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PARTICULAR SPECIFICATION

M13: MECHANICAL SLUDGE THICKENER TANK EQUIPMENT

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PARTICULAR SPECIFICATION: M13: MECHANICAL WASTE ACTIVATED SLUDGE THICKENER TANKS EQUIPMENT

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M13.1 SCOPE

This specification covers the detailed design parameters, manufacture, supply, installation, test and commissioning of the mechanical equipment for Sludge Thickener tanks. The Specification shall be read in conjunction with the Project Specification.

M13.2 INTERPRETATIONS

M13.2.1 Abbreviations

In this Specification the following abbreviations will apply:-

| | |
|-------|--|
| ANSI | : American National Standards Institute |
| ASTM | : American Society for Testing and Materials |
| BS | : British Standards Institution |
| SANS | : South African National Standards |
| SIS | : Swedish Institute of Standards |
| DIN | : Deutsch Industry Normen |
| ISO | : International Organisation for Standardization |
| ASME | : American Society of Mechanical Engineers |
| SAECC | : South African Electrolytic Corrosion Committee |
| AGMA | : American Gear Manufacturers Association |

M13.2.2 Standards

All design standards for the WAS thickener tanks shall be subject to the latest amendments and editions of the following standard specifications:-

| | |
|---------------------|--|
| SANS 10400 | : National Building Regulations |
| BS 5304 | : Code of practice for safeguarding of machinery |
| SANS 9096-1: 1994 | : Testing of welders, where applicable to the type of welding required |
| BS 292 Part 1: 1987 | : Dimensions of ball bearings, cylindrical and spherical roller bearings |
| SANS 10162-1 | : The structural use of steel Part1: Limit-states design of hot-rolled steelwork |
| SANS 10162-2 | : The structural use of steel Part1: Limit-states design of cold-formed steelwork |
| SANS 10162-4 | : Structural use of Steel Part 4: The design of cold-formed stainless steel structural |
| SANS 10044-3 | : Welding Part 3: The fusion of steel (including stainless steel): Tests for the approval of welding procedures |
| SANS 10044-4 | : Welding Part 4: The fusion welding of steel (including austenitic stainless steel): Tests for the approval of welders working where weld procedure approval is not required. |
| SANS 10064 | : The preparation of steel surfaces for coating |
| SANS 10102-4 | : Selection of pipes for buried pipelines Part 1: General Provisions |
| SANS 10104 | : Hand railing and balustrading (safety aspects) |
| SANS 10111-2-1 | : Engineering Drawing Part 1: General Principles Engineering Drawing Part 2: Geometric Tolerancing Section 1 |
| SANS 10332 | : Homologation of tyres |
| SANS 10341 | : Installation and maintenance of bearings – General guidelines |

SANS 1700-5-9 : Fasteners Part 5: General requirements & material properties
Section 8: Corrosion resistant stainless steel fasteners-Bolts,
Screws & Studs

SANS 1700-5-10 : Fasteners Part 5: General requirements & material properties
Section 8: Corrosion resistant stainless steel fasteners-Nuts

M13.2.3 General Requirements

This specification must be read in conjunction with the following specifications:-

M01: Particular Specification for Mechanical Screens

M08: Particular Specification for Gearboxes

M20: Particular Specification for Valves

M21: Particular Specification for Pressure Pipework

E01: Particular Specification for Electric Motors

G01: Particular Specification for Colour Codes

G02: Particular Specification for Corrosion Protection

M13.3 **DESIGN OF WASTE ACTIVATED SLUDGE THICKENER TANKS**

M13.3.1 General Design Parameters

Waste Sludge Thickener Tanks shall be designed such that the following requirements are met:-

- To facilitate manufacture, inspection, installation, maintenance, cleaning and repairs,
- To ensure safe and satisfactory operation for an acceptable life expectation of 12 years under the ambient conditions prevailing at the Site,
- To prevent undue stresses being produced by expansion due to temperature changes.
- To keep maintenance costs to a minimum,
- To comply with the legal requirements in respect of safety as well as the prevention of water and air pollution,
- To satisfy any specific requirement contained in the statutory codes and legislation, and
- To be suitable for operation 365 days per year, 24 hours per day under specified design conditions.

M13.3.2 Specific Design Parameters

The mainstream BNR treatment process generates two waste sludge streams:

- The primary sludge which is typically fermented to generate Volatile Fatty Acids (VFA)
- Waste activated sludge

The aim of the sludge thickening tanks is to thicken the waste sludge or the individual waste sludges before the anaerobic digestion or aerobic digestion process.

The design waste sludge flows and loads are based on:

- 50% wastewater flows and loads to define the average sludge loading rates
- 95% wastewater flows and loads to define the peak sludge loading rates

Design Loads:

| Type of Sludge | Loading Rates (kg TS/m ² /day) | |
|----------------------------------|---|--------------|
| | Average Loading | Peak Loading |
| Waste activated sludge (WAS) | 30 | 45 |
| WAS and primary sludge | 75 | 110 |
| WAS and fermented primary sludge | 60 | 90 |
| Primary sludge | 90 | 135 |

M13.3.3 Operational Requirements

Before thickening the sludge must be screened and properly blended and mixed. The thickened sludge must be withdrawn on a continuous basis for large thickeners and intermittently for small thickeners. Overflow must return to the head of works or to the primary clarifiers.

M13.3.4 Welds and Fasteners

All stainless steel metals are welded together unless otherwise stipulated. All welds are to be in accordance with SANS 10044. All submerged fasteners shall be 316 SS and mating flanges shall be sealed against the ingress of any crevice corrosion by means of a sealant suitable for underwater conditions and approved by the Engineer.

M13.4 **WASTE SLUDGE SCREENING**

Waste sludge screening may be required, depending on the main stream screening process. The primary sludge screening process will occur before the sludge enters the waste sludge thickener tanks. Refer to particular specification M37: for a detailed specification for Sludge Screens.

M13.5 **WASTE ACTIVATED SLUDGE THICKENER TANK**

M13.5.1 Waste Activated Sludge Thickener Tank Parameters

The mechanical equipment to be supplied under this Contract shall be installed, tested and commissioned on concrete structures, constructed by others, to the dimensions indicated on the construction detail drawings.

The tank shall be circular with a conical bottom and a side water depth (SWD) of a 5m, unless indicated differently on the construction drawings. The peripheral wall shall be finished to 1 m above the finished terrace level. The floor of the tank shall be sloped, vertical to the horizontal 1:6, to assist the sludge being scrapped to a central collection hopper for withdrawal. The diameter of the tank shall be as shown on the civil construction drawings.

The scraper and picket fence shall be driven via a centre mounted gearbox assembly.

M13.5.2 Inlet Pipe

The inlet pipe shall have a minimum diameter as specified in the Project Specific Specification or as shown on the drawings and shall be manufactured with 304 SS, supplied and installed by the Civil Contractor.

M13.5.3 Centre Column

The inlet pipe shall have a minimum diameter of 350 mm unless specified otherwise in the Project Specific Specification or drawings and shall be manufactured with 304L SS, supplied and installed by the Civil Contractor.

M13.5.4 Drive Train

The design of the centre drive train shall be such that no slippage occurs, under the maximum design load. Refer to Particular Specification E01: for a detailed specification for electric motors.

M13.5.5 Access Bridge Parameters

The access bridge shall be manufactured in 3CR12 and shall cover half the tank diameter. A 3CR12 ladder with the necessary handrails shall be rigidly fixed by means of welds to the outer end of the bridge for access purposes.

- Designed Load: 2500N per square meter of walkway area
- Walkway: no less than 750 mm wide, 3CR12 stainless steel
- Open Grating: 3CR12
- Hand and kneerails: 3CR12 on both sides of walkway
- Kicker plates: 100 x 4,5mm 3CR12 attached to both sides of the bridge

The bridge shall be supported at the perimeter tank and by the centre support column.

M13.5.5.1 Walkway

The walkway shall be assembled by welding joints. The joints for the handrailing and walkway shall be welded after installation of the bridge.

M13.5.5.2 Fasteners

The torque drive shaft shall be connected to the gearbox/motor system by means of an upper bearing. The gearbox/motor system shall be secured to the bridge by means of bolts.

M13.6 SCRAPER MECHANISM

M13.6.1 General

Where possible all adjusters shall be above the water level. A detailed drawing of the proposed mechanism shall accompany the Tender.

M13.6.2 Scraper Mechanism Parameters

The scraper mechanism shall scrape the full diameter of the tank. The scrapers shall be fitted to a centre 304 SS drive cage by means of two 304 SS support frames. The support frames shall be joined together at the centre of the tank and supported vertically by linking the frames to a centre drive torque cage.

No underwater bearings shall be permitted.

M13.6.3 Support Frames

The scraper frames are to be at least 6 mm in thickness. Support for the scrapers must be of suitable angle or tubular construction and must be of sufficient strength to withstand the loads imposed by the scrapers when moving in sludge that has reached a thickness of 8%.

The support structure shall be rigid in design and shall be fixed to a centre drive torque cage suspended from the drive unit output shaft or from a bearing on the bridge in a rigid manner. A third support arm is to be connected horizontally between the support arms, and to the centre drive cage by means of a tie bar spar, to provide extra support.

M13.6.4 Scrapers

The scrapers shall be of Echelon type fitted with synthetic rubber squeegees shaped to fit snugly on the floor. The shape of the squeegees shall be such that at any point they will fit the curvature of the conical floor of the basin. Care must be taken to minimise the wear on the squeegees but no supporting wheels shall be considered

The overall height of the scraper shall be at least 300 mm, and the scrapers shall overlap by at least 10%.

M13.6.4.1 Fasteners

The squeegees are to be fitted to the scrapers by means of a back plate. The squeegees are to be secured 50 mm from the bottom of the scraper by means of a bolted connection. The bolt shall pass from the back plate, through the squeegees to the scraper. The squeegees back plate shall be 50 mm in height and have a minimum thickness of 4.5 mm.

M13.7 **PICKET FENCE**

A row of 304L SS angle members spaced equally along the scraper radius shall be installed to create a picket fence attached to each of the scraper support frames. The members must be spaced at no more than 300 mm and must be of a length so that the free ends terminate approximately 500 mm below SWD.

Angle iron members forming the picket fence must be sufficiently rigid to withstand the loads imparted by movement through sludge without distortion when the concentration is 6%. The angles must be attached to the scraper support frame using a bolted bracket that allows the removal of individual members from the framework.

Angles must be fitted with the apex of the angle facing away from the direction of movement.

M13.8 **SLUDGE REMOVAL PIPE (SUPPLIED BY OTHERS)**

The sludge removal pipe shall have a treated effluent purge connection and a blank flange 200 mm above the maximum water level in the tanks, as to remove any blockages in the pipe. The sludge removal pipes shall be provided with long radii bends in order to limit potential of any blockages occurring within the pipes. The number of bends in the pipe is to be kept to a minimum and there are to be no reducers on the sludge draw-off pipe.

The method of sludge draw off (hydrostatic or directly coupled pumps) will be as specified in the project specific specification.

M13.8.1 Sludge Hopper

The sludge hopper shall be a minimum depth of 1.5m and shall have a side slope of 60°. The diameter of the hopper shall be based on $0.15 - 0.2 \times \text{Diameter of the tank}$.

M13.9 **OVERFLOW WEIR**

An overflow weir manufactured of 4.5 mm 304L SS plate 200 mm deep shall be provided and installed on the inside of the concrete wall of the launder. The overflow weir shall be attached to

the wall of the tank by means of bolts and shall have no V-notches.

The installation of the flat weir shall ensure that the effluent discharges freely and evenly around the whole circumference of the tank without leakage through the joints between the weir and the wall or the joints between weir sections.

Tenderers shall allow in their process for sealing against “off the shutter” concrete finish and between ends of weir sections with an approved material such as closed cell expanded neoprene. Holes in the weir plate shall be slotted to permit adjustment.

M13.10 PIPEWORK

The following supply items shall be supplied and installed by others:

- The inlet under the floor and inside the inlet structure of the tank
- The sludge draw-off pipe
- The effluent pipe work

The pipes shall be manufactured from 304 SS. The contractor under this Contract must, however, supply and install the scum discharge pipe up to the scum discharge manhole adjacent to the tank, which will be built by the Civil Contractor.

M13.11 SPARES AND TOOLS

The Tenderer must submit on the appropriate schedule a priced list of spare parts which is recommended should be kept by the water treatment plant for maintenance of the plant. Spares which the Client decides to order must be manufactured simultaneously with the rest of the equipment and be subject to the same tests for dimensions, tolerances, strength, etc. All spares must be packed separately and the cases appropriately marked. All spares must be new and unused.

A full range of spares shall be kept available for not less than 15 years.

Tenderers must submit a provisional price (where applicable) for a complete set of spanners, keys and tools required for the operation, adjustment and overhaul of the plant supplied. All spanners, keys and tools shall be new and unused.

M13.12 PROOF OF MAINTENANCE

The period of maintenance will extend over a period of 12 months calculated from the Completion as defined in the Appendix.

However, should a portion or all of the plant and equipment fail / or require rectification during this period, the Engineer reserves the right to extend the Period of Maintenance in respect of such portion or all of the plant and equipment for a further period of not more than 12 months calculated from the date of Commissioning of such plant and equipment after rectification.

M13.13 BOLTS

Weir plates and steady bearings shall be attached to the tank using 316 stainless steel anchors set in holes drilled by the Contractor under this Contract.

M13.14 METAL PREPARATION AND CORROSION PROTECTION

Refer to Particular Specification G02: Corrosion Protection

M13.15 COLOUR CODES

The standard final colour codes for equipment supplied under this Contract shall be in accordance with Particular Specification G01: Colour Coding.

M13.16 QUALITY MANAGEMENT (QM) AND QUALITY ASSURANCE

QM shall be categorised as 'critical and major' for this section of the Project.

M13.16.1 Manufacture

Tenderers shall submit with their tender a detailed Project Quality Plan, stating how they control the flow of paperwork from commencement of the Project through final handover to the Client, a sample of their Quality Control Plan, (QCP) and Project Quality Plan, (PQP) both during the course of the Project, manufacture and finally, installation.

The successful Tenderer shall submit a QCP covering all aspects of the manufacturing process, indicating held points to allow the Engineer opportunities to evaluate the equipment for compliance to this specification.

All items of equipment shall be subject to inspections by the Engineer during design and manufacture as per these QCP's.

In general, it is anticipated that this Project shall be in accordance with the relevant ISO 9000 requirements.

M13.16.2 Installation

The successful Tenderer shall submit a QCP covering all aspects of the installation of each item of equipment to be installed under this Project. The Engineer shall be afforded every opportunity to certain stages of completion of the installation to ascertain compliance with the Specifications and to witness the Contractor's site activities at the Engineer's discretion.

M13.17 SYSTEM PERFORMANCE

Works testing

Each item of equipment shall be subject to inspection and testing prior to despatch from the works. All performance test results shall be made available to the Engineer for verification or when the QCP's require intervention or hold points for inspection.

In the case of gearboxes, they shall be subject to testing under operating conditions for at least 12 hours on the test bed. All results shall be available for inspection

Before commissioning

- Check for correct oil level in gearboxes and that motors are greased properly.
- Ensure all HD bolts are torqued down correctly.
- The alignment and levelling of each assembly shall be checked and the results shall be available for inspection by the Engineer.
- The electrical functions and control shall be checked by a responsible inspector prior to attempting to start any motor on this Project.

M13.17.1 Prior to Filling of the Tanks

After Initial Commissioning

- Ensure all oil pumps and flow or pressure switches are functional

M13.17.2 After filling of the Tanks

M13.17.2.1 Weirs

The even distribution of flow over the weirs and the absence of bypassing are to be ensured after commissioning.

M13.17.3 Before Expiry of the Defects Liability Period

The Engineer requires the Contractor to visit the site every quarter to inspect for the correct operation of the installed equipment. A report after each visit shall be submitted in writing

M13.18 MEASUREMENT AND PAYMENT

Measurement and payment will distinguish between supply/delivery and installation/commission as well as per installation point. The respective tender rates shall cover all costs from supply to commission of each WAS thickener.

The tendered rates or sums shall cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, off loading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of equipment or a part thereof is not specifically mentioned.