures, compliance with ISO 9001 and compliance by Sub-Contractors to ensure compliance with ISO 9001, 9002 or 9003, as appropriate to the classification of the product or service.

The Project Quality Plan shall identify all documentation concerning implementation of the procedures and will form part of the demonstration of conformance to requirements for the plant materials and equipment to be supplied under this Contract.

The Quality Control Plan shall be prepared and submitted with method statements relevant to the milestones for testing, tests on completion, trial operation, and tests after completion.

In addition, the Contractor shall submit, for review, along with the Quality Control Plan, a list of all testing relevant to this project (standard factory and site testing, specific to this project, and recommended additional tests, as well as performance proofing/testing procedures), for appending to the Project Quality Control Plan. The detailed test plan and the requirements thereof are covered under the Section on Commissioning in this Specification.

Quality Control plans shall include items such as the following:

- Inspection of material
- Hydrostatic testing of uncoated castings, pipes and fittings
- Manufacture of components
- Fettling or dressing
- Degreasing
- Water soluble salts test
- Blast cleaning and application of the first coat.
- Application of corrosion protection
- The commencement of site repairs.

2.5 Intervention points for the Employer and Engineer

In addition to any witness/intervention points detailed in other specifications the Engineer and the Employer will specifically require that the tests listed in Section 4 will be witnessed (Factory Acceptance Tests and Site Acceptance tests), hence these will be included as hold points on the Quality Plan unless otherwise indicated by the Engineer or the Specifications.

Costs for witness testing and inspections shall be included in the Contract price.

The Engineer's inspection shall in no way relieve the Contractor or Sub-contractors of any of their obligations to design, manufacture and supply equipment of superior quality and workmanship in accordance with the specification.

The Engineer may employ an independent, technically qualified organisation to carry out quality surveillance of the work on his behalf. The inspection authority has the right to inspect any item covered in the Contract at any stage of execution of the Contract.

Where imported supplies are to be inspected before shipment, the Contractor shall notify his suppliers of the conditions applicable to inspections.

2.6 Approvals and Notification Periods applicable to Inspections

The Project Quality Plan shall be subject to the Engineer's approval, and the allowed duration for approvals shall be in accordance with the Conditions of Contract (Clause 5.2) shall be observed by the Contractor, and duly allowed for in his project programme.

The Contractor shall provide at least 14 days' notice to the Engineer or Employer, for inspections, or witness points, hold points, and the like located within 50km of the site as required by the Quality Control Plan. The notice period required for inspections located more than 50km from the site shall be agreed with the Engineer in advance.

2.7 Quality Control records

Accurate and detailed quality control records shall be kept by the Contractor for all stages of the work.

Quality control, material and testing records for all stages of the work, such as (but not limited to) cable square areas, insulation testing, cable pressure test records, hydrostatic tests, all equipment material certificates, standard manufacturers' test certificates, parts lists, paint batch numbers, soluble salt tests or equivalent testing for fasteners and electrical panels, standard data sheets, factory release notes, storage records (where applicable), and all test data pertaining to various stages of manufacture, shall be recorded as part of the approved Quality Control Plan for manufacture. Data related to corrosion protection shall be recorded the Corrosion Protection Quality Control Plan and ancillary documents such as Coating Application Records, and surface Profile and Dry Film Thickness readings.

All equipment records shall include manufacturing dates and information relevant to manufacture, and storage conditions and relevant maintenance records during storage, if any.

All the quality control records shall be available for inspection by the Employer and the Engineer, at all times during the contract period.

Incomplete, inaccurate or inadequate records shall be regarded as non-compliance with the Specification, and re-testing will be the remedy in such cases. Concessions will not be granted in such cases.

The collection of documents for each item of equipment shall be collated and bound in a logical manner and retained by the Contractor as proof of quality achieved. These shall be available on demand for quality control and part payment releases, if applicable. The records shall be handed over to the Engineer on completion of the work, as outlined in the last section (Completion Documentation) of this Specification.

2.7.1 The Quality Control records shall be bound in the Quality Control Data pack.

The Contractor shall specifically submit the following to the Engineer, including data sheets where applicable, for information or approval, as required by the Specifications or as instructed by the Engineer:

1.1.1 For manufacture:

- Drawings (Workshop and Design drawings)
- Process and Instrumentation Drawings, with all tag numbering sequential and correct
- Design calculations to be supplied to the Engineer
- A programme
- A quality control plan
- A draft Operation and Maintenance manual

1.1.2 For corrosion protection:

- The Quality Control Plan for corrosion protection duly completed
- Blast material
- Coating products
- Pickling and passivating products

1.1.3 Substandard Quality Control

All material, certification and records of the Contractor shall be subject to examination by the Engineer.

This shall include the checking and testing of the equipment. If any deviation is found, additional testing and quality surveillance shall be carried out.

If the additional testing confirms inaccurate quality control by the Contractor, all work shall be stopped and shall only proceed after appropriate remedial action has been implemented.

2.8 Non-Compliance with the Specification

Equipment, materials and services that do not conform to the requirements of this Specification shall be rejected. Such rejected equipment shall be held at the cost and risk of the Contractor who shall, when called upon, and at his own cost, repair the defects or corrosion protection according to the Contract.

Failing satisfactory repair of rejected equipment, the equipment shall be returned to the Contractor at his cost and risk without any opportunity to substitute the rejected equipment. Alternative equipment may be purchased at the Contractor's expense or an approved Contractor may be employed to do the repair to the corrosion protection.

Should the Contractor fail to comply with the provisions of the Corrosion Specification, the Taking over or Performance Certificate shall not be issued.

No equipment shall be accepted nor be delivered to site unless all Quality Control requirements have been complied with, and recorded.

2.9 Provision for testing

The Contractor shall at no additional cost provide all material, samples, labour and the necessary calibrated instruments which may be required for the purpose of inspection, testing and analyses, unless otherwise specified.

2.10 Material Tests

The Manufacturer's material test data certification and the Contractor's quality records shall be subject to examination by the Employer or the Engineer. Reasonable samples of the cleaning and coating materials to be used may be removed for testing.

Rejection of the samples shall place a hold on the use of materials of the same batch number and any components that have already been cleaned / coated with rejected material shall be reworked.

2.11 Destructive Testing

The Engineer or his representative may carry out reasonable destructive tests to ascertain compliance with the Specification. Areas thus damaged shall be repaired by the Contractor to the satisfaction of the Engineer at no additional cost.

3 TRANSPORT, PACKING AND INSTALLATION

3.1 Scope

This section of this specification covers the transport and packaging of equipment to be delivered to site and the installation of equipment on site, as well as the maintenance of equipment in it standby state prior to completion of the tests on completion/commissioning of the Works.

Clause 4 of the conditions of contract outlines the Contractor's general obligations, and in particular, sub-clause 4.16 is highlighted as in regard to transport of goods under this contract.

3.2 General

All goods shall be carefully packed to ensure safe transport. The rates/prices shall include all packing necessary to attain this. All material liable to damage in transit should be crated.

All plant and material shall be protected before despatch against all climatic conditions during transit and storage. All bright parts liable to rust shall receive a coat of anti-rust composition before despatch and shall be suitably protected.

Special precautions shall be taken to protect bearing journals where they rest on wooden or other supports likely to contain moisture. At such points, wrapping shall be used, impregnated with anti-rust composition and of sufficient strength to resist chafing though when subjected to the pressure and movement likely to occur in transit.

The Contractor shall take special steps to ensure that damage to bearings is avoided during transit. Any bearing found to be damaged due to "false brinelling" or other cause shall be replaced at the Contractor's expense.

Plant and equipment manufactured for building into the permanent works shall be handled with care at all times to avoid damage to them or to any protective coatings. The equipment for the purpose of loading, transporting, unloading and moving and the manner in which they are handled shall be subject to the approval of the Engineer. The Contractor shall, at his own cost, make repairs to all damaged protective coatings, and the like, in accordance with an approved Quality Control procedure.

During transport, the plant and equipment shall be properly supported. All items shall be separated so that they do not bear against each other and shall be firmly secured by suitably padded lashings to prevent movement and damage in transit. The plant and equipment shall not be dropped, bumped or subject to shock or rough handling and any damage occurring during transit or handling may result in the Engineer rejecting the damaged article.

The use of bare cables, chains, hooks or narrow skids will not be permitted and the Contractor shall supply canvas sleeves and padded skids and ramps of a sufficient width to prevent damage and shall not subject the plant and equipment to excessive weight loads.

The dragging or skidding of plant and equipment in contact with the ground shall not be permitted and the Contractor shall supply all necessary properly designed skids, ramps, trailers, cradles, etc. for the purpose.

All costs related to transport of goods and equipment are to be included in the Contract rates.

The Contractor shall furnish the Employer with all relevant Quality Control Records upon delivery of equipment to site, and no equipment shall be accepted as delivered on site without such records.

In addition, storage or standby maintenance instructions shall be provided to the Employer upon delivery of equipment to site.

3.3 Storage on Site

The Contractor shall make all necessary arrangements for the safe storage of all plant, materials and equipment stored on site prior to use or installation.

All storage shall be in demarcated secure laydown areas which shall be agreed in advance with the Engineer.

Weatherproof storage shall be provided by the Contractor for all plant, materials and equipment which could be damaged by adverse weather conditions or sunlight.

3.4 Erection/Installation of Plant

The Contractor shall supply all temporary plant, tools, and all things necessary for safe and suitable installation on site.

The plant for erection purposes shall be of modern design adaptable for the purpose for which it is required, in sound condition and ample in capacity for carrying out the works expeditiously. Should the Engineer be of the opinion that the plant in use is in any way unsuitable for carrying out the works in a manner or at a rate commensurate with his requirements, he shall have the right to call on the Contractor at any time during the progress of the Works to provide such additional or improved plant and tools as may be necessary to meet these requirements.

3.5 Labour and Supervision

The erection of the plant is to be carried out under the supervision of a skilled and experienced erector and the plant, when erected, is to be of neat and workmanlike appearance, solidly and evenly supported, true to line and level, plumb and in proper working order and complying strictly with the Specification. All plant and pipework shall be maintained in correct alignment during the work of grouting up.

3.6 Placing and Fixing of Equipment

All equipment supplied and delivered under the Contract shall be placed and fixed in position by the Contractor who will be responsible for supplying all anchor bolts, bolts, nuts and washers, supports and brackets etc. for fixing purposes.

The costs for fixing and provision of fixings, supports and brackets must be included in the Contract prices.

3.7 Acceptance of work carried out by others prior to installation on site

Within a period of 60 days or an agreed reasonable time thereafter, prior to the Contractor's commencement of installation on site, the Contractor will carry out a detailed inspection of the works carried out by others (Civil Works, Buildings, Electrical works, etc) which are required to be in place prior to commencement of his installation activities on site.

The Contractor shall, within a maximum period of 2 days after such inspection, submit a report detailing his acceptance of the works by others, or his conditional acceptance (and the required modifications, or required corrections). Failure of the Contractor to undertake the inspection in a reasonable timeframe prior to installation, or failure to necessary corrections to work carried out by Others, shall constitute acceptance of the works carried out by Others, and any required corrective work or remediation and consequences for delay shall be for the Contractor's own account.

3.8 Costs for Installation

All costs related to installation of equipment are to be included in the Contract rates for Supply of the equipment.

3.9 Completion of Installation

When the installation of the equipment has been carried out to an appropriate stage, the Contractor shall, before operating any section of the Works, clean the equipment and check that all nuts are tightened correctly and that all equipment is complete and ready for operation and the plant has been installed correctly and that all operating and maintenance documentation is supplied as specified in Section 18.

The equipment shall be operated by the Contractor, and he shall ensure that all oil fillings, lubrication, etc., must have been correctly completed at his cost. In addition, he must be responsible for the first refilling of all lubricating oils, greases, etc., as well as adjusting the plant to operate to Specification.

The Contractor shall carry out his own tests on the equipment and only when these tests meet the Specification shall he notify the Engineer, giving him a minimum of 14 days notice, that he is ready to commence initial commissioning and other tests on completion.

4 TESTING, COMMISSIONING AND PERFORMANCE OF THE WORKS

4.1 Scope

This section of this Specification provides the general requirements for the testing of and the Performance of the Works, once the installation has been completed. This includes all initial testing (factory or manufacture stage testing) as well as requisite site acceptance testing.

This specification serves to expand upon the Contractor's general obligations under the Contract.

This stage of the Contract will include the successful completion of testing of plant or sections of the Works, in accordance with the individual product specifications.

The Contractor is to plan and streamline his commissioning activities to minimise establishment and de-establishment, including that for his sub-contractors.

It is to be noted that three distinct phases of the Works testing will be covered under this section, namely:

a) Testing (Factory, Site, and Other Specific System or Equipment tests),
b) Tests on Completion (Pre-commissioning, Commissioning, and Preliminary Proof of Performance Testing
c) Tests after completion.

The three stages will take place in sequence, with Tests after Completion taking place some months after successful passing of the Tests on Completion.

All testing must comply with both this specification and the testing described under the relevant specifications.

4.2 General

The Performance of the Works shall be demonstrated through Testing of plant, Testing of Sections of the Works (Factory and Site acceptance testing), Tests on Completion for the whole of the Works, and, after the Plant has operated for a significant period; Tests after Completion for the whole of the Works and Sections thereof in order to demonstrate long term stable Performance of the Works in

accordance with the Employer's requirements. The required outcome is that the Permanent Works must consistently and reliably meet the standards as specified by the Employer's requirements in the Contract

Testing as defined under clause 7.4 of the Conditions of Contract refers to tests by the Contractor prior to Tests on Completion, (i.e. prior to pre-commissioning, commissioning and preliminary proof of performance testing). Testing includes both Factory acceptance Testing (FATs) and Site Acceptance Testing (SATs), and will refer to individual equipment/plant testing as well as testing of sub-systems, as is required to demonstrate suitability of equipment and combinations of equipment for use in the plant to meet requirements. This testing will be carried out in accordance with individual product specifications.

On successful completion of Testing of plant and or Sections of the Works (as per Sub-clause 7.4 of the FIDIC Conditions of Contract); Tests on Completion shall take place in accordance with Clause 9 of the FIDIC Conditions of Contract. This phase shall be deemed to be completed once the preliminary proof of performance testing has been completed. The Employer will then provide a provisional date for Tests after Completion.

It is a condition of this Contract that Tests after Completion will be carried out, in accordance with Clause 12 of the FIDIC Conditions of Contract. Tests after Completion will take place after a suitable period of stable and reliable operation of the Works. This phase shall be deemed to be completed once the trial operation/performance test has been successfully completed. The trial operation will demonstrate that the Works can reliably meet the requirements of the specifications (endurance and reliability testing). Once the Tests after Completion are successfully passed the Taking Over Certificate will be issued.

The Performance Certificate will be issued in accordance with the Contract, on expiry of the Defects Notification Period, provided the Tests after Completion are passed, and defects, if any, are rectified to the satisfaction of the Employer.

The following sections cover the different stages of testing as follows:

a) Section 5 TESTING
b) Section 6 REQUIREMENTS FOR TESTS ON COMPLETIONREQUIREMENTS FOR TESTS ON COMPLETION
c) Section 1313REQUIREMENTS FOR TESTS AFTER COMPLETIONREQUIREMENTS FOR TESTS AFTER COMPLETION

5 TESTING

5.1 Overview

The Contractor shall submit a detailed works testing plan as required above and shall carry out testing in accordance with the prepared plan that has been agreed upon with the Engineer. The Works Testing Plan shall consist of a check lists, inspections, performance and other tests that the Contractor proposes to carry out to ensure that both the equipment is manufactured, and the Works constructed are complete and operational in all respects.

Tests shall include, but not be limited to the following:

a) OEM Factory work tests of all major items of equipment including all electrical components (as well, but not limited to cabling, IO, insulation and glanding).
b) Those recommended by the manufacturer of any items of equipment.
c) Inspections to ascertain that all equipment, as installed, is in good order and condition.
d) Pressure tests on pipework and equipment.
e) Any water tightness tests as required by the Contract. This is included for individual plant and

entire sub-systems within the Works as a whole.

f) Noise tests.
g) Electrical tests to prove the integrity of the safety systems.
h) Running tests to prove that all equipment is capable of continuously, safely and reliably performing the operations and functions required under the contract.
i) Checking appropriate certification and approvals have been obtained to operate equipment.
j) Checking appropriate signage and occupational health and safety equipment is in place to enable safe operation of the equipment.

The results of all installation checks shall be recorded on suitable log sheets, which are to be submitted and approved by the Engineer along with the entire Works before use, in accordance with the duration for contract approvals.

At the end of the testing phase, the Contractor will forward a report to the Employer confirming that all the items on the program have been satisfactorily tested. The checklist shall be supplied to the Engineer prior to commencement of the Tests on Completion (the pre-commissioning phase).

The Employer or his representative reserves the right to be present at any or all of the tests for the purpose of observation, result verification, obtaining technical verification or operator training. The Contractor shall keep the Engineer and Employer fully informed as to the time and location of all tests and notify the Employer 10 days before any tests are carried out. The provision of all required testing apparatus and equipment shall be the responsibility of the Contractor.

The Contractor shall rectify any defects and carry out repeat tests where necessary. The Contractor shall meet all costs of the test and any subsequent remedial works.

5.2 Tests

The manufacturer shall perform all routine tests in the factory as required by SANS, IEC and/or BSS, as well as the manufacturer's own standard routine tests on all materials, equipment and/or auxiliary equipment.

The Contractor shall submit a list of tests and inspections to be performed on the equipment for approval.

The Contractor shall perform any additional standard tests that may be required by the Engineer.

The Engineer will indicate which tests shall be witnessed by the Engineer or his representative, once the equipment design/selection has been finalized.

The Contractor shall submit copies of the test certificates, with the test results of all the tests performed prior to delivery of equipment, to the Engineer not later than the delivery date of the equipment.

The Contractor shall provide his own test equipment which shall be of acceptable standards.

The Contractor shall submit a list of site tests and inspections to be performed on the equipment for approval.

The Contractor shall perform any additional standard tests that may be required by the Engineer.

At the end of this phase (Testing), the Contractor is to have prepared his first draft of Completion Documentation for submission and use in the Pre-commissioning Phase.

Copies of the site test certificates/records shall be submitted to the Engineer within 7 days after completion of each test carried out on Site.

5.3 Attendance for Tests And Inspection Of Plant

All the tests shall be witnessed by representatives of the Client and the Engineer, unless otherwise agreed.

The Contractor shall give the Engineer adequate notice of the dates on which the various items of plant and equipment will be ready for inspection and testing in the workshop.

The Contractor shall give the Engineer adequate notice of the dates on which the various items of plant and equipment will be ready for inspection, testing and commissioning on site. No plant shall be commissioned without the Engineer or his representative being present.

The Contractor will be responsible for all costs incurred by other parties in attending tests on plant and equipment which has not been adequately tested by the Contractor before it is presented to the Engineer for testing and commissioning.

5.4 Test Certificates

a) Workshop/Factory Tests
One soft copy and one hard copy of all workshop/factory test certificates shall be supplied to the Engineer.
b) Site Tests
Prior to and during commissioning, the Contractor shall maintain a record of each test which shall be countersigned by the Engineer or his representative immediately after it has been successfully performed.

5.5 Preparation for Testing

The Contractor shall undertake any necessary work by way of temporary connections, connection of instruments, cleaning of vessels, tanks, pipelines and equipment, safety measures and other preparations for carrying out testing in a workmanlike and expeditious manner before commencement of testing, and make good or clear away after completion of testing.

5.6 Specific Tests Required:

In addition to the testing that must be carried out as detailed in the Project specifications for equipment; the following additional requirements are to be met during the Testing Phase, prior to the test on completion of the Works as a whole.

5.6.1 Butterfly, Gate, Non–Return and Gate Valves Performance

After satisfactory completion of the above tests, valves shall be subjected to performance testing as follows after installation. These tests also to be repeated once the Works are operational.

a) Manual Valves – Open and close valves to be checked for ease of operation and position indicator.
b) Pneumatic Actuated Valves – During the test only clean and dry compressed air shall be used. Check the operation of the limit switches where they are fitted.
c) Electric Actuated Valves – Check all functions of electric actuators, including limit switches operation, protection devices, position indicators, controls, etc.

5.6.2 Insulation Resistance Level Tests

Insulation resistance tests shall be carried out on all motors, MV cable, switchboards, MV distribution panels and auxiliary equipment as follows:

a) Resistance shall be greater than 10 M ohm, measured with a 1000 V insulation tester.
b) Unacceptable resistance values shall necessitate:

c) cables to be rejected and replaced;
d) machines to be dried out and subsequently re-tested;
e) busbar and wiring systems to have faults localised and corrected.
f) Control cables - carry out insulation resistance test on 0.6/1 kV grade cables. Control cables shall be insulation resistance tested between earth and each core and between conductor.
g) Check that the cable size on the equipment as installed complies with the requirements of AS 3008, AS/NZS 3000 and the Service and Installation Rules of the Local Electricity Distributor.

5.6.3 Cabling and Circuit Tests

The following tests shall be carried out by the Contractor and witnessed by the Engineer:

a) Check all relays, contactors, selector switches, push buttons for operation, installation, adjustment, rating and labelling.
b) All circuit breakers, fuses, type and rating shall be checked against the drawings.
c) Cable installations shall be inspected and sizes shall be checked against the drawings.
d) Cabling shall be checked and tested against the interconnection wiring diagrams.

If the circuit is interlocked with other drives or equipment the logic of these interlocks shall be checked.

Particular care shall be taken in circuits which may contain semi-conductors to ensure that they are not damaged during testing.

Check that all safety and field devices and auxiliary equipment are installed, connected and set for correct operation. Check tightness of cable terminations, and freedom of operation of pushbuttons, limit switches, and the like. Check correct labelling of all cables, cable cores and termination strips.

With control circuits only energised, verify that each field device and associated relays operate correctly, and that they prevent contactor closing or cause tripping etc. Repeat for each motor in the installation commencing with auxiliaries and finishing with the main drive.

Complete schedule for each distribution panel and insert within panel in storage provided.

The drawings used in these tests shall be the latest issue.

5.6.4 Switchboards

All switchboards (MV and LV) shall be tested at the Manufacturer’s Works. The Contractor shall not deliver switchboards or accessories to site until all tests have been satisfactorily completed and all defects detected during such tests have been rectified. Submit test certificates to the Employer prior to dispatch from works.

The test would include, but not limited, the following:

a) Circuit continuity, termination checks and component installation checks.
b) Fuse and circuit breaker ratings check.
c) Functional check of all components, including logic testing of hard-wired elements, programmable circuitry and colour graphics.
d) Provide input simulation and output status indication.

For the purposes of functional testing, temporarily wire all inputs to labelled switches and/or analogue signal generators as appropriate would be required. Temporarily wire all outputs to labelled indicating lights.

5.6.5 Control and Instrumentation System

Elements of the control and instrumentation system shall be tested by the Contractor at the Manufacturer’s Works in a similar manner to the switchboards. Simulate the operation of the control

system at the works by the Contractor and carry out all improvements and optimisation of the system operation

5.6.6 Equipment Testing

Test all equipment to ensure that the equipment supplied is operational and conforms to the Specification.

5.6.7 Electrical Testing During Construction

At completion of installation work and prior to energising all medium and low voltage circuits, continuity and insulation testing, using a 1000V Megger, shall be made as follows by the Contractor:

a) Power circuits shall be checked, phase to phase, phase to neutral and phase to earth (as appropriate). Control circuits shall be checked core to core and core to earth. Circuits must show a minimum insulation resistance of 10 Megohms. Reading obtained shall be recorded and included in the Operation and Maintenance Manual.
b) Switchboards, control panels etc. shall be retested to ensure the control functions are as per the Specification.

Where instrument loops are such that the measured variable cannot be altered, the appropriate variations shall be simulated using pressure and/or current injection. The value of the earth resistance of the local earth station(s) shall be measured and recorded in the Operation & Maintenance Manual.

5.6.8 Factory Tests and Inspections

The Engineer or his appointed representative reserves the right to inspect the equipment or associated parts at any stage of manufacture.

In addition to Workshop/factory tests as ordered in the Project specifications for plant and equipment, tests listed below will also be required, but shall not be limited to:

a) Welds

After manufacture, pipework, mixers, sedimentation tank bridges, etc. shall be subject, before painting and protection, to the application of an approved permanent dye on the inside of the welded surfaces and no trace of this dye shall appear on the outside. In addition to the dye tests, the Engineer may call for certain welds to be radio graphically examined, when the standard of acceptance shall be in accordance with the latest edition of API Standard 5L. Defects shall be repaired and retested at the Contractor's expense and in accordance with the same standard.

b) Gear Boxes

Certified copies of the manufacturer's performance tests for all gearboxes shall be provided.

c) Electric Motors

Certified copies of SABS performance tests or manufacturer’s performance tests for all motors shall be provided. Refer also to Electrical Specification

5.6.9 Site Acceptance Tests

After completion of erection and at least 14 days after all concreting and grouting up of plant and equipment has been completed, the Contractor shall carry out site tests which shall include, but not be limited to, the following:

a) Pipework Tests

There will be no specific witnessed pressure testing of installed above-ground pipework. All pipework

will be examined during commissioning by the Contractor and the Engineer's Representative. Any leaks or defects shall be rectified at the Contractor's expense to the satisfaction of the Engineer.

b) Electrical/Control Tests

Such tests as are necessary to verify that the equipment concerned can be made live and run with safety to both persons and plant.

The tests are set out in detail in the Electrical specifications.

c) Plant and Motor Performance Tests

Tests are to be conducted on each plant-motor by the Contractor who shall measure and record the motor and plant speeds, the voltage, amps drawn in each phase of the motor, the capacitor-corrected amps in each phase and the flow rates. These tests will be carried out prior to the commissioning of the Works. During each test the following items shall be checked:

i. Mechanical operation of plant and current drawn by motor against factory test curves submitted.
ii. Maximum Conditions: Check against maximum rate of supply
iii. Duty conditions and Performance Test: Check conditions and flow and motor current against Contract data in accordance with the Specification. The plant sets shall be run for a period of four hours at the duty point.
iv. Maximum Delivery: Check that power absorbed by plant set does not exceed full-load continuous rating of motor.
v. Flow switches and control gear to be checked for proper operation.
vi. Start-up against limiting conditions to be repeated three times, after motor has warmed up, to establish satisfactory starting currents and running times.
vii. Vibration check on plant and motor bearings. The limits of vibration of motor and plant bearings shall not exceed those set out in BS 4999.

d) Control equipment

Tests to confirm operation as specified.

5.6.10 Other Tests

The Contractor shall perform tests to confirm the capacities/ performance of all plant and equipment in terms of the specifications. Tests relating to specific pieces of equipment are detailed in the individual particular technical specifications and shall also include any pre-commissioning testing specified or recommended by the manufacturer of the equipment.

All testing and commissioning (including process performance testing) methods shall be submitted for approval in accordance with the Contract, to the Engineer.

6 REQUIREMENTS FOR TESTS ON COMPLETION

Tests on Completion shall comprise of three distinct phases, namely; pre-commissioning, commissioning, and Preliminary Proof of Performance Testing of the Works.

a) Pre-commissioning tests, which shall include the appropriate inspections and ("dry" or "cold") functional tests to demonstrate that each item of Plant can safely undertake the next stage;
b) Commissioning tests, which shall include the specified operational tests to demonstrate that the Works or Section can be operated safely and as specified, under all available operating conditions (Commissioning shall be separated into two discrete stages. The first stage will be commissioning of equipment or combinations of equipment. The second stage will be overall process commissioning of the whole Works); and

c) Preliminary Proof of Performance testing, which shall demonstrate that Sections of the Works, as well as the whole of the Works perform according to the design and producing final treated effluent complying with the effluent discharge specifications. The duration of the preliminary Proof of Performance testing shall be agreed upon between the Contractor and the Employer but shall be a minimum of 3 days. (Note that full Trial Operation of the works, for a minimum of 21 days, shall be required during the Tests after Completion, to demonstrate reliability).

The Contractor shall prepare a detailed testing plan which shall detail each of the individual elements of Tests on Completion of the Works listed (a) to (c) above, the Instruction and Training of Operators, and the handing over of the training materials and Operation and Maintenance Manuals.

The Contractor must ensure that suitable provision is made for equipment to be put temporarily out of service, run at low flow, or run in recirculation mode wherever the testing schedule demands it. The use of energy, potable water and chemicals shall be minimized as far as possible.

The costs of any de-establishment and of any re-establishment on Site shall be deemed to be included in the contracted rate.

The Contractor shall be required to ensure the efficient and proper operation of the Works until after the successful completion of the Performance Acceptance Test. Attendance to Site by the Contractor during any period where no commissioning or testing is taking place until the Performance Acceptance Test is successfully completed will be required at least once every two weeks, or as necessary. The Contractor's rate shall be all inclusive of overheads, transport, establishment and de-establishment costs, overtime, profit and any other costs.

6.1 Test Plan

At least four (4) weeks before the Tests on Completion commence, the Contractor shall furnish to the Engineer a detailed program for the testing, pre-commissioning, commissioning and preliminary proof of performance testing of all equipment and the Works covered in this Contract. Tests on completion cannot commence until the detailed program, and testing Methodology is approved by the Engineer. The Contractor shall allow for period of review set out in the conditions of contract. The Testing program shall identify dates and duration of all tests, as well as allow for approval processes, and notice period for witnessing tests of 10 days. The Contractor must, in his program, allow for integration with other Contractors, where applicable, as well as municipal service providers, where applicable.

The Testing Plan can only be reviewed and approved in conjunction with the Contractor's Method statements/methodology for the tests on completion.

7 EQUIPMENT & COMPONETNS FOR TESTING ACTIVITIES

For each of the above phases of the Tests on Completion, the Contractor shall, in accordance with Clauses 7.4 and 9 of the conditions of contract, provide all equipment, materials, labour, services, advice, instructions and other facilities necessary to test, demonstrate and commission, and to ensure that the facility is compliant and operates in accordance with the Specification. All testing equipment used shall be calibrated, and calibration certificates will be furnished prior to the witnessing of testing or the commencement of any of the above.

The Contractor shall, at all stages up to the Employer's Taking Over, supply and install those components which, during normal operational of the Works, require regular replacement. Unused commissioning spares shall remain the property of the Contractor.

8 CHEMICALS AND CONSUMABLES FOR TESTING ACTIVITIES

The Contractor shall, at all stages up to the Employer's Taking Over, supply all chemicals and consumables used for the testing and operation of the works.

9 PRE-COMMISSIONING

Pre-commissioning cannot commence until testing has been completed. Pre-commissioning is the preparation of plant and equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical equipment, mechanical equipment and instrumentation. A pre-commissioning report shall be prepared. The Contractor shall be responsible for pre-commissioning and providing the necessary resources to undertake this phase of the Contract.

During the pre-commissioning phase the contractor is required to demonstrate to the Engineer and the Engineer that the plant is ready for commissioning. The contractor shall provide 5 days' notice to the Engineer and Engineer that pre-commissioning will commence.

Work during the pre-commissioning shall include but not be restricted to the following (apply items only relevant to this plant):

a) Checking completeness of installation.
b) Checking conformance of equipment to specification.
c) Checking that all equipment and pipework labelling is complete and correct.
d) Ensuring all equipment is correctly lubricated and lubrication reservoirs are charged with adequate quantities of suitable lubricants.
e) Checking clearance, end play and operation of major bearings.
f) Checking alignment of drive systems and tightness of couplings, mounting of bolts, vibration etc
g) Checking electrical circuit continuity in accordance with drawings.
h) Checking electrical insulation integrity in accordance with the design requirements.
i) Checking electrical earthing integrity in accordance with design and statutory requirements.
j) Checking calibration and ratings of safety devices such as circuit breakers and overloads.
k) Checking calibration of measuring and indication equipment such as instruments, signal converters, meters etc.
l) Checking operational integrity of controlled equipment.
m) Checking operational integrity of safety devices such as isolators and interlocks.
n) Checking the direction of rotation of rotating electrical equipment.
o) Carry out simulated fault testing and checking alarm reporting and logging.
p) Carry out simulated failure of equipment and check start-up of all stand-by equipment.
q) Running in new equipment.
r) Checking for unusual heat and noise generation.
s) Checking safety guards, safety showers and other personnel safety equipment for correct installation.
t) Check stairways, walkways and platforms to approved standards.
u) Pipework arrangements to approved standards.
v) Check correctness of operation and correctness for setting of parameters for each instrumentation loop.
w) Check correct operation of all field connected items.
x) Supply lubricants for commissioning period.
y) Provide special tools and supply detailed schedule.

10 COMMISSIONING OF EQUIPMENT

Commissioning is the running of plant and equipment, carrying out all necessary adjustments and tuning until it is ready for normal starting and running under service conditions.

Commissioning shall only take place after all pre-commissioning has been successfully completed.

During the equipment commissioning period, the Contractor shall ensure that the plant is fully operational and reliable and that the following works have been completed:

a) Activation of alarms by inducing actual fault conditions (electrical simulation is not acceptable).
b) Functional check on interlocks and control system for the whole plant.
c) Calibration of all instruments and result sheets completed.
d) Testing and commissioning of equipment electrics, instrumentation, control systems alarms and set-points etc.
e) Check completeness of entire installation, paying particular attention to integration of all sub-systems.
f) Check integration of control systems, particularly with off-site equipment.
g) Undertake simulated fault condition tests.

The Contractor shall have responsibility for the following:

a) Develop, monitor and control equipment commissioning procedures.
b) Resolve performance problems.
c) Arrange for outstanding work to be completed to enable the plant to commence process commissioning.

Non-conformances or defects shall be classified as:

a) Severe: Equipment commissioning to discontinue, urgent action required.
b) Moderate: Equipment commissioning to continue but action required before process commissioning can continue.
c) Minor: Equipment commissioning and process commissioning can continue with action programmed for resolution.

The Employer’s personnel (or representatives), who will eventually be responsible for the operation of the plant, shall be permitted to participate in the equipment commissioning process.

Not all equipment or controls may be able to be commissioned until the effluent is introduced into the plant. Where this is the case, the Contractor shall clearly state this is so and ensure that commissioning of equipment after effluent is introduced is not likely to adversely affect the process commissioning.

The importance of pre-commissioning and equipment commissioning to the overall success of the process commissioning cannot be overstated.

11 Process Commissioning and Performance testing of the Works

Process Commissioning refers to the activities following the completion of the equipment commissioning during which the plant is put into operation.

The Contractor shall be responsible for process commissioning. The contractor shall prepare the process commissioning checklist and procedures to bring the plant online. This shall be an integral component of the Quality Plan.

Procedures shall include the following as a minimum:

a) Monitoring of all process variables in all systems and sub-systems.
b) Checking integration of control systems and sub-systems, particularly with offsite equipment.
c) Wet run performance tests.
d) Simulation of fault condition tests.
e) Monitoring PLC logic operation.
f) Monitoring the operation of each and every piece of equipment in operation and how they integrate into the whole process.
g) Fine tuning of controller settings.
h) Fine tuning of process set-points.

The Contractor shall have responsibility for the following:

a) Develop, monitor and control process commissioning procedures.
b) Resolve performance problems
c) Arrange for outstanding work to be completed to enable the plant to commence performance trials.

Non-conformances or defects shall be classified as:

a) Severe: Process commissioning to discontinue, urgent action required.
b) Moderate: Process commissioning to continue but action required before process commissioning can be completed.
c) Minor: Process commissioning can continue with action programmed for resolution.

The Employer's personnel, (or representatives), who will eventually be responsible for the operation of the plant, shall be permitted to participate in the process commissioning process.

All readings and results of monitoring and testing shall be logged in a form agreed to by the Employer and Engineer and as included in the Quality Procedures.

The completion of process commissioning shall occur when the treatment process produces stable effluent quality that is within design requirements.

The Contractor shall provide results from a minimum of three day testing proving effluent quality meets the targets defined in the Process and Project specifications and all control loops and functionalities are operating.

Contractor to supply commissioning spares as necessary and make them available on site to ensure a smooth uninterrupted commissioning of the plant. Unused commissioning spares shall remain the property of the Contractor.

The Contractor shall provide the Employer with a Commissioning File, including all log sheets, test records and all other relevant documentation. This information shall be included in the Quality Control Data Pack.

12 Preliminary Proof of Performance Testing

Preliminary Proof of Performance testing will be carried out by the Contractor to prove that the whole of the Works is capable of achieving the specified performance parameters. Preliminary proof of performance testing can only occur after the Employer has determined that process commissioning has been successfully completed, including the seeding and establishment of the biological treatment processes.

Preliminary proof of performance testing will consist of a 3 day continuous test with an operating time of at least 20 hours/day.

During the preliminary proof of performance testing the Contractor shall be responsible for manning, sampling and operating the Works for the entire period of the test program. The Engineer of the Works (or the Employer's representatives) shall witness all proof of performance tests. All costs associated with sampling and testing (laboratory analyses) will be included in the Contract rates/prices for commissioning and preliminary proof of performance testing.

The Contractor shall supply any additional equipment required for preliminary Proof of Performance Testing.

If during any of the preliminary proof of performance tests any of the following occur, then the Engineer shall determine any extension required to the testing period, after the necessary rectification work has been completed:

a) The Plant does not meet the specified performance criteria
b) Any mechanical and electrical equipment does not operate as specified.
c) Any automatic function fails to operate as required.
d) Any alarms fail to activate under the appropriate conditions and simulated conditions.
e) Any of the control systems fail to adequately operate in the mode they were designed for, for example, flow-proportional control of chemical dosing.

The Employer reserves the right to alter or stop plant flow at any time during the preliminary proof of performance testing.

The Contractor shall maintain detailed records throughout the preliminary proof of performance testing and shall record any modifications made to the system. Log sheets will be developed and completed with entries at a frequency agreed with the Engineer, detailing the parameters set out in the testing schedule. The log sheets shall form part of the final Commissioning File submitted to the Employer.

The Contractor shall utilise the Plant on-site testing equipment for on-site testing during the preliminary proof of performance period. Any testing costs are to be met by the Contractor up to the taking over of the works, with the exception of chemicals, as stated previously.

The Contractor shall satisfy himself as to the accuracy level and condition of the on-site testing equipment with regards to the ability to compare with results from an external NATA accredited laboratory. Where discrepancies occur between the results from the external laboratory and the on-site generated results, the external laboratory results shall be used to determine compliance with the proof of performance targets. The Contractor shall supply additional testing equipment to meet these requirements.

The Contractor shall meet the costs of sample analyses by external laboratories, including any re-testing. Should the test fail to be completed satisfactorily then the Contractor shall repeat the test in full until the test is satisfactorily completed.

Where a test cannot be carried out, e.g. an equipment function relying on ancillaries that have not yet been installed by others, the test shall be carried out as part of Tests after Completion instead.

The Contractor will be responsible for the cost of all preliminary proof of performance testing and analyses, and shall make allowance for these in his Contract rates.

Pre-requisites for the preliminary proof of performance testing:

a) Completion and pressure testing of all pressure pipelines
b) Delivery of operations and maintenance manuals
c) Written confirmation by an independent specialist consultant regarding compliance with OH&S requirements and risk assessment
d) Satisfactory completion of equipment and process commissioning including a completed

report on commissioning

e) Work-As-Executed drawings
f) Submission to and approval from the Engineer of detailed test protocol
g) A list of any non-conformances, with each individual corrective action plan approved by the Engineer.
h) Ten (10) days' notice to the Employer and Engineer

Should the preliminary proof of performance testing fail to be completed satisfactorily, the Contractor shall carry out any plant modifications necessary to overcome the problems identified within three (3) weeks of the test.

The test procedure shall then be repeated, at a time to be nominated by the Engineer, until the test is satisfactorily completed.

In the final review of the works data from the relevant hour-run meters, chemical usage records and power usage etc. will be analysed by the Engineer to determine if the plant has met the performance guarantee.

Should the Contractor fail to carry out the rectification works within a reasonable time then the Engineer shall determine the additional annual cost involved in the difference between the rate in the Contract and actual performance on failed parameters. An amount equivalent to ten times the annual cost difference on failed parameters will be deducted from payments due to the Contractor

13 REQUIREMENTS FOR TESTS AFTER COMPLETION

13.1 General

Tests after completion will be carried out after a significant running period of the Works. The Tests after Completion shall include the Trial Operation period and demonstrate that there has been no undue decline in the performance the Works or any Sections thereof.

The minimum duration for all the Tests after Completion shall be 21 days, during which the Works are to remain fully operational. The Contractor shall test the overall Works and such parts of as specified by the Employer.

A detailed programme for the testing shall be submitted by the Contractor within 7 days of receiving the request/notice to carry out the Tests after Completion.

The programme/test plan shall include methods for testing and shall reference/comply with the relevant requirements and standards provided in the Particular Specifications.

The schedule for tests after completion will be agreed between the Contractor and the Engineer, dependent on the tests carried out successfully during Tests on Completion, with the aims of

a) Proving reliability of the plant, during the Trial Operation period
b) Proving no decline in the plant's performance over time (comparison of testing results from preliminary proof of performance testing with results from the Trial Operation period)
c) Carrying out tests with the plant at a fully operational status
d) Repeating any tests previously failed and/or arising as a result of defects

All costs of tests after completion shall be deemed to be included in the Contract price. Cost of repeat tests as a result of test failure during previous testing periods and/or defects shall be borne by the Contractor.

Clause 12.4 of the FIDIC Conditions of Contract shall apply in its totality if the Works Tests after Completion fail.

13.2 Performance Acceptance Test

The Performance Acceptance Test (PAT) shall be a trial operation to demonstrate that the whole of the Works performs, i.e. reliably meets the standards set out in the Contract. The duration of the PAT shall be a minimum of 21 days.

If a longer duration is required by the Contractor, a reasonable duration shall be agreed upon between the Contractor and the Employer. Trial Operation testing will consist of a 21 day continuous test with an operating time of 24 hours/day. The 21 day proof of performance test is designed to test the long term reliability of the equipment. The Contractor shall give ten (10) days' prior notice to the Employer and the Engineer.

During the Trial Operation testing the Contractor shall be responsible for manning, sampling and operating the Works for the entire period of the test program. The Engineer of the Works (or the Employer's representatives) shall witness all tests. All costs associated with sampling and testing (laboratory analyses) will be included in the Contract rates/prices for Performance testing.

The Contractor shall supply any additional equipment required for Trial Operation Testing.

If during any of the PAT any of the following occur, then the PAT period shall be restarted after the necessary rectification work has been completed:

a) The Plant does not meet the specified performance criteria
b) Any mechanical and electrical equipment does not operate as specified.
c) Any automatic function fails to operate as required.
d) Any alarms fail to activate under the appropriate conditions and simulated conditions.
e) Any of the control systems fail to adequately operate in the mode they were designed for, for example, flow-proportional control of chemical dosing.

The Employer reserves the right to alter or stop plant flow at any time during the Trial Operation period.

The Contractor shall maintain detailed records throughout the PAT and shall record any modifications made to the system. Log sheets will be developed and completed with entries at a frequency agreed with the Engineer, detailing the parameters set out in the PAT schedule.

The Contractor shall utilise the Plant on-site testing equipment for on-site testing during the PAT period. Any testing costs are to be met by the Contractor up to the taking over of the works.

The Contractor shall satisfy himself as to the accuracy level and condition of the on-site testing equipment with regards to the ability to compare with results from an external SANAS accredited laboratory. Where discrepancies occur between the results from the external laboratory and the on-site generated results, the external laboratory results shall be used to determine compliance with the proof of performance targets. The Contractor shall supply additional testing equipment to meet these requirements.

The Contractor shall meet the costs of sample analyses by external laboratories, including any re-testing. Should the test fail to be completed satisfactorily then the Contractor shall repeat the test in full until the test is satisfactorily completed.

The Contractor will be responsible for the cost of all Trial Operation testing and analyses, and shall make allowance for these in his Contract rates.

Scheduling of the PAT period shall take into account the turnaround time required for the analysis of samples by external laboratories. The PAT shall not be deemed to be successfully completed until all required analytical results are known.

Pre-requisites for the PAT shall include:

a) Delivery of operations and maintenance manuals
b) Written confirmation by an independent specialist consultant regarding compliance with OH&S requirements and risk assessment
c) Satisfactory completion of equipment and process commissioning including a completed report on commissioning
d) Submission to and approval from the Engineer of detailed test protocol
e) A list of any non-conformances, with each individual corrective action plan approved by the Engineer.
f) Ten (10) days' notice to the Employer and Engineer
g) Successful completion of commissioning and preliminary proof of performance testing

Should the PAT fail to be completed satisfactorily, the Contractor shall carry out any plant modifications necessary to overcome the problems identified within three (3) weeks of the test. The test procedure shall then be repeated, at a time to be nominated by the Engineer, until the test is satisfactorily completed.

In the final review of the works data from the relevant hour-run meters, chemical usage records and power usage etc. will be analysed by the Engineer to determine if the plant has met the specified performance.

Should the Contractor fail to carry out the rectification works within a reasonable time then the Engineer shall determine the additional annual cost involved in the difference between contracted and actual performance on failed parameters. An amount equivalent to ten times the annual cost difference on failed parameters will be deducted from payments due to the Contractor.

Taking over Certificate for the Contract will not be issued until the final review of the PAT is satisfactorily completed.

14 DEFECTS NOTIFICATION PERIOD

14.1 Quarterly Service Maintenance Visits

After the completion of the Performance Acceptance Test and during the Defects Notification period, quarterly service maintenance visits shall be required to ensure the smooth operation of the Works during this period.

14.2 Training provided by Contractor during Defects Notification period

During the service / maintenance visits carried out after the completion of the Performance Acceptance Test and during the Defects Notification period, the Contractor shall provide any additional training required.

15 INSTRUCTION OF OPERATORS FOR THE WORKS

15.1 Scope

The Employer's operational Staff will be trained in accordance with the requirements of this specification. Training material shall be divided into 2 phases, theoretical/classroom training and practical training on the Plant. The Operators will then be required to undertake an assessment facilitated by the Contractor. The greater emphasis of the training shall be on practical training on the Plant. The initial training period is expected to take place during the Tests on Completion phase – i.e. during the pre-commissioning (theoretical training), commissioning (practical training) and preliminary

proof of performance testing of the entire Works.

The Contractor shall also allow for a provisional additional training period, for a minimum period of 7 days, during the Tests after Completion phase of the Works testing. This training period shall be implemented if any additional items arise after the initial training period that necessitate additional or re-training of Operators on any section of the Works.

By arrangement with the Engineer and Employer, the Contractor will run a training course on-site to instruct the Employer's personnel on all equipment supplied and installed and on operation of the Facility. During this course, provide a fully informed Engineer, plus any Technicians required, for the instruction of these personnel.

The Contractor shall provide a brief report on training delivered verifying the workplace skills that have been provided to the personnel undergoing training.

The course shall cover, but not be limited to, the following:

a) Description of the process.
b) Training of operations staff in required workplace skills for daily operation of the plant.
c) Setting up, calibration, testing, maintenance and cleaning of all equipment provided under this Contract.
d) Manual and automatic plant operation, including plant startup and shut down procedures.
e) Overview of the SCADA system for plant monitoring and control.
f) Configuration of the plant for all potential dosing options.
g) Fault-finding procedures.
h) Explanation on the use of the Operation and Maintenance Manual, section by section.
i) Explanation on the work-as-executed drawings.
j) Explanation on the daily log sheet and record keeping.
k) Responding to alarms.

The Contractor shall supply technical input as needed to the client's asset care specialist during the preparation of maintenance schedules for the plant and shall review and approve the client's maintenance schedules developed.

15.2 Instruction Material

Visual aids and demonstration equipment or materials shall be provided by the Contractor as required or appropriate. Copies of all Visual aids shall be provided to the Operators along with any other printed documents (drawings, check lists, etc) that would ordinarily be provided. These will be bound together in the Completion Documentation (including O&M manuals and training manuals) for any future training.

15.3 Duration of Training

It is expected that the initial training course shall run for two weeks (14 days). Contractor shall advise if this period will be sufficient to provide satisfactory training and if not Contractor shall nominate the duration for this.

Provide to the Engineer a program of the training course four weeks prior to the commencement of the course. The time to be allocated to classroom-based training and to practical training must be stated in the program.

Any additional training required during the Tests after Completion phase of the Works testing shall be agreed on with the Engineer and the Employer, and a training program provided to the Engineer two weeks prior to the commencement of the training.

16 Training and Operation & Maintenance Manuals

16.1 General

The Contractor shall:

a) Submit Draft 1 of the proposed Training and Operation & Maintenance Manual(s) to the Engineer for review
b) Submit Draft 2 of the Training and Operation & Maintenance Manual(s) to the Engineer for review and approval after the Works is commissioned by a date directed by the Engineer.
c) Allow three weeks for the review of each version,
d) Incorporate any alterations or amendments directed by the Engineer or Employer within seven days of receipt of any direction,
e) Submit Final Training and Operation & Maintenance Manuals before the date of Final Completion
f) The approval and submission of the final Training and Operation & Maintenance Manuals is a requirement for issuing of the Taking Over Certificate.

The requirements for the different versions of the Training and Operation & Maintenance Manual(s) are as follows:

a) Draft 1 to be a complete document, only excluding the final values for setpoints and any information not known until after the completion of wet commissioning.
b) Draft 2 to be a complete document including correct values of setpoints necessary to run all wet-commissioned areas of the plant.
c) Final version to be the complete, final document, covering the entire Works with values for all setpoints included and appropriate to running the plant under the final flows and loads.

17 TRAINING MANUALS

17.1 Contents of the Training Manuals/materials

The training manuals and materials shall be included in the completion documentation. Content of the training manuals and materials shall be as specified above. Two (2) hard copies and one soft copy shall be submitted. The format shall follow the specified format below. Soft copies may be submitted on the same CD or DVD as the Operation and Maintenance Manuals. Hard copies shall be submitted as separate documents.

The Training materials shall include a set of standalone Best Operating Practice documents and checklists for the operation of the Works. Procedures to be covered by these documents shall be agreed on with the Employer. These documents shall be targeted at Operator level and shall be submitted as separate hard copy documents to the rest of the training material and the Operation and Maintenance Manuals.

17.2 Format

Hard copies of manuals shall be bound in A4-size four-ring hard cover lever-arch folders with the Works divided up into logical sections.

Soft copies shall be submitted on CD-ROM or DVD (as required by size) in a fully searchable PDF format with consistent headings and bookmarks to allow for navigation.

18 OPERATIONS AND MAINTENANCE MANUALS

18.1 Format

Hard copies of manuals shall be bound in A4-size four-ring hard cover lever-arch folders with the Works divided up into logical sections.

Soft copies shall be submitted on CD-ROM or DVD (as required by size) in a fully searchable PDF format with consistent headings and bookmarks to allow for navigation.

An A3 hardcopy of all as-built drawings shall be bound into an A3-size four-ring hard cover lever arch folder as part of the O&M documentation.

The soft copy of the O&M manuals shall include pdf copies of all as-built drawings.

The number of final copies will be as follows

a) Two hard copies of the O&M manuals to be supplied in colour
b) One software copy on a CD-ROM or DVD, as appropriate to file size.

O&M manual to be labelled on front cover and on spine with following details:

SOUTHERN WWTW

OPERATING AND MAINTENANCE MANUAL. (BOOK ONE OF XXXX)

PLANT DETAILS (NAME)

EQUIPMENT DETAILS

DATE OF ISSUE. (eg 23rd OCTOBER 2017)

VERSION

Contractor's details to be included on cover page

The contents page will be in a colour-coded table format and will include the following:

a) Section numbers
b) Description
c) Page numbers

All files shall include the contents page of the entire O&M manual in addition to the contents page of the specific manual.

Each section must be separated by coloured and numbered plastic separators that correspond with that of the contents page.

All body text to be Arial text font size 10.

All pages of the O&M manual must be numbered.

All drawings will be inserted into plastic A4 sleeves. Instrument loop drawings to be in a yellow colour and inserted in an A4 plastic jacket.

All CDs/DVDs supplied will be clearly labelled with description, version and be dated.

Change control must be applied when making changes to the manuals

18.2 Contents of the O&M manual

The O&M manual must contain the following items as a minimum requirement.

a) Contents page

b) Revision list
c) The contractor's name and contact details
d) Full Details of the equipment – Make , Model numbers, Description, Serial numbers
e) Suppliers' details for all equipment – address, telephone numbers, website, email address.
f) The detailed operating instructions, settings and procedures of the equipment.
g) Maintenance information must be supplied:
   i. Detailed maintenance required to be performed.
   ii. Job plan giving detailed task to be performed and frequency.
   iii. As well as individual equipment pamphlet /s with instructions.
   iv. Contractor to supply recommended maintenance plan for all plant & equipment supplied.
h) Individual supplier pamphlets/documentation on equipment supplied (indicate which item actual items are supplied.)
i) Specific information must be included is as follows:
   a) Instrument loop drawings
   b) Final Process & Instrument Drawings(P&ID) (all numbering to be sequential, correct and aligning with Control Philosophy and Functional Design Specification documents) / Instrument & Control Drawings(I&CD)
   c) PLC Input and Output lists
   d) Cable schedules
   e) PLC program code
   f) Maintenance schedules as per the Employers maintenance managements system requirements
   g) Critical spares list
   h) Supplier details
   i) Quality control certificates
   j) Electrical schematic drawings
   k) Instrument process signal list
   l) Equipment list
   m) Instrument datasheets: one per individual tagged instrument on the P&ID
   n) Essential spare parts list for the plant, categorized by level of need
   o) Final Functional Design Specification documents for the entire Works

19 QUALITY CONTROL DATA PACK

19.1 General

The Contractor shall submit all quality control and commissioning records in a data pack. This shall include at least the following:

a) Calibration certificates
b) Electrical compliance certificates
c) Load test Certificates
d) Pump tests
e) Pressure tests / certificates
f) Commissioning test data

19.2 Format

The data pack shall be bound in A4-size four-ring hard cover lever-arch folders with the Works divided up into logical sections where the information for each item of equipment can be easily found.

20 AS-BUILT DRAWINGS

20.1 General

The Contractor shall produce as-built drawings for the works.

During construction the Contractor shall continuously mark-up or update information on construction drawings. The Contractor shall on an ongoing basis, check and monitor the field location of all pipelines, services, building construction works and other structures that may be buried or covered over during construction.

Drawings shall comply with the drawing numbering and naming convention to be issued to the Contractor by the Engineer and shall be on the client's standard title block.

All as-built drawings shall be either A1 or A4 size.

All drawings shall be produced in AutoCAD 2018 or later.

20.2 Submission

The Contractor shall submit a complete set of full-scale draft as-built drawings on paper for the Engineer's review.

All final drawings shall be submitted in following format:

a) 1No A1 signed hardcopy on sepia film
b) 1No A1 softcopy PDF
c) 1No softcopy AutoCAD
d) All design as well as final documents to be stored on suitable external hard drive with 10% spare capacity

ENVIRONEMTAL MANAGEMENT PROGRAMME

EMPLOYER'S HEALTH AND SAFETY SPECIFICATION