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16 TERTIARY TREATMENT GRANULAR FILTERS

16.1 GENERAL

16.1.1 Scope

1 This part specifies the requirement for the design, manufacture, construction, installation, testing and commissioning of tertiary treatment granular filters.

2 Related Sections and Parts are as follows:

Section 1 General

Section 8 Drainage Works

Section 10 Instrumentation, Control and Automation

Section 13 Building Electrical Works

Section 21 Electrical Works

16.1.2 References

BS 970 ..... Specification for wrought steels for mechanical and allied engineering purposes (ISO 683 - Heat-treatable steels, alloy steels and free-cutting steels)

BS 1780 ..... Specification for bourdon tube pressure and vacuum gauges (EN 837-Pressure gauges)

BS 4870 ..... Specification for approval testing of welding procedures; (ISO 14732 Welding personnel. Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials; ISO 15614-1 Specification and qualification of welding procedures for metallic materials. Welding procedure test - Arc and gas welding of steels and arc welding of nickel and nickel alloys; ISO 15614-2 Specification and qualification of welding procedures for metallic materials. Welding procedure test - Arc welding of aluminium and its alloys; ISO 15614-8 Specification and qualification of welding procedures for metallic materials. Welding procedure test - Welding of tubes to tube-plate joints)

BS 4871 ..... Specification for approval testing of welders working to approved welding procedures; (ISO 9606 Qualification testing of welders. Fusion welding : ISO 9606-1 Qualification testing of welders. Fusion welding - Steels; ISO 9606-2 Qualification test of welders. Fusion welding - Aluminium and aluminium alloys)

BSI PD 5500 ..... Specification for unfired pressure vessels

EN 10084 ..... Case hardening steels - Technical delivery conditions; (ISO 683-3 Heat-treatable steels, alloy steels and free-cutting steels — Part 3: Case-hardening steels)

List of ‘Approved Suppliers’ prepared by the Public Works Authority

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16.1.3 Submittals

1 In addition to the requirements of Part 1 of this Section, the Contractor shall reconfirm the information provided in the Technical Submission Schedules submitted with his Tender.

16.2 PRODUCTS

16.2.1 General

1 Filters shall be of the downward flow sand type and shall include a minimum of two batteries operating in parallel. Access to valves and pipework etc shall be constructed such that operation and maintenance can be carried out safely and without obstruction. The contractor shall be responsible for providing all access walkways and ladders.

2 Unless otherwise specified in the Contract Documents the filter material shall have an effective size of 1.8mm and a uniformity coefficient of 1.5.

3 Valving, penstocks and associated pipework shall be provided on each filter for raw water inlet, filtered water outlet, washwater inlet, washwater outlet, air scour, filter slow drain and air after back wash. All valves shall be butterfly type and with the exception of the slow drain valve shall be controlled automatically and shall include provision for manual operation. Valves shall be in accordance with the valves section of this specification. Actuators shall be electrically operated, quarter turn type. Valves and penstocks shall be positioned to allow for manual operation from adjacent walkways. The backwash delivery manifold and air scour delivery manifold shall be fitted with a pressure gauge to BS 1780 or equivalent.

4 Pipework shall be stainless steel, uPVC, HDPE or GRP and in accordance with Section 8 of this Specification.

5 Filters shall be automatically backwashed using air scour blowers and washwater pumps.

6 The washwater pumps shall draw filtered water from a backwash tank, which shall automatically be replenished following a wash cycle. The working volume of the tank shall be equivalent to the volume of backwash water required for two complete wash cycles.

7 The backwash pumps shall be controlled to give a gradual increase in wash cycle. Control will either be by speed control of the pump motor or by a controlled slow opening valve on the washwater pipe. A non-return valve shall be included in the delivery pipework.

8 The air scour pipework shall incorporate a non-return valve, which shall rise to a height above the filter top water level, before dropping down to the filter and d an automatic drain valve at the lowest point to relieve the system of leakage water through the valve, to prevent process water passing from the filter to the blower.

9 The backwash delivery manifold and air scour delivery manifold shall be fitted with a pressure gauge

10 Pressure filters shall be provided with a pressure gauge mounted on the front of the vessel visible from the walkway.

11 Loss of media from the filters is not acceptable. The raw water inlet/washwater outlet shall be designed to prevent the passage of media during the backwash cycle. The level of the fluidised bed shall be well below the washwater outlet to prevent sand loss.

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12 Flow measuring and recording equipment shall be provided to indicate the flow through each filter, washwater flow and air scour flow.

13 Rapid gravity filters shall be provided with loss of head measuring instrumentation.

14 Sample taps shall be provided on the raw water inlet / washwater outlet and the filtered water outlet pipework of each filter. The taps shall be accessible from walkways.

16.2.2 Filtration Rates

1 Filtration rates shall not exceed 7.5 m/hour for single media filtration and 12m/hour for multi-media filtration. Sufficient capacity shall be provided to ensure that these flowrates are not exceeded with one unit out of service and one unit backwashing.

2 The maximum allowable solid loading shall be 1.2 kg/m^2 between backwashes unless otherwise specified in the Contract Documents. Depending on the type of media selected, a variation to the solid loading of 1.2kg/m^2 may be permitted provided that reasons substantiating the variation are clearly stated in the tender as an alternative option.

3 The maximum acceptable number of backwashes shall be ONE per filter per day during "AVERAGE - CONDITIONS".

16.2.3 Nozzle Plates

1 Where a nozzle plate is incorporated into the design of the filter then the plate shall be stiffened to withstand sand, surge and backwash pressure loading. Nozzle fixing access shall be from below. Access through the nozzle plate is not permitted.

2 Where the design of the filter incorporates a nozzle plate, the underfloor section shall be vented to prevent air pocket accumulation and subsequent major sand disturbance during the back wash cycle.

3 Laterals and headers shall be uPVC with nozzles for water and air distribution. Support brackets shall be Grade 316 S31 Stainless Steel.

16.2.4 Pressure Filters

1 Pressure filters shall be all steel, designed, manufactured, inspected, tested in accordance with BSI PD 5500 or equivalent.

2 Longitudinal seam welds shall not cross at any intersection with circumferential welds but shall be offset a minimum length corresponding to 90° of shell circumference.

3 Allowance for a vessel life expectancy of 25 years shall be made and the corrosion allowance shall be not less than 2.0mm.

4 Pressure filters shall be fabricated from Carbon Manganese steel, and full fabrication details shall be submitted for approval by the Contractor. The vessel shall comprise two domed ends with an intermediate cylindrical section. Not less than two lifting lugs shall be provided for lifting of the complete vessel. Vessels may be vertically or horizontally mounted.

5 The inlet and outlet pipework shall be designed to the same criteria as the pressure filter terminating in flanged connections. A drain line shall be provided complete with isolating globe valve and flanged hose connection suitable for a flexible hose of 50mm diameter.

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6 Pressure filters shall be supplied complete with associated fittings internal manhole access, sand door, pressure gauges and air valves.

7 The sand door shall be located at the lower end of the centre cylindrical section of the filter shell. The underfloor inspection hatch shall be located on the lower domed end of the vessel.

8 The filter shell shall be mounted on fabricated feet for mounting on pre cast concrete plinths on the filter room floor at a height to enable man entry into the lower inspection access hatch.

9 Pressure filters shall be provided with a double acting large orifice air valves.

10 A 150 mm nominal diameter pressure gauge shall be surface mounted on the vessel using a purpose made mild steel bracket welded to the vessel.

11 The man access shall be of the "T-bolt" closure type of not less than 600 mm internal diameter with the hinge running parallel to the filter diameter and be provided in the cylindrical section of the vessel to permit access and located such that internal launders and bellmouths can be visually inspected without entry into the filter.

12 Both the sand door and under floor inspection hatch shall be of the flanged type and be provided with a lifting swing davit which shall incorporate a lifting screw, so that the whole flange cover may be lifted up and then swung out from the entry port. The davit shall be fabricated onto the cylindrical wall of the vessel.

13 A safety/hand rail shall be located adjacent to the man-way with a fixing for a safety rope. Each man-way access shall incorporate a traffolite warning notice permanently fixed to the cover in view of an operative intending to access the vessel. The notice shall state "WARNING Ensure full isolation and permit to work and depressurisation before entry".

14 Welding shall only be carried out by Contractors' staff who are qualified and experienced to undertake this work in accordance by BSI PD 5500 or equivalent by reference to the following:-

(a) BS 4870 or equivalent.

(b) BS 4871 or equivalent.

15 The Contractor shall mark clearly with their respective safe working pressure in lettering not less than 80mm in height in gloss paint.

16 A brass plate shall also be fixed to the vessels which will state:-

(a) Name of manufacturer with address.

(b) Identification number.

(c) Client's Order number.

(d) Shell Thickness.

(e) Corrosion Allowance.

(f) Shell Diameter.

(g) Head Diameter.

(h) Head Thickness.

(i) Head Corrosion Allowance.

(j) Degree of X Ray Inspection.

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(k) Tan Length.

(l) Design Pressure.

(m) Hydraulic Test Pressure.

(n) Weight.

(o) Length.

(p) Inspection Date.

(q) Inspectors Initials.

(r) S.W.P.

17 The Contractor shall allow for 100% category 1 radiographic testing.

18 The Contractor shall employ an independent testing authority to oversee the design, fabrication and testing of pressure vessels as defined in BSI PD 5500. The independent testing authority shall report direct to the Engineer.

19 The Contractor shall make provision for all the necessary work associated with carrying out the Inspecting Authority's recommendations resulting through the use of BSI PD 5500 or equivalent in assessing design, manufacturing procedure, documentation and testing of the vessel.

16.3 INSTALLATION AND COMMISSIONING

16.3.1 Installation and Commissioning

1 The equipment delivered to Site shall be examined by the Engineer to determine that it is in good condition and in conformance with the approved working drawings and certification. All equipment shall be installed in strict accordance with Part 1 of this Section 9, the relevant Parts of this Section 9 for ancillary equipment installed and the manufacturer’s instructions.

16.3.2 Testing

1 Test Procedures shall be in accordance with Part 1 of this Section 9 and in addition those listed below.

2 Unless otherwise stated in the Contract Document the performance of the filter shall be assessed by samples taken from the following points within the works.

(a) Raw water - prior to any treatment.

(b) Individual filters outlet.

(c) Final water into storage reservoir

3 Samples are to be collected using automatic composite samplers over a period of 7 days. Each sample shall comprise 24 No discreet hourly samples. Spot samples may also be taken for the performance assessment by the Engineer.

4 The performance of the works will be judged to be acceptable if samples, collected during the Tests before Completion meet all of the criteria for all the determinants listed in the Contract Document.

5 Sample collection and analysis shall be undertaken by an approved independent laboratory at the Contractor’s cost.

END OF PART

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